5.ULUSLARARASI

Gaziantep

Bilimsel Araştırmalar Kongresi

27-28 ARALIK 2025

GAZİANTEP



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CONGRESS TITLE

5. INTERNATIONAL GAZİANTEP SCIENTIFIC RESEARCH CONGRESS

DATE AND PLACE

27-28 DECEMBER 2025, GAZİANTEP ONLINE PRESENTATIONS

ORGANIZATION

ISARC INTERNATIONAL SCIENCE AND ART RESEARCH CENTER

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Scıentific Development and Innovative Approach

5. INTERNATIONAL GAZİANTEP SCIENTIFIC RESEARCH CONGRESS
27-28 DECEMBER 2025
GAZİANTEP

Congress Program

Participant Countries:

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27.12.2025 / Hall-1, Session-1			
	ANKARA LOCAL TIME		**MEETING ID:** 844 4053 5966
	11 ^{00} : 13 ^{00}		**PASSCODE:** 450687

HEAD OF SESSION: ***Assist. Prof. Dr. Semih Mahmut AKTARER***

TOPIC TITLE	AUTHORS	AFFILIATION
A Data-Driven Approach To Anomaly Detection In Smart Meters Using Machine Learning Methods: A Comparative Analysis	Assist. Prof. Dr. Önder CİVELEK	Karadeniz Technical University
Machine Learning-Based Multi-Fault Classification For Electrical Power Systems	Assist. Prof. Dr. Önder CİVELEK Dr. Metin TÜYSÜZ	Karadeniz Technical University
Investigation Of The Stretch Formability Behavior Of High-Strength Low-Alloy Steel Jomed By Frıctıon Stir Welding	Assist. Prof. Dr. Semih Mahmut AKTARER	Recep Tayyip Erdogan University
One Dimensional Analysis Of Thermal And Hydraulic Performance Of A 50-Cell Battery Module Under Different Flow Regimes	Assist. Prof. Dr. Emre BULUT	Bursa Uludağ University
Integration Of CFRP Composite Electric Vehicle Parts Designed And Analyzed In A Cage Structure Suitable For 3d And CFIP Processes	Ali Mert GÜRBÜZ Kemal ERŞAN Dilara ÇİÇEK Hüseyin Kamil BALBABA	Gazi University
Technical Performance Assessment Of Standalone Hybrid Renewable Energy Systems For Green Hydrogen Production	Lect. Batın DEMİRCAN Tuğçe YAREN	Balıkesir University
Modelling Of 1D Micro Gas Turbine For Range Extender Electric Vehicles	Assist. Prof. Dr. Harun GÜÇLÜ	Bursa Uludağ University
Investigation Of The Service Durability Of Environmentally Friendly Shock Absorber Oil In Heavy Commercial Vehicle Groups	Selin EFE KAYABAŞI	Maysan Mando Otomotiv Parçaları San. Tic. A.Ş

27.12.2025 / Hall-2, Session-1			
	ANKARA LOCAL TIME		MEETING ID: 844 4053 5966
	11 ^{00} : 13 ^{00}		PASSCODE: 450687
HEAD OF SESSION: *Mahir ŞAHİN*			

TOPIC TITLE	AUTHORS	AFFILIATION
Characterization Of Prep And Gas Atomized Ti6al4v Powders	Mert Can DEMİR Prof. Dr. Egemen AVCU Prof. Dr. Rıdvan YAMANOĞLU	Kocaeli University
Production Of New Generation B-Titanium Alloys By Powder Metallurgy: A Study On The Ti-15mo-3al-2.7nb-0.2si Alloy	Mert Can DEMİR Prof. Dr. Egemen AVCU Prof. Dr. Rıdvan YAMANOĞLU	Kocaeli University
Experimental Investigation Of The Effect Of Turbulent Flow Conditions On The Heat Transfer Performance Of A Plate Heat Exchanger	Mahir ŞAHİN Mustafa KILIÇ	Adana Alparslan Türkeş Science and Technology University
Hybrid Modeling Of Heat Transfer Effectiveness In A Plate Heat Exchanger Using Ann Predictions And Empirical Correlations	Mahir ŞAHİN Mustafa KILIÇ	Adana Alparslan Türkeş Science and Technology University
Bibliometric Analysis Of Research Trends In Low Reynolds Number Aerodynamics	Kaan Can AKBABA Mehmet Enes ERSÖZ Mustafa Arif ÖZGÜR Ramazan KÖSE	Kütahya Dumlupınar University
Thermodynamic And Environmental Performance Comparison Of CFC, HCFC, HFC And HFO Refrigerants In A Vapor Compression Refrigeration Cycle	Mehmet Enes ERSÖZ Kaan Can AKBABA Halit ARAT Ramazan KÖSE	Kütahya Dumlupınar University
The Use Of Hydrophobic Coatings In Quick-Connection Components And Their Effects On Coupling Performance	Alev DEMİR Ali KİBAR	Tamsan Bağlantı Elemanları A.Ş./ Kocaeli Üniversitesi

27.12.2025 / Hall-3, Session-2			
	ANKARA LOCAL TIME		MEETING ID: 844 4053 5966
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HEAD OF SESSION: *Assoc. Prof. Dr. Abdurrahman GÜNDAY*			

TOPIC TITLE	AUTHORS	AFFILIATION
Performance Analysis Of Mppt With Ga Optimized Pi Controller For Photovotaic Based Dc/Dc Boost Converter	İlyas YAMAÇ Assist. Prof. Dr. Hasan ÜZMUŞ	Van Yüzüncü Yıl University
Current And Voltage Control Of Pem Fuel Cell-Based Dc-Dc Hybrid Boost Converter	Kübra Nur TOPRAK Assist. Prof. Dr. Hasan ÜZMUŞ	Van Yüzüncü Yıl University
Motor Imaginary Classification of EEG Based On Deep Learning	Fatih DÖNMEZ Çağrı YILMAZ Özgür SAVAŞ Assist. Prof. Dr. Kübra KESER	Kutahya Dumlupınar University
The Effects Of Mixed Gas Utilization On Cutting Performance In Industrial Laser Cutting Process	Eyüp ÇAĞLAR Assoc. Prof. Dr. Abdurrahman GÜNDAY	Bursa Uludag University
Analysis Of Renewable Energy–Supported Energy Storage Systems Based On The Electricity Consumption Profile Of Malatya Province	Sedrettin SÜLE Prof. Dr. Asım KAYGUSUZ	Inonu University
The Commercialization Potential Of Perovskite Technologies In Turkey And Their Integration Into The National Energy Strategy	Barış SUNAR Prof. Dr. Asım KAYGUSUZ	Inonu University
Offshore Wind Turbines (Turbines for the ocean)	Mohammed Ahmed Ali ALI AbdulWahab Ahmed JASIM Assist. Prof. Dr. ERCAN AYKUT	Gelisim Istanbul University
Fuel Flexibility and Operational Challenges in Modern Coal-Fired Power Stations	Assist. Prof. Dr. ERCAN AYKUT Mohammed Wakas Saad	Gelisim Istanbul University

27.12.2025 / Hall-4, Session-2			
	ANKARA LOCAL TIME		MEETING ID: 844 4053 5966
	11 [30] : 12 [15]		PASSCODE: 450687

HEAD OF SESSION: ***Prof. Dr. Aliye ÇİLAN AKIN***

TOPIC TITLE	AUTHORS	AFFILIATION
Food Safety In Tourism Enterprises: Tourist Perception, Practical Reality And Sectoral Risks	**Dr. Adnan AKIN Prof. Dr. Aliye ÇİLAN AKIN**	**Bolu Abant İzzet Baysal Üniversitesi**
Comparison Of The Functional Properties Of Organic And Conventional Foods-Review	**Nazan ÇAĞLAR Buket ÖZBAL Didem GÜN**	**Gaziantep University/Hasan Kalyoncu University**
Dietary Fiber And Gut Barrier Integrity In Type 2 Diabetes Mellitus: Current Evidence	**Serap BALABAN BARTA**	**Gaziantep Üniversitesi**
Effect Of Plant-Based Additives On The Storage Stability Of Whole Wheat Flour	**Assist. Prof. Dr. Yeşim BEDİR Mehmet Murat KARAOĞLU**	**Atatürk University**

27.12.2025 / Hall-5, Session-2			
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HEAD OF SESSION: ***Prof. Dr. Hasan Hüseyin YILDIRIM***

TOPIC TITLE	AUTHORS	AFFILIATION
Climate Crisis And Public Policies	Assist. Prof. Dr. Cevriye YÜKSEL YILDIRIM Prof. Dr. Hasan Hüseyin YILDIRIM	Balıkesir University
Financial Technologies And The Banking Sector	Prof. Dr. Hasan Hüseyin YILDIRIM Assist. Prof. Dr. Cevriye YÜKSEL YILDIRIM	Balıkesir University
The Effect Of Asymmetric Shocks In Turkey's Housing Market: A Nardl Analysis Based On Gold Price, Exchange Rate, And Deposit Interest Rate	Resc. Assist. Buğra POLAT Resc. Assist. Dr. Hüseyin İÇEN	İstanbul University
Investigating the Unemployment Invariance Hypothesis in Türkiye: Evidence from Nonlinear Cointegration Tests	Assoc. Prof. Dr. Yaşar Serhat YAŞGÜL Prof. Dr. Burak GÜRİŞ Resc. Assist. Buğra POLAT	İstanbul University Marmara University
Gaslighting In Financial Markets: Behavioral Manıpulation, Investor Vulnerability, And Perceived Irrationality	Aysel KAVLAKOĞLU Prof. Dr. Tolga ULUSOY	Kastamonu University
Growth Dynamics in BRICS-T Countries: A Panel ARDL Analysis of the Effects of Trade, Finance, Population, and Corruption	Assoc. Prof. Dr. Nigar ALEV Assoc. Prof. Dr. Mustafa TORUSDAĞ	VAN Yüzüncü Yıl University
Analysis Of The Relationship Between The Quality Of Life Index And Economic Growth: A Panel Data Approach For Brics-T Countries	Assoc. Prof. Dr. Nigar ALEV Assist. Prof. Dr. İbrahim YILDIRIMÇAKAR	VAN Yüzüncü Yıl University
Electronic On-Site Inspection And Widespread-Intensive Tax Auditing Practices In Turkey	Nergis Feride KAPLAN DÖNMEZ	İstanbul Medeniyet University
The Role Of Digital Infrastructure İn Expanding Financial Accessibility And Reducing Inequality	Yrd.Doç.Dr. Dastan ASEINOV	Kyrgyz-Turkish Manas University/KIRGIZİSTAN

27.12.2025 / Hall-6, Session-3			
	ANKARA LOCAL TIME		MEETING ID: 844 4053 5966
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HEAD OF SESSION: *Assoc. Prof. Dr. Serdar ALEMDAĞ*

TOPIC TITLE	AUTHORS	AFFILIATION
An Analysis Of The Aggressiveness And Body Awareness Levels Of Traditional Wrestlers	Ezgi DEMIR Uğur BAKAY	Gaziantep University
Examining The Patriotism Attitudes Of Sports Sciences Faculty Students In Terms Of Various Variables	Gizem YILMAZER Uğur BAKAY	Gaziantep University
Treatment Effects Of A Home-Based Vestibular Rehabilitation Program In Posterior Semicircular Canal BPPV	Şule Bensu KARAHAN Bayram Sönmez ÜNÜVAR	KTO Karatay University
Exercise And The Immune System: A Five-Year Review	Erhan KIZMAZ Sedat YİĞİT	Gaziantep University
Comparison Of Body Composition, Exercise Capacity, Symptoms, And Quality Of Life In Pancreatic And Colon Cancer Patients With Cachexia	Ezgi ERGİN, Didem KARADİBAK Ümit AKAY, Burcu AÇIKGÖZ Aytaç TERZİ, Tuğba YAVUZŞEN İlhan ÖZTOP	Dokuz Eylül University Hospital/Dokuz Eylül University
Investigation Of Exercise Health Belief According To Body Mass Index	Assoc. Prof. Dr. Serdar ALEMDAĞ	Trabzon University
Current Situation Analysis And Recommendations For City Branding In Şanlıurfa	Furkan ÖZGÜZEL Melih ÖZTOP	Gaziantep University

27.12.2025 / Hall-7, Session-3			
	ANKARA LOCAL TIME		MEETING ID: 844 4053 5966
	12 00 : 13 15		PASSCODE: 450687

HEAD OF SESSION: ***Assist. Prof. Dr.Suzan ONUR***

TOPIC TITLE	AUTHORS	AFFILIATION
The Mediating Role Of Sport In The Relationship Between Dark Tetrad Personality Traits And Nomophobia Among Physical Education Teacher Candidates	Nida FIRAT Assoc. Prof. Dr. Metin KUŞ	Hitit University
Psychological Resilience And Mental Health: A Study On Sports Science Faculty Students	Kenan KOÇ Mustafa Soner YÜCE Hayati ARSLAN	Erciyes University İstanbul Sabahattin Zaim University
Examination Of Physical Activity Levels And Healthy Eating Attitudes Of Women Practicing Pilates	Mustafa Soner YÜCE Kenan KOÇ Bayram KARAKUŞ	Erciyes Üniversitesi İstanbul Sabahattin Zaim University
The Relationship Between Health Literacy And Pain Management In Students Of The Faculty Of Health Sciences	Fzt. Aslınur ATALAY Assist. Prof. Dr. Tuba ZOROĞLU	Karabük University
The Role Of Effective Communıcatıon In The Physıcal Therapy And Rehabılıtatıon Process And Dıgıtal Applıcatıon Desıgn: E-Ftr	Melisa Nur YABAN Betül Kuzubaş Emre KÜÇÜKGÖÇER Mehmet Emre TEK Assist. Prof. Dr.Suzan ONUR	Karabuk University

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	ANKARA LOCAL TIME		**MEETING ID:** 844 4053 5966
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HEAD OF SESSION: ***Lect. Dr. Rana BAYTİN ALACI***

TOPIC TITLE	AUTHORS	AFFILIATION
Properties And Nutritional Importance Of Milk Fat Globule Membrane	**Assist. Prof. Dr. Yusuf ÇAKIR Prof. Dr. Songül ÇAKMAKÇI**	**Bingöl University/ Atatürk University**
Geographically Indicated Foods From Türkiye Registered By The European Commission	**Prof. Dr. Songül ÇAKMAKÇI Assist. Prof. Dr. Yusuf ÇAKIR**	**Bingöl University/ Atatürk University**
Turkish Adaptation Of The Food Noıse Questionnaire: A Validity And Reliability Study	**Res. Assist. Şeyma Nur ERCAN Mehmet KORKMAZ Tuğba YILDIRIM, Aycan KAYALAR, Elif ALTUN Sevda UZUN**	**Yozgat Bozok University/Çankırı Karatekin University/Gazi University/Kırşehir Ahi Evran University**
The Effect Of Organic Foods On Human/Environmental Health And Sustainability	**Kübra ÖZAYDIN AL Assist. Prof. Dr. Murat KAYA**	**Kayseri University**
Evaluation Of The Replacement Of Gelatin With Agar Agar As A Stabilizer In Glaburu- Fortified Soft Confectionery	**Assist. Prof. Dr. Murat KAYA**	**Kayseri University**
Phosphorus Nutrition In Lettuce (*Lactuca Sativa* L.): Current Approaches On Growth Physiology, Stress Tolerance, And Phosphorus Use Efficiency (Pue)	**Lect. Dr. Rana BAYTİN ALACI**	**Van Yüzüncü Yıl University**
Effects Of Phosphorus On Vegetable Growth And Physiology	**Lect. Dr. Rana BAYTİN ALACI**	**Van Yüzüncü Yıl University**

27.12.2025 / Hall-9, Session-3			
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HEAD OF SESSION: ***Lect.Aliye AŞIKKUTLU***

TOPIC TITLE	AUTHORS	AFFILIATION
Molecular Docking And DFT Analysis Of Lasmiditan As A Therapeutic Agent For Migraine	**Özlem GÜNDOĞDU AYTAÇ Sertan AYTAÇ Lect. Dr. Emel EKİNCİ**	**Kırşehir Ahi Evran Unıversity/Çankırı Karatekin University**
The Effect Of Mushroom Usage As A Fat Substitute On Quality Properties Of Chicken Patties	**Mine KIRKYOL Prof. Dr.Ahmet AKKÖSE**	**Artvin Çoruh University/Atatürk University**
The Effect Of Using Cauliflower In Chicken Meatballs On Physicochemical, Sensory, And Textural Properties	**Mine KIRKYOL Prof. Dr. Ahmet AKKÖSE**	**Artvin Çoruh University/Atatürk University**
Effects Of Different Ionizing Irradiation Techniques On Meat Color	**Lect.Aliye AŞIKKUTLU Prof. Dr. Cemalettin SARIÇOBAN**	**Selcuk University**
The Effect Of Essential Oil Applications In Biopolymer-Based Active Packaging On Meat And Meat Products	**Lect.Aliye AŞIKKUTLU Prof. Dr. Cemalettin SARIÇOBAN**	**Selcuk University**
Pelemir (*Cephalaria syriaca* L.) Bitkisinin Besin İçeriği	**Diyanet TEKİN Assoc. Prof. Dr. Fatma HEPSAĞ**	**Osmaniye Korkut Ata University**

27.12.2025 / Hall-10, Session-3			
	ANKARA LOCAL TIME		**MEETING ID:** 844 4053 5966
	12 ^{00} : 13 ^{45}		**PASSCODE:** 450687
HEAD OF SESSION: ***Assoc. Prof. Dr. Ayhan IŞIK***			

TOPIC TITLE	AUTHORS	AFFILIATION
Mutezile'nin Tıp Sahasına Yönelik Değerlendirmeleri	**Prof. Dr. Veysi ÜNVERDİ**	**Necmettin Erbakan University**
İsrâ Hadisesi'nin Mu'tezilî Yorumu	**Prof. Dr. Veysi ÜNVERDİ**	**Necmettin Erbakan University**
To What Extent Is Rawlsian Justice Egalitarian? A Feminist Assessment	**Tuba İLHAN DALAR**	**Kilis 7 Aralık University**
Reasons For The Destruction Of Nations	**Cumali ÇAKAN**	**Kahramanmaraş Sütçü İmam University**
Tradition, Identity And Politics In Islamic Thought: An Analysis Of The Milli Görüş Movement	**Assoc. Prof. Dr. Ayhan IŞIK Emine Betül FAZLIOĞLU**	**Karabük University**
From Idea To Action: The Assassination As A Radical Movement	**Assoc. Prof. Dr. Ayhan IŞIK Sevgi AKÇAY**	**Karabük University**
The Concept Of Istınbāṭ Among Qur'anic Commentators And Jurists: A Semantic And Terminological Analysis	**Dr. Ahmet AKIL**	**Bağımsız Araştırmacı/Van Yüzüncü Yıl University**

27.12.2025 / Hall-11, Session-3			
	ANKARA LOCAL TIME		MEETING ID: 844 4053 5966
	12 30 : 13 45		PASSCODE: 450687

HEAD OF SESSION: ***Assist. Prof. Dr. Deniz TAŞKIN***

TOPIC TITLE	AUTHORS	AFFILIATION
Effect Of Ocimum Basilicum (L.) Extract On Total Protein Content In Model Organism *Galleria Mellonella* L. (Lepidoptera: Pyralidae)	Assist. Prof. Dr. Deniz TAŞKIN Resc. Assist. Dr. Serhat KAYA	İstanbul Yeni Yüzyıl University /Çanakkale Onsekiz Mart University
Determination Of Total Phenolic And Flavonoid Amounts In Dianthus Tabrısianus Stem Water Extract	Zafer YAREN, Abdülhalim GÜNEŞ Deniz İRTEM KARTAL, Ayten EROĞLU	Van Yüzüncü Yıl University
Effects Of Salinity And Thermal Processing On The Antioxidant And Antimicrobial Properties Of Cinchona Officinalis Extracts	Beyza BEDİR, Müdahhara KARACA Mustafa ÇİÇEK, Aytaç KOCABAŞ	Necmettin Erbakan University/Karamanoglu Mehmetbey University
Antıbıofılm Effect Of Edıble And Nonedıble Parts Of Tuber Of Arum Italıcum Plant	Assist. Prof. Dr.Uğur KARDİL Azer ÖZAD DÜZGÜN Zeynep AKAR	Gümüşhane University
Evaluation Of Sod2 Gene Expression In Thyroid Carcinoma According To Clinical Parameters: Ualcan-Based In Silico Study	Eda TÜRKYILMAZ, Elif Sude TİKEN, Lect. Mirsajjad ESLAMKHAH TAGHIZAD, Leyla HÜSEYNOVA, Assist. Prof. Dr. Lütfiye KARCIOĞLU BATUR	Biruni University
Investigation Of The Phylogenetic Relatıonships Of Ellobius Lutescens In The Van Population Based On The Mitochondrial D-Loop Gene	Teoman KANKILIÇ İrem Eda DİRİL İlkay CİVELEK Burcu KÖSE Gökhan YÜRÜMEZ	Batman University/Niğde Ömer Halis Demir University

27.12.2025 / Hall-12, Session-3			
	ANKARA LOCAL TIME		MEETING ID: 844 4053 5966
	12 30 : 14 00		PASSCODE: 450687

HEAD OF SESSION: ***Assoc. Prof. Dr. Seyit Ali GÜNGÖR***

TOPIC TITLE	AUTHORS	AFFILIATION
Design And Synthesis Of A New 1,2,3-Triazole Derivative As A Potential Anti-Alzhimer Agent: Investigation Of Its ACH And BCH Inhibitory Properties	Dr. Büşra Albayrak MISIR Assist. Prof. Dr. Özge GÜNGÖR	Kahramanmaras Sutcu Imam University
Synthesis Of New 1,2,3-Triazole Hybrid Compound And Investigation Of A-Glucosidase Inhibition And BSA Binding Properties	Dr. Büşra Albayrak MISIR Assist. Prof. Dr. Özge GÜNGÖR	Kahramanmaras Sutcu Imam University
Dna Binding And Molecular Docking Studies Of 1,2,3-Triazole Aldehyde-Containing Compounds	Assoc. Prof. Dr. Seyit Ali GÜNGÖR Assist. Prof. Dr. Özge GÜNGÖR	Kahramanmaras Sutcu Imam University
α-Glucosidase And Molecular Delivery Studies Of 1,2,3-Triazole Aldehyde-Containing Compounds	Assoc. Prof. Dr. Seyit Ali GÜNGÖR Assist. Prof. Dr. Özge GÜNGÖR	Kahramanmaras Sutcu Imam University
Effects Of Ag-ZnO Nanocomposites Of Usnea Barbata Lichen Species On Ht29 Cell Line Using The Comet Test	Kenan GÖK Prof. Dr. Dilek PANDIR Assoc. Prof. Dr. Zekiye KOCAKAYA	Yozgat Bozok University
Biologically Derived Green Synthesis Approaches And Their Applicatiıons	Kenan GÖK Prof. Dr. Dilek PANDIR İlayda Ünal	Yozgat Bozok University

27.12.2025 / Hall-13, Session-3			
	ANKARA LOCAL TIME		MEETING ID: 844 4053 5966
	12 30 : 13 45		PASSCODE: 450687

HEAD OF SESSION: ***Prof. Dr. Arif BABANLI***

TOPIC TITLE	AUTHORS	AFFILIATION
Conductance Of Quantum Dots With A Delta Potential Barrier	**Prof. Dr. Arif BABANLI**	**Süleyman Demirel University**
Design, Synthesis, And Characterization Of New 1,2- Disubstituted Tetralins	**Assist. Prof. Dr. Kadir AKSU Nilsu UZUNLAR**	**Ordu University/Ondokuz Mayis University**
Search Potential Of High Energy Hadron Colliders To Discover New Heavy Quarks	**Prof. Dr. Orhan ÇAKIR**	**Ankara University**
Heat Capacity Of The Kane Oscillator In The Application Of Superstatistics Theory	**Prof. Dr. Arif BABANLI Mustafa BALCI Vepa SABYROV**	**Suleyman Demirel University/Isparta University/Technical and Transport Communications of Turkmenistan/ TÜRKMENİSTAN**
Heat Capacity Of Gaas Cylindrical Quantum DOT In Application Of Superstatistics Theory	**Prof. Dr. Arif BABANLI Mustafa BALCI Vepa SABYROV**	**Suleyman Demirel University/Isparta University/Technical and Transport Communications of Turkmenistan/ TÜRKMENİSTAN**

27.12.2025 / Hall-14, Session-3			
	ANKARA LOCAL TIME		MEETING ID: 844 4053 5966
	12 30 : 14 30		PASSCODE: 450687

HEAD OF SESSION: ***Lect. Ebru SOLMAZ***

TOPIC TITLE	AUTHORS	AFFILIATION
The Role And Responsıbılıtıes Of Occupatıonal Health Nurses In Preventıng Workplace Accıdents	Firdevs KUZU	Sivas Cumhuriyet University
A Scopıng Revıew Of Postgraduate Theses On Dıabetıc Foot In The Fıeld Of Nursıng In Turkey	Meryem KAR Cansu POLAT DÜNYA Nurten ÖZEN	Istanbul Bilgi University/Istanbul University
Doxorubicin And 4-Hydroxyperoxycyclophosphamide Alter Mitochondrial Dynamics In Spermatogonia And Spermatocytes	Assist. Prof. Dr. Mustafa ÖZTATLICI, Kemal ÖZBİLGİN Rukiye Betül ÇOLAKSEL Suna KARADENİZ SAYGILI Hülya ÖZTATLICI	Gaziantep Islam Science and Technology University/Manisa Celal Bayar University/Kütahya Health Sciences University
The Effect Of Nonpharmacological Methods Used During Episiotomy On Anxiety: A Meta-Analysis Study	Ph. D. Sümeyye KÖSE Assoc. Prof. Dr. Handan ÖZCAN	Pendik İlçe Sağlık Müdürlüğü/Sağlık Bilimleri Üniversitesi
The Effects Of The Climate Crisis And Increasing Environmental Stress On Reproductive Health And The Roles Of Midwives	Ph. D. Sümeyye KÖSE	Pendik İlçe Sağlık Müdürlüğü
Effectiveness Of Basic Electrocardiography Training For Nurses	Assist. Prof. Dr. Fatma İLTUŞ Yasemin TOKEM Serdar BAYATA	Selçuk University/İzmir Kâtip Çelebi University
Glycemic Control In Enterally-Nutritioned Diabetic Patients	Assist. Prof. Dr. Fatma İLTUŞ Çiğdem BERK ÖZCAN	Selçuk University
Preparation For General Anesthesia: Preoperative Medical Optimization In Oral And Maxillofacial Surgery Patients	Res. Assist.Serra ACAR Seçil ÇOBANOĞLU	Eskişehir Osmangazi University
Virtual Reality–Supported Teaching In Undergraduate Nursing Education: Current Approaches	Assist. Prof. Dr. Ebru ŞAHİN Lect. Ebru SOLMAZ	Ordu University/Ağrı İbrahim Çeçen University

27.12.2025 / Hall-15, Session-4			
	ANKARA LOCAL TIME		MEETING ID: 844 4053 5966
	12 30 : 14 00		PASSCODE: 450687
HEAD OF SESSION: *Assist. Prof. Dr. Semra ŞİRİN KIRIŞ*			

TOPIC TITLE	AUTHORS	AFFILIATION
Lessons From Earthquakes In Turkey: An Evaluation From The Perspective Of Structural Behavior, Inspection, And Implementation	Assoc. Prof. Dr. Ali SARIBIYIK Aysu ASLANKILIÇ, Berranur ÇETIN Berranur DÜZCAN, Ebrar ERTÜRK Esra AKARSU, İnanç AKAY Özge AKGÜLLÜ, Şenol ERDOĞAN	Sakarya University of Applied Sciences
Evaluation Of Ag And Rgo-Coated Textile And Polymer Substrates For Biomedical Electrodes	Elif Nur SELÇUK Hatice AKMAN Gökçenur ÇAKMAK Mustafa Reşit USAL	Suleyman Demirel University/Isparta University of Applied Sciences
Comparative Evaluation Of Ground Motion Parameters Based On Structural Response: A Case Study Of The 2023 Pazarcık And Elbistan Earthquakes	Assist. Prof. Dr. Semra ŞİRİN KIRIŞ	Doğuş University
Comparative Trend Analysis Of Carbon Intensity In Turkey And Germany	Assoc. Prof. Dr. Mahsum AYDIN Fatma Fehime AYDIN	Van Yüzüncü Yıl Üniversitesi
Roundabout Optimization With Signalization And Channelization Integration: An Evaluation Of Literature Findings	Timur Ozan ÖZAY Dr. Fatih YONAR	DSI 252nd Branch Directorate/Çanakkale Onsekiz Mart University
Microstructural Changes Of 6000 Series Aluminum Welded By Mig Method Under Different Production Parameters	Lect. TURGAY TEHÇİ SAMET OĞURLU Prof. Dr. Fatih ÇALIŞKAN	Sakarya Uygulamalı Bilimler Üniversitesi/Cumhur Metal Sac Boru Profil

27.12.2025 / Hall-16, Session-4			
	ANKARA LOCAL TIME		MEETING ID: 844 4053 5966
	12 30 : 13 45		PASSCODE: 450687

HEAD OF SESSION: *Assist. Prof. Dr. Esra KEŞER*

TOPIC TITLE	AUTHORS	AFFILIATION
A Review Of Children Exposed To Peer Bullying And Family Relationships	Merve BARUTCU Merve İBRAHİMOĞLU Ercümend ERSANLI	Ondokuz Mayıs University/Miera Akademi Psikolojik Danışmanlık ve Atölye Merkezi
Examining Peer Bullying In Secondary Education In Terms Of Various Factors	Dilan GÜNEŞ Uğur BAKAY	Gaziantep University
The Effect Of Body Movements With Rhythm Training On Rhythm Perception–Application Skills And Reaction Time In Students Aged 12–13	Mehmet AKA Zinnur GEREK	Gaziantep University
The Relationship Between Phantom Earthquake Sensation And Obsession, And Disease Self-Management In Diabetic Individuals Living In An Earthquake Zone	Assist. Prof. Dr. Esra KEŞER Ulviye ÖZCAN YÜCE Derya ATİK, Cengiz ÖZTÜRK	Osmaniye Korkut Ata University
Machıne Learnıng Approaches For Predıctıng Endometrıosıs Ovarıan Cyst And Rısk Assessment In Usıng Clınıcal And Bıomarker - Il6	Tasdemir Rabia Marina Adriana Mercioni Samfireag Miruna Suciu Oana Petre Izabella Petre Ion	University of Medicine and Pharmacy "Victor Babes" Timisoara/Politehnica University/ROMANIA

27.12.2025 / Hall-17, Session-4			
	ANKARA LOCAL TIME		**MEETING ID:** 844 4053 5966
	12 ^{30} : 14 ^{30}		**PASSCODE:** 450687

HEAD OF SESSION: ***Assoc. Prof. Dr. Fatma Dilek TURAN***

TOPIC TITLE	AUTHORS	AFFILIATION
Aile İçi Şiddete Kültürel Bakış	Assoc. Prof. Dr. Zeliha KAYA ERTEN Evrim BAYRAKTAR	Nuh Naci Yazgan University Erciyes University
Kültürel Yapı İnfertil Kadınlarda Cinsellik ve Evlilik Uyumunu Etkiler mi?	Evrim BAYRAKTAR Assoc. Prof. Dr. Zeliha KAYA ERTEN Semih ULUDAĞ	Nuh Naci Yazgan University Erciyes Üniversitesi/Kayseri Memorial Hospital
Toplumsal Cinsiyet Özellikleri Yönünden Göç	Assoc. Prof. Dr. Zeliha KAYA ERTEN Handan ZİNCİR	Nuh Naci Yazgan University Erciyes University
One-Year Evaluation Of Linear Accelerator Output Stability: Analysis Of Drift And Seasonal Variation	Lect. Selami EKEN Assoc. Prof. Dr. Yusuf KAVUN	Kahramanmaras Sütçü Imam University
Theoretical Investigation Of The Radiation Shielding Capacity Of Nio-Doped Photopolymer Resins Developed For The Dlp 3d Printing Process	Assoc. Prof. Dr. Yusuf KAVUN Lect. Selami EKEN	Kahramanmaras Sütçü Imam University
The Relationship Between Fear Of Surgery And Postoperative Pain And Anger Levels In Patients Hospitalized In A Breast Endocrine Surgery Clinic	Assoc. Prof. Dr. Vesile ESKİCİ İLGİN Canan AKGÜL	Atatürk University
Technological Approaches To Nutrition In Children: A Contemporary Review	Assoc. Prof. Dr. Fatma Dilek TURAN	Akdeniz University
Childhood Immunization In The Digital Era: Innovative Strategies And The Role Of Pediatric Nursing	Assoc. Prof. Dr. Fatma Dilek TURAN	Akdeniz University

27.12.2025 / Hall-18, Session-4			
	ANKARA LOCAL TIME		MEETING ID: 844 4053 5966
	12 30 : 14 45		PASSCODE: 450687

HEAD OF SESSION: *Assoc. Prof. Dr. Arzu KARABAĞ AYDIN*

TOPIC TITLE	AUTHORS	AFFILIATION
Differential Diagnosis Process In Psychiatric Symptomatology: Clinical Integration Of Structural, Functional Imaging And Electrophysiological Methods	Assoc. Prof. Dr Gamze SARIKOÇ Beyza KAYA	University of Health Sciences
Investigation Of The Cytotoxic Properties Of The Bı-5521 Inhibitor In A Colon Cancer Cell Line	Assist. Prof. Dr. Aydın SEVER Havva AYBEK	Bingöl University
A New Fructose Metabolism Inhibitor Bı-9787 In Cancer Treatment	Havva AYBEK Assist. Prof. Dr. Aydın SEVER	Bingöl University
Evaluation Of Methodological Features Of Doctoral Theses In The Field Of Nursing	Maşide HURMANLI Assoc. Prof. Dr. Emine Derya ISTER	Kahramanmaraş Sütçü İmam University
Fatigue In Cancer Patients And Nursing Approaches To Fatigue Management	Assoc. Prof. Dr. Arzu KARABAĞ AYDIN Zehra MERİÇ	Kafkas University
Pain And Nursing Approaches To Pain In Cancer Patients	Assoc. Prof. Dr. Arzu KARABAĞ AYDIN Zehra MERİÇ	Kafkas University
Loneliness, Social Isolation, And Suicide Risk Among Older Adults: A Comprehensive Bibliometric Analysis (1980–2025)	Assist. Prof. Dr. Ece ALAGÖZ	Maltepe University
Adolescent Lonelıness And Dıetary Rısk Behavıors: Explorıng Mukbang Vıewıng As A Psychologıcal Pathway	Eungyeong Kim	Kunsan Nationalniversity/KOREA

27.12.2025 / Hall-19, Session-4			
	ANKARA LOCAL TIME		MEETING ID: 844 4053 5966
	12 30 : 14 15		PASSCODE: 450687

HEAD OF SESSION: *Dr. Hamdi DAĞISTANLI*

TOPIC TITLE	AUTHORS	AFFILIATION
Detection Of G6pd Canton, Kaiping, And Gaohe Mutations In The Diyarbakır Region	Dr. Kadir Sinan ASLAN Hüseyin Hakan İNCE	Dicle University
Synthesis And Characterization Of Newly Substitutioned Pyrıdıne Rıng-Drıven Sns-Type Pıncer Lıgand And Metal Complexes	Beyza NACAR Hatice Gamze SOĞUKÖMEROĞULLARI Mehmet SÖNMEZ	Gaziantep Üniversitesi
Different Countries Political Perspectives On Compulsory Military Service For Women	Fatma AĞ Prof. Dr. Bülent ALAGÖZ	Gaziantep University
Comparative Investigation Of The Gamma-Ray Attenuation Properties Of Lead-Containing Galena (PBS) And Altaite (PBTE) Minerals	Büşra AVDAN DURAK Assist. Prof. Dr. MEHTAP YALÇINKAYA	Istanbul University
Investigation Of The Mesogenic Properties Of The 6ba/3aba Binary Mixture Complex	Zafer EKER Prof. Dr. Mustafa OKUMUŞ	Batman University
Pytorch Application On Condensed Matter Physics	Buse KARAMAN, Kamile Elvin KAMBUR Selen GÜLMÜŞ Dr. Hamdi DAĞISTANLI	Buca Radikal Anatolian HighSchool
Theoretical Evaluation Of Quinoxaline Derivatives As Potential Electron Donors İn Advanced Organic Solar Cells (Oscs)	El Mostafa Benharaf, Ikram Mennas ZIDANE Zohra, Abdellah Zeroual Mohammed El idrissi	Sultan Moulay Slimane University/Chouaib Doukkali University/ MOROCCO

27.12.2025 / Hall-20, Session-5			
	ANKARA LOCAL TIME		MEETING ID: 844 4053 5966
	13 ^{00} : 15 ^{00}		PASSCODE: 450687

HEAD OF SESSION: ***Dr. Chukwuemeka G. EME***

TOPIC TITLE	AUTHORS	AFFILIATION
Gluten Sensitivity Vs. Celiac Disease: Nutritional And Clinical Perspectives	Dr. Saloni SHARMA Suhani SHARMA	Deemed to be University/INDIA
Mental Health Disorders Associated With Celiac Disease: Clinical Evidence And Pathophysiological Links	Dr. Saloni Sharma Suhani Sharma	Deemed to be University/INDIA
Study Of Laminated Composites Kevlar/ Epoxy Accrding A Various Criteria Of Failure	Adel DELIOU, Takieddine Boukelia Samir DJIMLI, Mohamed Kemiha Abdelkader FIDJAH, Khmissi BELKAID, Meriem DEHBI	University of UMSB of Jijel/ALGERIA
Multinational Corporations And Their Effects On Nigeria's Economic Growth And Development	Dr. Chukwuemeka G. EME	University of Nigeria
Issues And Challenges Of Coronavirus Outbreak In Nigweia	Dr. Chukwuemeka G. EME Dr. Elikwu MICHAEL	University of Nigeria/Veritas University
Dynamic Capabilities And Firm Performance Of Selected Food And Beverages Companies In South-West Nigeria	Dr. Chukwuemeka G. EME Prof. NNABUIFE, E. K. N.	University of Nigeria/Nnamdi Azikiwe University
Wrongful Termination Of Contracts Of Employment In Nigeria – A Case For Reinstatement Of Private Employees	Dr. Chukwuemeka G. EME	University of Nigeria
A Critical Examination Of The Right To Strike In Nigeria: A Review Of Some Selected Jurisdictions	Dr. Chukwuemeka G. EME	University of Nigeria

27.12.2025 / Hall-21, Session-5			
	ANKARA LOCAL TIME		MEETING ID: 844 4053 5966
	13 ^{00} : 15 ^{00}		PASSCODE: 450687

HEAD OF SESSION: ***Elizabeta POPOVA RAMOVA***

TOPIC TITLE	AUTHORS	AFFILIATION
Molecular Docking, Exploring Diverse Selectivities And Mechanistic Insights İn The Cycloaddition Reaction Between 3-Benzoylpyrrolo- [1,2-A] Quinoxaline-1,2,4(5H)-Triones And Butyl Vinyl Ether	Soukaina AMEUR Assiya ATIF Abdellah ZEROUAL Noureddine MAZOIR	ChouaïbDoukkali University
Enhanced Photocatalytic Degradation Of Ibuprofen Using An Amorphous Zn–Fe Bimetallic Mof	Lynda FERFECHE Nadra DEBBACHE	Frères Mentouri Constantine 1 University/ALGERIA
Marine Fish Leeches In Tunisia: New Host Data For Trachelobdella Lubrica And Pontobdella Muricata	Ben Ahmed RAJA Gammoudi MEHREZ	University of Tunis El Manar/TUNISIA
Numerical Simulation Of Thermal Behaviour Of Wallboards Containing A Phase Change Material (Pcm) For The Light Envelope Of Buildings	Selka GHOUTI	Université Abou bakr belkaid/ALGERIA
Complementary And Alternative Medicine Use Among Children To Increase Mental Health	Elizabeta POPOVA RAMOVA Vladimir APOSTOLOV	MIT University/MACEDONIA
Pulmonary Thromboembolism After Surgical Treatment Of Knee Related Fracture. (Case Report)	Poposka BILJANA, Ramov LEONID, Spasovska MARIJA Pejkovska SAVA	University Clinic fo pulmonology and allergology/MACEDONIA
Granulomatosis With Polyangiitis (Wegener's Granulomatosis), Diagnosis And İnitial Treatment(Case Report)	Ramov LEONID Zdraveska MARIJA Dimitrievska DESKA	University Clinic fo pulmonology and allergology/MACEDONIA
The Impact Of Technological Innovation On Energy Security In South Asia	Haleema Azam KHAN Dr. Dilawar KHAN	Kohat University of Science and Technology /PAKİSTAN

27.12.2025 / Hall-22, Session-5			
	ANKARA LOCAL TIME		MEETING ID: 844 4053 5966
	13 ^{00} : 15 ^{00}		PASSCODE: 450687

HEAD OF SESSION: ***Prof. Dr. El Mahdi BOUABDALLI***

TOPIC TITLE	AUTHORS	AFFILIATION
Impact Of Employee Motivation On The Performance Of Manufacturing Firms In Lagos State, Nigeria	Dr. Chukwuemeka G, EME	National Open University of Nigeria
An Appraisal Of Succession Planning In Family-Owned Businesses In Nigeria: Empirical Evidence From Selected Smes In Lagos State, Nigeria	Dr. Chukwuemeka G, EME	National Open University of Nigeria
Smart Analytics–Enhanced Educational Management And Its Impact On Learning Outcomes Quality In Syrian Universities	Dr. Khalel -Al Hamo AL HAMDAN Dr. Salwa Al-Muhammad AL-HUSSEIN	Al-Furat University/SYRIA
Synthesis And Theoretical Design Of 6,6′-(1,3,4-Oxadiazole-2,5-Diyl)Bis (3-Chloroaniline)	Assiya Atif Soukaina Ameur Houssine Ait Sir	Chouaib Doukkali University/MOROCCO
Tailoring The Structural, Physicochemical, Optical, Thermal, And Photoluminescent Properties Of Europium Doped Strontium Phosphate Glasses Synthesized Via Melt-Quenching For Photonic And Photovoltaic Applications	Prof. Dr. El Mahdi BOUABDALLI Mohamed El JOUAD, Samira TOUHTOUH, Ilyass El KADMIRI Nathalie GAUMER, Mostapha SINITI, Abdelowahed HAJJAJI	Mohamed Ben Abdellah University/ Chouaib Doukkali University/ University Mohamed First Oujda/MOROCCO
Syzygium Aromaticum (L.) : A Spice Of Pharmacological Interest For The Central Plateau Of Morocco – Synthesis Of Biological Activities And Prospects For Valorization	JAAYEFAR Fatima-ezzahra DAHMANI Jamila	Laboratoire des Productions végétales, animales et agro-industrie
Quantum Efficiency In Gan/Ingan Solar Cells Under External Perturbation	Rajab YAHYAZADEH Zahra HASHEMPOUR	Islamic Azad University/IRAN
The Role Of Physics In A Civil Engineering University In Preparing Students To Solve Environmental Problems	Prof. Dr. Usarov U.T. Assoc. Prof. Dr. Nodirov G. Yu Nishonov U.	Samarkand State University/UZBEKISTAN

27.12.2025 / Hall-23, Session-6			
	ANKARA LOCAL TIME		MEETING ID: 844 4053 5966
	13 ^{00} : 15 ^{00}		PASSCODE: 450687

HEAD OF SESSION: ***Dr. Tahir QURESHI***

TOPIC TITLE	AUTHORS	AFFILIATION
Breast Cancer Detection In Digital Mammography Using A Cross-View Vision Transformer With Hierarchical Attention	Al Mahmud SURUJ Qiu XIAOPING Shimul Mahmud KHATAMI	Southwest Jiaotong University/ Harbin Institute of Technology/ University of Frontier Technology/CHINA/BANGLADESH
Structure Activity Relationship Analysis Of Betulinic Acid And Avenasterol As Bioactive Natural Products	H. A. Kwazo, U. Z. Faruq L. G. Hassan, M. E. Sadiq M.Salihu	Usmanu Danfodiyo University/NIGERIA
A Double-Blind Randomized Comparative Interventional Study On The Impact Of Regional Analgesia On Acute Postoperative Pain And Chronic Postsurgical Pain In Breast Cancer Surgery	Khadija El HIMER	Ibn Tofail University/ Morocco
Adaptive Clinical Trial Designs: Improving Efficiency And Patient Outcomes	Dr. Saloni SHARMA Suhani SHARMA	Deemed to be University/INDIA
Water And Hydraulic Structures Engineering In Georgia: Managing Resources For The Future	Ketevan GORDEZIANI Lasha KAVELASHVILI	Georgian Technical University/GEORGIA
AI Unbound: Challenges And Opportunities For International Legal Frameworks	Dr. Tahir QURESHI Dr. Dhananjay Kumar MISHRA Dr. Aakriti SHUKLA	(Deemed University/INDIA
Spatiotemporal Prediction Of Air Pollutants İn Pakistan Using Machine Learning	Dr. Muhammad IMRAN Engr. Haseeb HASSAN	University Of Sargodha/PAKİSTAN
A Comparative Study Of Job Satisfaction In Public And Private Sector Banks With Special Reference To Sbı And Hdfc Bank	Gopa Kumar R.D., Irfan K.Y Joel Jose ANTONY Ms. Soumya VARGHESE	Bharata Mata College Autonomous Thrikkahra/Mahatma Gandhi University/INDIA

27.12.2025 / Hall-24, Session-6			
	ANKARA LOCAL TIME		MEETING ID: 844 4053 5966
	13 ^{00} : 15 ^{00}		PASSCODE: 450687

HEAD OF SESSION: ***Dr. Jayasree KRISHNAN***

TOPIC TITLE	AUTHORS	AFFILIATION
The Psychology Of Digital Spending: How E-Wallets Shape Impulsive Buying Among Young Consumers	Dr. Jayasree KRISHNAN	Vels Institute of Science Technology and Advanced Studies (VISTAS)
A Review Of Policy Initiatives For Rural Development In India Since Independence	Karuna Shanker KANAUJIYA Rajat SAINI	University of Lucknow
Domesticating A New Ecotype Of Sauveolens Mint Growing At In Regions With Extreme Climatic Conditions To Confirm The Causes Of Differentiation	Amal ERRADY, Mohamed MERZOUKI, Mohamed BOUHRIM El hassania EL, HAMZAOUI Hassane ABD-DADA	Sultan Moulay Slimane University/MOROCCO
Informality In The Albanian Coastal Tourism Sector: An Analysis Of Partial Client Declarations, The Bed Tax, And Beach Parcel Payments	Brunilda LICAJ	University A. Moisiu /ALBANIA
Uamd's Role In Tourism Workforce Development And Institutional Marketing	Brunilda LICAJ, Marsida ABDYL Prof. As. Dr. Mirela TASE	University A. Moisiu
Climate Challenges And Adaptive Technologies In Ukrainian Sunflower Seed Production	Serhii YEROMENKO Sergiy LAVRENKO	Kherson State Agrarian and Economic University /UKRAINE
Crystal Violet Dye Degradation Using Monoculture And Blended Culture Bacteria Isolated From Poultry Faeces	Faisal AHMED, Johirul ISLAM Tasmia Jahin MIM, Iftakhar AHMAD	Noakhali Science and Technology University/BRAC University
An In Silico Pharmacological And Molecular Docking Approach For The Development Of Potential Inhibitors Against Ctx-M-9 Class A Beta-Lactamase From Escherichia Coli	Johirul ISLAM, Faisal AHMED Tasmia Jahin MIM, Iftakhar AHMAD	Noakhali Science and Technology University/BRAC University

27.12.2025 / Hall-1, Session-6			
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HEAD OF SESSION: ***Assoc. Prof. Dr. Ho Son DAI***

TOPIC TITLE	AUTHORS	AFFILIATION
The Problem Of Microplastics In Environmental Medicine	Mariami MANAGADZE	Tbilisi State Medical University
Numerical Simulation Of The Proton Exchange Membrane Electrolyzer Performance	Ibrahim NACHIT	Laboratory of Renewable Energy and Dynamic of Systems
Health Informatics And Electronic Health Records	SNEHA Ajesh CHAUHAN	Hindu College of Pharmacy
Two Different Mechanisms Involved In The Bacteriorhodopsin-Atp Synthase Biosystem In Halobacterium Salinarum Cells	Gabi DROCHIOIU	1 Alexandru Ioan Cuza University of Iasi/ROMANIA
Effects Of Crushed Periwinkle Shells On The Compressive Strength Of Hollow Sandcrete Blocks	OMISANDE Lawrence A. IMASUEN Victoria	The Federal Polytechnic Ilaro/NIGERIA
Narrative Architecture In Immersive Games: Ai-Powered Story Worlds And Dynamic Player Experiences	Radhika H.	Presidency University/INDIA
The Internationalist Obligations Of The Ho Chi Minh City Military Specialist Group In Phnom Penh From 1979 To 1988	Assoc. Prof. Dr. Ho Son DAI Dr. Duong To Quoc THAI	Ho Chi Minh City University of Education/Dong Thap University, VİETNAM
Methodology For The Formation Of Speech Competence Of Primary School Students Based On An Integrative Approach	Lobar Mukhtarova Dilshoda Chorshanbiyevna Mamatraimova	Termez State Pedagogical Institute

27.12.2025 / Hall-2, Session-6			
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HEAD OF SESSION: ***Mouassa BOCHRA***

TOPIC TITLE	AUTHORS	AFFILIATION
Analysis Of Policies And Responses To The Plastic Waste Crisis In Indonesia	Nurul Amir SYAKILA Nur Suqya RAHMA	Muhammadiyah University of Makassar
Effectiveness Of Implementation Of Social Inclusion Program For Persons With Physical Disabilities At The Social Rehability Center For Persons With Physical Disabilities (Brspdf) In Makassar City Indonesia	Nurul Amira SYAKILA Abdul MAHSYAR Ihyani MALIK Nur Suqya RAHMA	Muhammadiyah University of Makassar
Analyzing Levi Strauss & Co.'s Cash Flow, Capital Structure, and Shareholder Returns in 2024	Nindya Reska PUTRI Raya Shakila HANNA	Universitas Lampung/INDONESIA
Histological Assessment Of Gonadal Maturation In The Gilthead Sea Bream (Sparus Aurata) From Algerian Waters	Mouassa BOCHRA	University Chadli benjdid/ Algeria
Histological And Morphological Assessment Of Gonadal Maturation In The Gilthead Sea Bream (Sparus Aurata) From Algerian Waters	Mouassa BOCHRA	University Chadli benjdid/ Algeria
Histological Characterization Of Gonadal Development In Penaeus Kerathurus: Implications For Aquaculture In Algeria	Mouassa BOCHRA	University Chadli benjdid/ Algeria
Evaluation Of Mechanical Properties Of Pozzolanic Treated Base Pavement Layer	Shubhangi AGARWAL Avinash OJHA Lokesh GUPTA	Sir Padampat Singhania University/India
Accelerating Biotherapeutics: The AI Pipeline For Antibody Design And Clinical Translation	Maria Fareed SIDDIQUI Ans Amjad, Irfa JAVAID Saman ZAHRA, Umar RAEES	-------

27.12.2025 / Hall-3, Session-6			
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HEAD OF SESSION: ***Prof. Dr. Ivan PAVLOVIĆ***

TOPIC TITLE	AUTHORS	AFFILIATION
MHD Heat and Mass Transfer Analysis of a Reactive Casson Nanofluid with Bioconvection on a Stretching Disk	E. O. FATUNMBI S. A. ODUNLAMI	Federal Polytechnic/nıgerıa
First-Principles and SCAPS-1D Simulation Analysis of a Potential Halide Double Perovskite Absorber for Photovoltaic Devices	Chokri El KHADER, Mossab OUBLAL, Mustapha MARDY, Fadoua El AISAOUI, Ihsane BENSASSI, Mustapha BGHOUR, Abdeslam El FANAOUI, Mounir LOTFI	Hassan I University/Ibn Zohr University
Investigation On The Properties And Potential Application Of Foam Concrete Using Different Mix Proportion	Lawal N.A. Odetunde M.W.	Federal Polytechnic/nıgerıa
Cybersecurity Partnerships and the Evolution of Cyber Diplomacy: Strategic Pathways for National and International Resilience	Dinu ALEXANDRA Teodorov ALEXANDRU	The Bucharest University/ROMANIA
The Significance And Types Of Correct Grazing For The Purpose Of Preserving Pastures	Prof. Dr. Ivan PAVLOVIĆ	Scientific Institute for Veterinary Medicine of Serbia/SERBIA
IMPORTANCE OF FOREST PASTURES IN THE DIET OF DOMESTIC ANIMALS	Prof. Dr. Ivan PAVLOVIĆ	Scientific Institute for Veterinary Medicine of Serbia/SERBIA
Personalized Experiences And Recommendation Algorithms: Their Influence On Customer Satisfaction In E-Business	Prof. Ass. Dr. Kushtrim GASHI Muhamed SHABANI	University “Ukshin Hoti” Prizren/KOSOVA
The Impact Of Information Systems On Decision-Making In Small And Medium Enterprises İn Developing Countries	Prof. Ass. Dr. Kushtrim GASHI Arena DURAJ	University “Ukshin Hoti” Prizren/KOSOVA
Enhancing Students’ Speaking Confidence In The English Classroom	Natalia BOLGARI Ina ANDONI	University Lecturer, Academy of Economic Studies of Moldova

27.12.2025 / Hall-4, Session-7			
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HEAD OF SESSION: *Zeineb DAMMAK*

TOPIC TITLE	AUTHORS	AFFILIATION
Working Through Illness : The Hidden Crisis Of Presenteeism Among Nurses İn Southern Tunisia	Fedi Ben DHAOU, Zeineb DAMMAK Feriel DHOUIB, Maroua TRIGUI Mondher KASSIS, Kaouthar JMAL HAMMAMI, Ali LAAMOURI Yosra MEJDOUB	Habib Bourguiba University Hospital/Hedi Chaker University Hospital/TUNISIA
The Body Under Strain - Mapping Musculoskeletal Disorders Across The Nursing Workforce	Fedi Ben DHAOU, Zeineb DAMMAK Feriel DHOUIB, Maroua TRIGUI Mondher KASSIS, Kaouthar JMAL HAMMAMI, Ali LAAMOURI Yosra MEJDOUB	University of Sfax/ Habib Bourguiba University Hospital/Hedi Chaker University Hospital/TUNISIA
High Demands, Low Control - Occupational Stress And The Karasek Model İn Hospital Nursing	Fedi Ben DHAOU, Zeineb DAMMAK Feriel DHOUIB, Maroua TRIGUI Mondher KASSIS, Kaouthar JMAL HAMMAMI, Ali LAAMOURI Yosra MEJDOUB	University of Sfax/ Habib Bourguiba University Hospital/Hedi Chaker University Hospital/TUNISIA
Profiling Surgical Candidates In A North African Teaching Hospital	Fedi Ben DHAOU, Amal AYEDI Maroua TRIGUI, Fares MEZGHANI Mohamed Seddik REGAIEG, Mariam KHROUF, Ahlem KANNOU, Sana BACCOUCHE, Samer BAGHDADI Mondher KASSIS, Bassem ABID	University of Sfax/ Habib Bourguiba University Hospital/ TUNISIA
Beyond Fear - Unraveling The Web Of Preoperative Anxiety Through Patient Eyes	Fedi Ben DHAOU, Amal AYEDI Maroua TRIGUI, Fares MEZGHANI Mohamed Seddik REGAIEG, Mariam KHROUF, Ahlem KANNOU, Sana BACCOUCHE, Samer BAGHDADI Mondher KASSIS, Bassem ABID	University of Sfax/ Habib Bourguiba University Hospital/ TUNISIA
The Informed Patient Paradox - Unmet Information Needs In The Preoperative Setting	Fedi Ben DHAOU, Amal AYEDI Maroua TRIGUI, Fares MEZGHANI Mohamed Seddik REGAIEG, Mariam KHROUF, Ahlem KANNOU, Sana BACCOUCHE, Samer BAGHDADI Mondher KASSIS, Bassem ABID	University of Sfax/ Habib Bourguiba University Hospital/ TUNISIA
Beneath The Surface - Dissecting Emotional States Through State-Trait Anxiety Inventory	Fedi Ben DHAOU, Amal AYEDI Maroua TRIGUI, Fares MEZGHANI Mohamed Seddik REGAIEG, Mariam KHROUF, Ahlem KANNOU, Sana BACCOUCHE, Samer BAGHDADI Mondher KASSIS, Bassem ABID	University of Sfax/ Habib Bourguiba University Hospital/ TUNISIA

27.12.2025 / Hall-5, Session-7			
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HEAD OF SESSION: ***Fedi Ben DHAOU***

TOPIC TITLE	AUTHORS	AFFILIATION
Anxiety Through Multiple Mirrors - Comparing Preoperative Assessment Instruments	**Fedi Ben DHAOU, Amal AYEDI Maroua TRIGUI, Fares MEZGHANI Mohamed Seddik REGAIEG, Mariam KHROUF, Ahlem KANNOU, Sana BACCOUCHE, Samer BAGHDADI Mondher KASSIS, Bassem ABID**	**University of Sfax/ Habib Bourguiba University Hospital/ Higher Institute of Nursing Sciences, Sfax, Tunisia/ TUNISIA**
From Awareness To Action - Prostate Cancer Screening Practices And Barriers In Tunisia	**Fedi Ben DHAOU, Amal AYEDI Maroua TRIGUI, Fares MEZGHANI Mohamed Seddik REGAIEG, Mariam KHROUF, Ahlem KANNOU, Sana BACCOUCHE, Samer BAGHDADI Mondher KASSIS, Bassem ABID**	**University of Sfax/ Habib Bourguiba University Hospital/ Higher Institute of Nursing Sciences, Sfax, Tunisia/ TUNISIA**
The Waiting Game - Temporal Patterns In Surgical Care Pathways And Patient Flow	**Fedi Ben DHAOU, Amal AYEDI Maroua TRIGUI, Fares MEZGHANI Mohamed Seddik REGAIEG, Mariam KHROUF, Ahlem KANNOU, Sana BACCOUCHE, Samer BAGHDADI Mondher KASSIS, Bassem ABID**	**University of Sfax/ Habib Bourguiba University Hospital/ Higher Institute of Nursing Sciences, Sfax, Tunisia/ TUNISIA**
What Healthcare Workers Don't Know Can Hurt - Influenza Vaccination Knowledge Deficits Among Nursing Staff	**Fedi Ben DHAOU, Amal AYEDI Maroua TRIGUI, Fares MEZGHANI Mohamed Seddik REGAIEG, Mariam KHROUF, Ahlem KANNOU, Sana BACCOUCHE, Samer BAGHDADI Mondher KASSIS, Bassem ABID**	**University of Sfax/ Habib Bourguiba University Hospital/ Higher Institute of Nursing Sciences, Sfax, Tunisia/ TUNISIA**
The Knowledge Gap - Understanding Prostate Cancer Screening Awareness And Its Social Determinants	**Fedi Ben DHAOU, Amal AYEDI Maroua TRIGUI, Fares MEZGHANI Mohamed Seddik REGAIEG, Mariam KHROUF, Ahlem KANNOU, Sana BACCOUCHE, Samer BAGHDADI Mondher KASSIS, Bassem ABID**	**University of Sfax/ Habib Bourguiba University Hospital/ Higher Institute of Nursing Sciences, Sfax, Tunisia/ TUNISIA**
The Digital Battlefield: Understanding Cyberbullying's Grip On Tunisian Youth	**Fedi Ben DHAOU, Amal AYEDI Maroua TRIGUI, Fares MEZGHANI Mohamed Seddik REGAIEG, Mariam KHROUF, Ahlem KANNOU, Sana BACCOUCHE, Samer BAGHDADI Mondher KASSIS, Bassem ABID**	**University of Sfax/ Habib Bourguiba University Hospital/ Higher Institute of Nursing Sciences, Sfax, Tunisia/ TUNISIA**
The Practice Gap - Influenza Vaccination Behaviors And Preventive Measures Among Healthcare Professionels	**Fedi Ben DHAOU, Amal AYEDI Maroua TRIGUI, Fares MEZGHANI Mohamed Seddik REGAIEG, Mariam KHROUF, Ahlem KANNOU, Sana BACCOUCHE, Samer BAGHDADI Mondher KASSIS, Bassem ABID**	**University of Sfax/ Habib Bourguiba University Hospital/ Higher Institute of Nursing Sciences, Sfax, Tunisia/ TUNISIA**

27.12.2025 / Hall-6, Session-7			
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HEAD OF SESSION: *Dr. S. SELVAM*

TOPIC TITLE	AUTHORS	AFFILIATION
Beyond The Schoolyard: Unveiling The Hidden Epidemic Of Bullying Among Tunisian Adolescents	Fedi Ben DHAOU, Amal AYEDI Maroua TRIGUI, Fares MEZGHANI Mohamed Seddik REGAIEG, Mariam KHROUF, Ahlem KANNOU, Sana BACCOUCHE, Samer BAGHDADI Mondher KASSIS, Bassem ABID	University of Sfax/ Habib Bourguiba University Hospital/ Higher Institute of Nursing Sciences, Sfax, Tunisia/ TUNISIA
Epidemiological Profile and Lifestyle Habits of High School Students in Sidi Bouzid	Fedi Ben DHAOU, Amal AYEDI Maroua TRIGUI, Fares MEZGHANI Mohamed Seddik REGAIEG, Mariam KHROUF, Ahlem KANNOU, Sana BACCOUCHE, Samer BAGHDADI Mondher KASSIS, Bassem ABID	University of Sfax/ Habib Bourguiba University Hospital/ Higher Institute of Nursing Sciences, Sfax, Tunisia/ TUNISIA
The Satisfaction Paradox: What Makes Tunisian Teenagers Thrive or Merely Survive?	Fedi Ben DHAOU, Amal AYEDI Maroua TRIGUI, Fares MEZGHANI Mohamed Seddik REGAIEG, Mariam KHROUF, Ahlem KANNOU, Sana BACCOUCHE, Samer BAGHDADI Mondher KASSIS, Bassem ABID	University of Sfax/ Habib Bourguiba University Hospital/ Higher Institute of Nursing Sciences, Sfax, Tunisia/ TUNISIA
The Impact Of Play And Play Materıals On Cognıtıve Development In Numeracy Among Pre-Prımary School Chıldren In Kaura, Kaduna State, Nıgerıa	TANKO, LINUS EMMMANUEL D. SAMBE EPHRAIM K. YUNANA	Kaduna State College of Education
Influence of Multi-Port Gas Distribution Configuration on DBD Ozone Generator Performance: Comparative Analysis of Single, Dual, and Quad Inlet-Outlet Systems for Enhanced Energy Efficiency	GHAITAOUI Essama Ahmed NASSOUR Kamel NEMMICH Said GHAITAOUI Touhami OULAD NAOUI Brahim El Khalil	Djillali Liabes University/ University Ahmed Draia
Optimization Of A Hybrid System (PV-Fuel Cell) Of EnergyProduction For An İsolated Site	T. GHAITAOUI, I. ARBAOUI A. E. GHAITAOUI, S. LARIBI Ali Abderrazak TADJEDDINE Dahbi HASSANE, Youcef HALALI	Université d'Adrar, d'Adrar, / University of Nour Bachir El-Bayadh/ University Ahmed Draia of Adrar/ALGERİA
Ethnobotanical Diversity of Medicinal Plants in Rural Communities of Rissani, Morocco	Maria EL ANSARI, Mariame NAJEM Khalid BOURAADA, Jamal IBIJBIJEN Laila NASSIRI	Sidi Mohamed Ben Abdellah University

The Impact of AI on the Human Element of Education: Opportunities and Ethical Challenges	**V. VISHAL** **Dr. S. SELVAM**	**Nadar College Nagamalai**

27.12.2025 / Hall-7, Session-8			
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HEAD OF SESSION: *Md. Rasel UDDIN*

TOPIC TITLE	AUTHORS	AFFILIATION
A Comparative Study of Astronomy and Astrology: Scientific Foundations and Conceptual Differences	M.DHINESH KUMAR, Dr. S. SELVAM	Nadar College Nagamalai
Neuro-Adaptive Federated Meta-Learning for Human–AI Collaboration in Distributed Systems	N. SANTHOSH, B. Madhan KUMAR Dr. S. SELVAM	
The Importance Of Pulse Oximetry In The Diagnosis And Monitoring Of Human Pathologies	ISMAILI Mohamed, RATTAL Mourad, LYAZIDI AISSAM	Biophysic and health Hassan 1st University
Femvertising As A Strategic Marketing Tool: A Conceptual Framework	Tamanna RATHEE, Dr. Mamta RANGA, Mamta RANI	MD University/Rohtak
Impact Assessment On Agricultural Crop And Land For Removal Of Top Rich Soil In Brick Manufacturing At Boali Union İn Gazipur, Bangladesh	Md Rasel UDDIN Nur NAHAR	Dhaka University of Engineering and Technology/ Tejgoan Women College /BANGLADESH
Patent Laws And Exclusıvıty In Pharmaceutıcals	R. KISHORE, K. VAISHNAVI S. MEENATCHI, V. KEERTHANA	Bharath institute of higher Education and research
AI In Gaming: Creating Immersive Experiences	R. KAMALAM, M. DEVIBALA, Dr S. SELVAM	Nadar Mahajana Sangam S. Vellaichamy Nadar College
The Limitations Of AI In Understanding Human Emotional Experience	K. Naveen RAJAN Dr. S. SELVAM	Nadar Mahajana Sangam S. Vellaichamy Nadar College

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HEAD OF SESSION: *Pr. AMZILE Rajaa*

TOPIC TITLE	AUTHORS	AFFILIATION
AI-Based Chatbots And Virtualassisstants	P. Kavi SRI S. DHARANI Dr. S. SELVAM	Nadar Mahajana Sangam S. Vellaichamy Nadar College
AI Representation In Anime Vs Real-World AI Development	A. JAYASREE K. Yogapriya SIVASANKARI Dr. S. SELVAM	Nadar Mahajana Sangam S. Vellaichamy Nadar College
Future Of Animation: AI In 2D Anime Vs 3D CGI- A Viewer Experience Comparison	P. Sankara NARAYANAN K. Santhosh RAJA Dr. S. SELVAM	Nadar Mahajana Sangam S. Vellaichamy Nadar College
A Smart Automated System For Fake News Detection Using Machine Learning	P. VEERALAKSHMI Dr. S. SELVAM	Nadar Mahajana Sangam S. Vellaichamy Nadar College
The Intersection Of Logistics, Machine Learning, And Digital Public Strategy: A Case Study Of Morocco In The Context Of "Digital Morocco 2030	Pr. AMZILE Rajaa	Mohammed V University
Synthesis, Characterization And Computational Investigation Of 5-Chloro-2-(5-(2-Methyl-1H-Benzimidazol-5-Yl)-1,3,4-Oxadiazol-2-Yl)Aniline	Assiya ATIF Soukaina AMEUR Houssine AIT SIR	Chouaib Doukkali University/MOROCCO
Synthesis And Characterization Of 2,5-Bis(2-(Trifluoromethyl)-1H-Benzimidazol-5-Yl)-1,3,4-Oxadiazole	Assiya ATIF Houssine AIT SIR	Chouaib Doukkali University/MOROCCO
From Displacement to Cultivation: Historical Trajectories of Agrarian Adaptation among Rohingya Refugees in Cox's Bazar (1978–2025)	Mst. Shamima ISLAM Abir HASAN	Khulna University

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HEAD OF SESSION: *Omar BENSATTE*

TOPIC TITLE	AUTHORS	AFFILIATION
Nanotechnology in Drug Delivery	N. Arshad AHAMED D. ARAVINDHAN K. Dinesh RAJAN S. Rubin THARA	Bharath institute of higher educational research
Strengthening Public-Private Partnerships for Disease Control in Nigeria: A Review of NCDCs Collaborations with Private Sector Stakeholders	Unamu Emmanuel U., Adekola S.A, Musah Khadijat TOYIN, Bakare Mustapha UMAR, Sodiq Adetunji ADEKOLA	University of Abuja
Long-Term Seawater Immersion Effects on the Microstructural Stability of 304L and 316L Stainless Steels	Omar BENSATTE	Université Moulay Ismail /Morocco
Combined Experimental and Theoretical Analysis of the Physicochemical Attributes of a New Strontium Polyphosphate, α-$Sr(PO_3)_2$	El. MAJDI, S. ZERRAF Said BELAAOUAD	Hassan II University
The Vulnerabılıty Of The Bıoelectrıcal Actıvıty Of The Heart In Older Patıents To The Impact Of Covıd-19	Gadimova Z. M.	Ministry of Science and Education Republic of Azerbaijan, Baku, Azerbaijan
Enhancing Lung Cancer Classification Through Advanced Data Balancing Techniques	Rajae Bouzidi IDRISSI Nabila ZRIRA	Mohammed V University
Screenıng Of Chılı (Capsicum Annuum L.) Genotypes For Salt Tolerance Based On Morpho-Physıologıcal Traıts	Md. Daraj Uddin PRODHAN	--------
Prevalence Of Irritable Bowel Syndrome (IBS) Symptoms Among Medical And Non-Medical Students	Amr R. HAIDAR, Salem Khaled ABDULRAHMAN, Abdullah Saleh ALI, Walid Abdulmalik BAJASH Amr FARHAN, Abduladeem G.M. Al-SELWI	Ain Shams University/ University Mohammed V/ Hassan First University/EGYPT/ MOROCCO

27.12.2025 / Hall-10, Session-9			
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HEAD OF SESSION: ***Prof. Dr. Sabeeha Hamza DEHHAM***

TOPIC TITLE	AUTHORS	AFFILIATION
Valorisation Of Bio-Eggshell Waste For The Synthesis Of Eco-Friendly Caco$_3$@Zn-Al Mmo Core–Shell Nanoflowers As An Efficient Photocatalyst For Enhanced Rhb Degradation Under Visible Light Irradiation	TAJAT Naoual, EL MOUHRI Wail, El HAYAOUI Widad, NADIF Iliass, BAKAS Idriss, TAMIMI Malika, ASSABBANE Ali, QOURZAL Samir	Ibn Zohr University
Thermal Analysis Of Marangoni-Driven Maxwell Nanofluid Flow Over A Porous Rotating Disk	E. O. FATUNMBI, S. A. ODUNLAMI	Federal Polytechnic, Ilaro, Nigeria.
The Effect Of Cultivation Strategy Of Critical Thinking In Developing Writing Skills Of College Students	Prof. Dr. Sabeeha Hamza DEHHAM Assist. Lect. Murtdha Ayad MOHAMMED	University of Babylon/IRAQ
Synergıstıc Effects Of Carbon Sequestratıon On Envıronmental Sustaınabılıty And Dısease Management	Mahmud Sindid IKRAM Sumiya Akter MONI	Bangladesh Agricultural University
Lumo - An Integrated Iot-AI Safety Assistance System For Real-Time Emergency Response	Md Mehedi Hasan NAEEM Mst Kamrunnahar RUMA Nafiza ANJUM, Shakila SULTANA	Jatiya Kabi Kazi Nazrul Islam University
Antiproliferative Effect Of The Crude Venom Of Moroccan Cobra Naja Haje On Brain Cancer Cell Lines	Salma CHAKIR, Reda CHAHIR, Nihal MESMOUDI, Paola INFANTE, Ludovica Lospinoso SEVERINI, Hinde AASSILA, Abdellah MOUSTAGHFIR, Lucia DIMARCOTULLIO, Naoual OUKKACHE	Sapienza University/ Mohammed V University/ITALY/ MOROCCO
Optimized Microwave Extraction Of Olive Seed (Olea Europaea L.): A Comprehensive Study Of Chemical Composition And Biological Activities	Iouknane-Debbou NEDJIMA Meriem ADOUANE Fatiha BRAHMI	Research Center in Agro-food Technologies (CRTAA)/ 2Laboratoire de Gestion et Valorisation des Ressources Naturelles et Assurance Qualité (LGVRNAQ)
Entrepreneurship Education Models For Empowering The Africa Girl-Child	Ndubuisi-Okolo Purity UZOAMAKA Grace Nwanonyigwe AKAEGBOBI Nwafor Euchaira EBELE	Nnamdi Azikiwe University/NIGERIA

27.12.2025 / Hall-11, Session-9			
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HEAD OF SESSION: *Tasbiul ISLAM*

TOPIC TITLE	AUTHORS	AFFILIATION
Management Of Root-Knot Nematode (Meloidogyne Spp.) Of Brınjal By Organıc Amendments	Tasbiul ISLAM Jakaria HOSSAIN Most. Olia Parvin HAPPY	Hajee Mohammad Danesh Science and Technology University
Identification And Antibiogram Assay Of Streptococcus Spp. Isolated From Cattle Farm Environment	Md. Najmus SAKIB, Annapurnna RAY, Faisal AHMED, Md. Sabbir HOSSAIN, Most. Surya SHARMIN, K. M. Mozaffor HOSSAIN	University of Rajshahi
Assessıng Potentıal Varıables Of Stress Management Among Workıng Adults Of Hıgher Instıtutıons In Ondo State	Omolola Justinah AWOSIKA	Wesley University
Dıetary Dıversıty And Bıofortıfied Crops Among Youth And Women Farmıng Households In Gwagwalada	Okwor Mary IJEOMA Sodiq Adetunji ADEKOLA	University of Abuja
A Qualitative Study On The Social Dynamics Between Pharmacy Shopkeepers And Slum Communities İn Sylhet, Bangladesh	Md Syful ISLA Faria Binte ARIF	Shahjalal University of Science and Technology
Green Infrastructure for Climate-Resilient Urban Growth in Bangladesh: A Conceptual Framework for Policy and Practice	Md. Safiuz ZAMAN Most. AYESHA	Khulna Agricultural University
Translation of Childrens Literature in the AI Era: Preserving Wonder in an Algorithmic Age	Narjes Asgari VARTOONI Fatemeh Aghakhani CHEGENI Mahmoud AFROUZ	University of Isfahan
An Accelerated Fourth-Order Fitted Numerical Approach For Singularly Perturbed Reaction-Diffusion Problems Of Small Time Lag	Amare Worku DEMSIE Awoke Andargie TIRUNEH Endalew Getnet TSEGA	Bahir Dar University/ Woldia University

27.12.2025 / Hall-12, Session-10			
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HEAD OF SESSION: ***Olorunlogbon Sunday Olorunnipa***

TOPIC TITLE	AUTHORS	AFFILIATION
Leveraging Youth Led Digital Innovation For Sustainable Community Development In Rural Areas: A Case Study Approach	Olorunlogbon Sunday OLORUNNIPA	Quintessential College
Deep Learning Models For Financial Forecasting: Advancements, Challenges, And Practical Implications	BOUNEFLA Alia ZAID Haizia	National School of Statistics and Applied Economics
The Role Of As Sunnah Foundation In Combating Poverty And Unemployment İn Bangladesh : A Review From The Perspective Of Social Justice	Dr. Muhammad Nasir UDDIN Muhammad Nezam UDDIN	Bangladesh Islami University/ Bursa Uludag University
Good Manufacturing Practice	S. Shakthi SREE, D. ARAVINDHAN, S. SWAPANA, Dr. Lavanya BABU	Bharath Institute of Higher Education and Research ,
Transformative Learning in Higher Education: Unpacking the Role of AI Tutors as Collaborative Pedagogical Partners	Dr. Almas SHOAIB, Dr. Raja Noshad JAMIL, Umair KHAN, Dr. Aisha SAMI Dr. Aqila RAFIQUE	Center of Educational Innovation, UMT
The Life Cycle Assessment of Single-use Plastic Bags: Evaluating Pyrolysis Oil as a Recycling Option of the Circular Economy	Md Abul HUSSAIN Mirza A.T.M. Tanvir RAHMAN Muhammad Tawhidul ISLAM Abdul KADER, Ibne KAMAL M. A. TAHER	Jahangirnagar University
The Modern Translator's Toolkit: The Importance of Matecat, Lokalise, Trados Studio, and Phrase	Narjes Asgari VARTOONI Mahmoud AFROUZ	University of Isfahan
Neurodermatology and Bannayan Riley Ruvalcaba Syndrome: Integrating Dermatological Indicators, Neurological Risks, and Emerging Precision Therapies	Fazna Fara ABDULLA	DTMU, Tbilisi, GEORGİA
Skin Biosensors and Wearable Endocrine Monitoring: A New Frontier in Dermatologic–Endocrine Diagnostics	Fazna Fara ABDULLA Iuri MIGRIAULI	DTMU, Tbilisi, GEORGİA

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HEAD OF SESSION: ***Moshfiq Momtasir NELOY***

TOPIC TITLE	AUTHORS	AFFILIATION
Sustainable Soil Management: How Omfs Improve Microbial Activity And Carbon Sequestration	Zakaria ASBAI Morad KADDOURI Nadia BOUTALEB	Hassan II University/Sultan Moulay Slimane University
Correlation And Heritability Of Morphology And Yield Characteristics İn NERICA Rice Genotypes	Fase O.B Oyekale, J. I	Federal Polytechnic, Ilaro, Ogun State/ Nigeria.
Assessment Of Proximate Composition, Fatty Acid Profile, Lipid Quality And Freshness Of Farmed Black Tiger Shrimp (Penaeus Monodon),Bangladesh	Moshfiq Momtasir NELOY Tasmia Islam KANTA Md. Abul MANSUR	Bangladesh Agricultural University
Neurobiological Mechanisms Through Which Physical Exercise May Slow The Pathophysiology Of Alzheimer's Disease: A Mini-Review	Jihane HILALI, Rochdi DAIBI Anas ANAYOUB, Mariam BEN SAGUA, Lamiae ZEROUAL, Amina El IMAM, Amine ARFAOUI, Bouchra TAIB	Ibn Tofail University/Mohammed VI University/Moulay Ismail University
Wastewater Treatment using Algae for Biofuel Production	Bate Garba BARDE Adamu ABDULLAHI	Federal University
Adsorptive Removal of Methylene Blue onto Activated Carbon Prepared from Bamboo: A Study of Kinetics and Isotherms	EL HANDAOUI EL MEHDI SALIM AHMED ABDERRAHIM JRIFI OMAR FANIDI	Hassan II university
Comparative Study Of The Phytochemical Composition Of Fumaria Parviflora From Three Regions Of Morocco	Salma MAKDOUF Karima El BOUQDAOUI Abdelhakim El MAKSSOUDI Mounia CHERKI	Hassan II University
Hardness, Fracture Toughness And Debye Temperature Of Yttrıum Monopnıctıdes Yx (X = N, P, As, And Sb) From Elastıc Constants	Salah DAOUD Nadhira BIOUD Abdelfateh BENMAKHLOUF	University Mohamed El Bachir El Ibrahimi of Bordj Bou Arreridj
Women's Rights Education in Traditional Societies	Noorjan MOSSAWI	Ahlul bayt international university /IRAN
Enhancing Women's Capacity to Respond to Security Threats	Noorjan MOSSAWI	Ahlul bayt international university /IRAN

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HEAD OF SESSION: ***Altiné Toga Hannatou***

TOPIC TITLE	AUTHORS	AFFILIATION
Refinement of High-Quality Shidol Production in Bangladesh	Md MONIRUZZAMAN David Rintu DAS Md Saiful ISLAM Md Shariful ISLAM Md Harunor RASHID Anuradha BHADRA	Bangladesh Fisheries Research Institute, Freshwater Station, BANGLADESH
Human Trafficking Scenario in Bangladesh: A Comprehensive Study on Child and Women Trafficking	OHAJIULLAH	University of Rajshahi
Desıgn Of Basın Irrıgatıon System For Pepper In Gonar Ganye, Tudun Wada, Zarıa	Sani Yakubu KHALIFA Usman Idris ABUBAKAR Nura Idris ABDULLAHI Aliyu Adamu DANDAJE Muhammad Mujahid MUHAMMAD	Ahmadu Bello University
Advancements İn Wind Energy Control Systems, Offshore Technologies, And Reliability Improvements	Mariam Aden Abdi ERCAN AYKUT	Gelisim Istanbul University
Electromagnetıc Compatıbılıty	Z. KARI, SHALL, Y. D. DARY J. J. ROUSSEAU	Djilali Liabes University/Jean Monnet,University/FRANCE ALGERIA
Effects of Praise Songs on Doguwa	Altiné Toga HANNATOU	Abdou Moumouni University of Niamey
Adherence To The Medıterranean Dıet And Metabolıc Parameters In Patıents Undergoıng Renal Replacement Therapy In Morocco	Moustakim RACHIDA, Friki FIRDAOUS, Barakat IMANE EL Hendaoui HAJAR, Liba HABIBA Mziwira MOHAMED, Belahsen REKIA	Chouaib Doukkali University//Hassan II University
Bridging Evidence And Practice: Knowledge And Clinical Use Of Non-Speech Oral Motor Exercises Among Speech And Language Therapists In Bangladesh	Kazi Sadia AFRIN	University of Dhaka
Singular Nonlinearities İn Non-Local Elliptic Equations	Y. EL GHALI, J. IGBIDA N. ELHARRAR, A. KADDAR	Chouaïb Doukkali University

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HEAD OF SESSION: ***Safir Ullah KHAN***

TOPIC TITLE	AUTHORS	AFFILIATION
Effect Of Zinc Oxide Nanoparticles On Mechanical, Magnetic And Dielectric Properties Of Nanocomposites	Safir Ullah KHAN	University of the Punjab Lahore
Perceptıons Of Pensıon Managers And Beneficıarıes On The Nature Of Pensıon Fund Investments In Nıgerıa	Agbeyangi Babatunde ADISA Ogunnusi, Oluwatobi NURUDEEN Salawu Rafiu OYESOLA	Federal Polytechnic/NIGEIRA
AI-Enhanced And Bıst-Drıven Dıgıtal System Testıng: From Early Methods To Nanometer Technologıes	Afaq AHMAD, Sayyid Samir AL BUSAIDI, Hotefa SHAKER Joseph MANI, Vijaya PADMANABHA Basant KUMAR, Rajeev RAJENDRAN	Sultan Qaboos University
Contribution Of Incubation Support Services To Start-Up Success: A Sector-Wise Analysis	M. Amta RANI Dr. Mamta Ranga Tamanna RATHEE	MD University
A Simple Algorithm Based On Zero/Pole Configuration For Designing An IIR Digital Filter	Benabdellah YAGOUBI	Mostaganem University, Algeria.
A Study of the Factors Contributing Towards Employee Attrition in Maruti Suzuki	Kanimozhi. N Dr. Sreeja K.	NSB Academy, Bangalore
Internalization of Harajaon Batak Toba as a Framework for Management Ethics in Christian Religious Education	Abdi Syukur SIAHAAN Yohanes OKTAVIANUS	Universitas Kristen Indonesia
High-Resolution Drought Assessment Using Python-Based Remote Sensing and Sentinel-2 Data	Ziaul Haider CHOWDHURY Md. Osman Gani RASEL Md. Mahfuj Ahmed SIZAN	Mohammad Danesh Science and Technology University

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HEAD OF SESSION: *Dr. S. KALAISELVAN*

TOPIC TITLE	AUTHORS	AFFILIATION
Design, Synthesis And Anti-Viral Evaluation Of Novel Pyrazoles	Aqsa MUSHTAQ Ameer Fawad ZAHOOR	Government College University
Ultrasound Assisted Synthesis, In Vitro And Computational Investigation Of Triazole Conjugates As Effective Therapeutics Against Tyrosinase	Ameer Fawad ZAHOOR Shagufta KAMAL Muhammad HAROON	Government College University
Recent Methodological Developments For The Synthesis Of Carbazole Scaffolds	Saba MUNAWAR Ameer Fawad ZAHOOR	Government College University
Utılızıng Seasonal Effects Throughout The Sır Approach To Model Dengue Dynamıcs In Bangladesh	Most. Halimatuj SADIA Md. Mojammel HAQUE M. Osman GANI	Bangladesh University of Business and Technology/ Dhaka University of Engineering and Technology/ Jahangirnagar University
ANFIS-Optimized Carbonaceous–TiO_2 Hybrid Nanostructures Synthesized from Plant Bio-Hydrocarbons for High-Performance Energy Storage Applications	Dr. S. KALAISELVAN, Mrs. M. Parveen BANU, Ms. R Catherine Melita BENIN, Ms. M. HARSHAVARDHINI Dr. M. Karthigai PRIYA	Rathinam Technical Campus, Coimbatore, Tamilnadu, India
Machine-Learning-Driven Optimization of Bio-Hydrocarbon–Derived MWCNTs for High-Density Energy Storage in Power Grid Applications	Dr. S. KALAISELVAN, Mrs. M. Parveen BANU, Ms. S. DHARSHNI Ms. B. K. BAVADHARANI Mrs. K. SUJITHA	Rathinam Technical Campus, Coimbatore, Tamilnadu, India
A New Era of Orthognathic Planning — Zero Radiation Required	S. LEPORALE, M. CIANFRIGLIA R. MORAMARCO, V. MARTINI C. MAROCCO, C. BRAMUCCI F. SESTITO, R.REDA, L. TESTARELLI, T. TESTORI, G. PERROTTI	Fondazione Policlinico Universitario Campus Bio-Medico/University of Michigan/University of Milan/Sapienza University/ROMA/USA/ITALY
Three-Dimensional Cephalometric Evaluation of Vertical Craniofacial Architecture	S. LEPORALE, M. CIANFRIGLIA R. MORAMARCO, V. MARTINI C. MAROCCO, C. BRAMUCCI F. SESTITO, R.REDA L. TESTARELLI, T. TESTORI G. PERROTTI	Fondazione Policlinico Universitario Campus Bio-Medico/University of Michigan/University of Milan/Sapienza University/ROMA/USA/ITALY
Wheatgrass Preparation Modulates Antigen Presentation In Acute Leukemia Through Immunomodulation And Epigenetic Mechanisms	Anuraag DASGUPTA, Bandi Moneesha REDDY, Sarnabi BANERJEE Merina ROY, Anushka KUMAR Oishi MUKHERJEE, Roshni BIBI Pradeep R., Melvin GEORGE Koustav SARKAR	SRM Medical College Hospital and Research Centre

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HEAD OF SESSION: ***Pooja Somashekhar DASHATTY***

TOPIC TITLE	AUTHORS	AFFILIATION
Impact Of Cattaneo - Christov Heat Flux On Mhd Flow Of Non-Newtonian Fluids Over A Stretching Sheet	C. SULOCHANA Pooja Somashekhar DASHATTY	Gulbarga University
Bindu - A Non-Invasive Blood Group Detection System Using Fingerprint	Talha Suhayeb ARKO Nusrhat Jahan SARKER	Daffodil Institute of IT/BANGLADESH
Dynamics Of Hybrid Nanofluid Flow Over A Extending Surface With Non-Uniform Heat Source	C. SULOCHANA H. HUSENAPPA	Gulbarga University
Evaluation Of Bioaugmentation For The Removal Of Heavy Metals From Brassware Effluents İn The City Of Fes, Morocco	Imane ZOUFRI, Malika AMMARI Abdelhadi MAZRHA, Mohammed MERZOUKI Amina BARI	Mohamed Ben Abdellah University
Unleashing the Value of Talent Management Strategies in Digital Transformation and Growth of Service Firms	Jawad MAHROOF, Faheem Ahmad KHAN, Muhammad Umer QUDDOOS, Muhammad BASIT Abdur RAHIM	National Defense University//Bahauddin Zakariya University/COMSATS University Islamabad/California State University
Innovation, Culture, and Society: Interdisciplinary Perspectives for a Changing World	Dr. Nishi TYAGI Vaishali SHARMA	Modern College of Professional Studies, Ghaziabad, Uttar Pradesh, India
Assessıng The Impact Of The Natıonal Currıculum Framework 2021 On Secondary Students' Learnıng Outcomes: Bangladesh Perspectıve	Muhammad Tanvir AHMMED Dr. Muhammad Nasir UDDIN Fahim SHAHRIER	Birshrestha Noor Mohammad Public College, Dhaka, Bangladesh
Performance Optimization Of Quasi-2d $(Ba)_2(Ma)_2Pb_3I_{10}$ Perovskite Solar Cells: A Comparative Tcad Study Of Niox, Ptaa, Cul, And Spiro- Ometad As Htl Materials	Mohammed Anes Belbachir Hichem ROUIGUEB, Oussama AMMOUR, Mohammed KHAOUANI, Abderrahmane Zakarya DJENNATI	University of Aboubekr Belkaid/ALGERIA
Energy-Efficient And Low-Emission Manufacturing Of Iron Tailings Based Geopolymers Through Microwave Curing For Green Applications	Y. BALLOUT, Y. EL MIZ H. EL HAROUACHI Y. EL MIZ, D. AHOUDI M. ELGETTAFI, R. HAKKOU M. LOUTOU	University Mohammed first/Cadi Ayyad University

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HEAD OF SESSION: *Rukayya Ibrahim TUKUR*

TOPIC TITLE	AUTHORS	AFFILIATION
Digital Innovations In Construction Procurement And Their Impact On Quantity Surveyors	Rukayya Ibrahim TUKUR	College of Environmental Studies Hassan Usman Katsina Polytechnic
Isolation, Characterization And Therapeutic Applications Of Bacteriophages Against Pathogenic Bacteria Of The ESKAPE Group	Imane ELBELGHITI, Noureddine SLIMANI, Zohra LEMKHENTE Fatima BOUBRIK, Ahmed BELMOUDEN	Ibn Zohr University
A Machine Learning-Based Approach For Automated Fake News Detection İn Online Media	P. VEERALAKSHMI Dr. S. SELVAM	Nadar Mahajana Sangam S. Vellaichamy Nadar College
Global Research Trends In Flipped Learning: A Comprehensive Bibliometric Analysis Across The SDG Era (2015–2026)	Md. Akash RAHMAN Ashraf Jaman PARBEZ Md. Shawan UDDIN Phd	University of Rajshahi
The Dawn Of Defined Collagen: Utılızıng Unnatural Amıno Acıd Incorporatıon For Hıghly Stable, Non-Immunogenıc Carrıers In Cosmeceutıcals And Drug Delıvery	Varshini VIJAYARANGAM Rekha RAVINDRAN	Rajalakshmi Engineering College/INDIA
Rewards and Recognition as Drivers of Employee Retention: A Human-Centred Study	Ms. Adhithya M. N. Mr. Jayashankar.J	DC School Of Management And Technology, Trivandrum, Kerala, INDIA.
Unmaskıng The Margıns: A Bıblıometrıc Analysıs Of Geographıcal Bıas In Afrocentrıc Archıtectural Research And Pathways To Pan-Afrıcan Equıty	A.H. Dadum, U.M. Bashir A.K. Sarkile, A.Y. Muhammad A.B. Shaba, M. Chukwuma-Uchegbu S. Umar, A.Y. Shinga A.I. Alkali, G.H. Malachi	Gombe State University (GSU) /Abubakar Tafawa Balewa University (ATBU) / Federal University of Technology Minna/Federal University of /Technoloy Owerri (FUTO)
Feasıbılıty Of Usıng Rıce Straw Bale As A Wallıng Materıal For Sustaınable And Affordable Low-Cost Mass-Housıng In Gombe Metropolıs, Nıgerıa	A. H. Dadum, S.O. Ayo-Odifiri W. G. Brisibe, A. Ebekozien C. Aigbavboa, I.H. Dadum	Abubakar Tafawa Balewa University/University of Johannesburg/Rivers State University/ Gombe State University
Investigating The Settlement Displacement In The Boropukuriya Coal Mining Area	Towhid Mursalin SHIFAT Md Rahedul Islam RAHE	Pabna University of Science and Technology
Accessible Ar For Efl Learners In The Global South: Bridging Digital Inequalities Through Low-Cost Pedagogies	Khaoula DJETNI	University of Jijel, Algeria

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HEAD OF SESSION: ***Dr. Akram Uzzaman***

TOPIC TITLE	AUTHORS	AFFILIATION
Detective Of Crime And Deviation, Family Relations İn The City And Their Role İn The Spread Of Violence İn İt	Amara Sahraoui	School for the Deaf and Mute, Khenchela, Algeria
Potential Of Biomaterials Derived From Agricultural Waste For The Treatment Of Hospital Effluents: Application To Date Pits And Cloves	SAYERH Fatimazahra MOUHIR Latifa SAAFADI Laila	Hassan II University
Assessing Cognitive Functioning and Basic Concept Development in Children with Autism and Typically Developing Children	Soyed Rakibuzzaman Roky Dr. Akram Uzzaman Akhi Akter Dola Al Amin Shuvo Rakibul Islam Jehad Sagota Deb	Jagannath University
Development and Optimization of an Integrated Solar Desalination System with Thermal Storage and Energy Recovery	Badre Zinaoui Pr.Labjar Najoua Pr.EL Hajjaji souad	Mohammed V University
Stability Analysis of a One-Dimensional Elastic System with Double Porosity and Visco- Porous Dissipation	Aicha NEMSI Hana MERAH	University of El Oued
Analysis of Steady MHD Mixed Convection with Streaming Potential in Cu, SnO_2, and SiO_2 Nanofluids:	Usman S Rilwan Michael O Oni	Ahmadu Bello University
Serological Profile (Anti-CCP and Rheumatoid Factor) for the Diagnosis of Rheumatoid Arthritis in Patients from the Batna-Region, Algeria	Djahida BENHOUDA Afaf BENHOUDA Mourad HANFER	Université Batna
Sukuk al-Safar: A Conceptual Framework for Shariah-Compliant Financing in Green Tourism and Sustainable Economic Empowerment	Muhammad Masud Parves Zahiduzzaman Zahid	University of Dhaka/ University of the Cumberlands/
Explorıng The Role Of Chatgpt In Computer Scıence Educatıon: A Lıterature Revıew On Advanced Educatıonal Technology	Moses Adeolu AGOI Ismail Olaniyi MURAINA Solomon Onen ABAM Bashir Oyeniran AYINDE Wasiu Olatunde OLADAPO	Lagos State University

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HEAD OF SESSION: ***Dr. Priya Vinod***

TOPIC TITLE	AUTHORS	AFFILIATION
Dıagnosıs And Improvement Of Concrete Block Properties: A Case Study In Tlemcen, Algerıa	Samir BELMAHİ Abdelmoutalib BENFRİD Ibrahim KLOUCHE DJEDİD	University of Sidi belabes/ University of Tiaret/ALGERIA
Astrocytic Calcium Waves As Therapeutic Targets: Redefining Early Intervention Strategies İn Neurodegenerative Diseases	Faazil Mohmadrafi Mansuri Sagarika Bhagatkar	David Tvildiani Medical University, Georgia/Caucasus Medical University, Georgia
Why is Bloom's taxonomy important	HASSAN ZARIOUH TARIK RHARMAOUI MOUNIA MOUZOURI	Director of Regional Academy of Education and Training of the Oriental/Morocco
Photocatalytıc Degradatıon Of Methylene Blue And Congo Red Usıng A Sıo2-Ag Based Catalyst: Preparatıon, Characterızatıon, And Reactıvity	LEBOUKH Badra LAHCENE Driss ADJDIR Mahdi	Université Tahri Mohamed Bechar
Synthesis of active $NiCl_2$ nanoparticles supported on chitosan as a reusable catalyst for the synthesis of functionalized pyridine derivatives	Taoufyk Azzeddine Mahfoud Agunaou Lahoucine Bahsis	Université Cadi Ayyad
Structure-Based Drug Repurposing To İnhibit The DNA Gyrase Of Mycobacterium Tuberculosis	Balasubramani G L Rinky Rajput Manish Gupta Pradeep Dahiya Jitendra K Thakur Rakesh Bhatnagar Abhinav Grover	Jawaharlal Nehru University/ Banaras Hindu University
"The New Archıtecture Of Dıgıtal Influence: How Socıal Search, Short-Form Vıdeo, And Faceless Content Are Reshapıng Consumer Engagement"	Dr. Priya Vinod Dr. Melvin Victor	Christ University
Households Poverty Influence On Youth Behavıour In Ogun State, Nıgerıa	Adelakun O.E Odetola O.	University of Ibadan
Comparative Analysis Of Genetic Disorders Using Machine Learning Algorithms	Mohammed Amaan Santosh S. Patil	VSK University

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HEAD OF SESSION: ***Dr. Ayesha Batool***

TOPIC TITLE	AUTHORS	AFFILIATION
Composıtıon And Dıstrıbutıon Of Aquatıc Insects In Relatıon To Water Qualıty Of Saru Lake, Gummı Local Government Zamfara State	Lauwali Yusuf I.O. Obaroh B.J. Danjumma Iliya Ibrahim	Abdullahi Fodiyo State University of Science and Technology
Exploring The Psychological Implications Of Hyper Reality On Young Adults İn The Era Of Social Media: A Critical Analysis For Mental Health	Hina Shahid Abdul Manan Dr.Ayesha Batool	University of Punjab Lahore. University of Agriculture, Faisalabad.
Mapping The Conceptual Structure Of Euro Adoption Literature, A Multi-Method Bibliometric Analysis Of Key Research Themes	Gıurgı Ana – Marıa	Alexandru Ioan Cuza University Of Iasi/Romanıa
Architecture, Environmental Externalities, And Economic Policy For Sustainable Cities	Melik Sami Khelil Sara Tallal Abdel Karim Bouzir	Mohamed Khider Biskra University
The Trade-Off Between Economic Growth And Environmental Architecture İn Developing Regions	Melik Sami Khelil Sara Tallal Abdel Karim Bouzir	Mohamed Khider Biskra University
The Green Waqf: Financing Eco-Architecture Through Islamic Endowments	Melik Sami Khelil Sara Tallal Abdel Karim Bouzir	Mohamed Khider Biskra University
Islamic Economic Principles İn Eco-Mosque Architecture: A Path To Sustainability	Melik Sami Khelil Sara Tallal Abdel Karim Bouzir	Mohamed Khider Biskra University
Economic Viability Of Vertical Farming İn Urban Architecture: A Sustainability Perspective	Melik Sami Khelil Sara Tallal Abdel Karim Bouzir	Mohamed Khider Biskra University
Embedding Circular Economy Principles İn Architectural Design For Sustainable Cities	Melik Sami Khelil Sara Tallal Abdel Karim Bouzir	Mohamed Khider Biskra University

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HEAD OF SESSION: ***Dr. Mehdi Shalchi Tousi***

TOPIC TITLE	AUTHORS	AFFILIATION
Radionuclide Mobility And Transfer Dynamics İn Semi-Arid Moroccan Agroecosystems	Zineb ELABOUDI Samira EL AOUIDI Radouan SAADI Azzouz BENKDAD Zineb EL Mouridi Abdelmourhit LAISSAOUI Abdelaziz MADINZI Salah SOUABI1	University Of Hassan II Casablanca
Mındset Of Students And Parents Towards Practıcal Agrıculture As Perceıved By Secondary School Admınıstrators In Borno State, Nıgerıa	Usman Abdullahı Abba Gambo Jamaji Dogo Samuel	Agricultural Technology Federal College Of Horticulture Dadin – Kowa Gombe State
Climate And Meteorology İn Civil, Environmental, And Architectural Engineering: Implications For Sustainable And Climate-Resilient Design	Dr. Mehdi Shalchi Tousi	Ahle Beyte Internatinal University/Iran
Media and Crisis Management: Strategies for Effective Communicationrtificial	Mariam Vekua	Caucasus International University/GEORGIA
Academic Performance And Financial Stress As Student Dropout Predictors: Evidence From A Secondary Data	Md Shahanur Hosen[1], Mst Sumaiya AKter 2 ,Pranto Roy	Hajee Mohammad Danesh Science and Technology University
Utilizing Artificial Intelligence İn Human Resource Management For Transforming Secondary Education İn Nigeria	Umar Muhammad BURWA PhD Rabi'u MUHAMMAD PhD	Northwest University/Maryam Abacha American University
Embracıng Artfıcıal Intellıgence And Dıgıtal Connectıvıty For Managıng Odl And Teachıng Learnıng Resources In Nıgerıan Unıversıtıes	Umar Muhammad Burwa Phd Rabi'u Muhammad Phd	Northwest University/Maryam Abacha American University
Desıgn And Development Of Novel Approach For Fıle Sharıng For Securıty Usıng Blockchaın Technology : Lıterature Revıew	Deepak Bansal	Indian Institute of Finance, Greater Noida, India
Thermo-Optıc Tunıng Of Polymer Fıber Sensors: Investıgatıng The Impact Of Sub-T G , Near-T G , And Post-T G Heat Treatments On Band Gap And Reflectıon Intensıty	AL AMIN MOHD ZAMANI ZULKIFLI	Islamic University MALAYSİA

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HEAD OF SESSION: ***Dr. Md. Ferdous Alam***

TOPIC TITLE	AUTHORS	AFFILIATION
Environmental Isotopic And Chemical Assessment Near The Rooppur Nuclear Power Plant	Asif Ahmed Redowan Dr. Md. Ferdous Alam	Hajee Mohammad Danesh Science and Technology University
3D Numerical Assessment Of Heat Extraction Enhancement İn PVT Collectors Using Nanofluid-Cooled Channels	Mouad Benaicha Mohammed El Goual	Mohammed 1st University
Enhancing Housing Quality İn Traditional Urban Cores: Insights From Ado-Ekiti, Nigeria	Omoniyi Sunday Samuel	Olabisi Onabanjo University
The Influence Of Culture And Religion On Childhood Immunization Usage: A Systematic Review	Afolayan, Moyosore Omotola Ozturk Candan	Child Health and Disease Nursing, Nicosia, TRNC
Spectral And Keller Box Analysis Of MHD Casson Fluid Flow With Temperature-Dependent Transport Properties And Viscous Dissipation Over APermeable Stretching Surface Embedded İn Porous Media	Vishwanath B. Awati Sachin S. Muchandi	Rani Channamma University/INDIA
Temperature Dependent Tensile Strength Additive Mixed Warm Mix Asphalt	Lokesh Gupta Shubhangi Agarwal	Sir Padampat Singhania University
Assessment of Plankton Assemblage and Water Quality of River Jega	Abubakar Yahaya	Kebbi State University
Inclusion İn Higher Education Through Sign Language Interpreters: Challenges And Opportunities	Sidra Bano Dr Irfan Bashir Prof Dr Yasira Waqar Dr Afshan Naseem Prof Dr Rizwan Akram Rana Dr Almas Shoaib Dr Aisha Sami Dr Abdul Malik Dr Aqila Rafique Ms Fareeha Sherazi Ms Yasmin Zohaib	University of Management and Technology
A First Kap Assessment And Microbiological Profiling Of Street Food İn Marrakech, Morocco	Morad Kaddouri , Omar Ait El Alia Khalid Boutoial	Sultan Moulay Slimane University

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HEAD OF SESSION: ***Dr.Rajaa.DIANY***

TOPIC TITLE	AUTHORS	AFFILIATION
Integrative Approach To The Chemodiversity And Antifungal Power Of Macroalgae From The Coast Of El Jadida: Towards New Fungicidal Biomolecules	**Nouzha Baki Senhaji Houda EL Yacoubi Aboukhalaf.A Atmane Rochdi**	**Ibn Tofail University**
Tensor-Based Machine Learning For Mixed Radiation Separation	**Imane Ahnouz**	**Mohammed V University**
Development Of Nanocellulose Extracted From Agricultural Waste As Additive İn Epoxy Composites	**Mohamad Nurul Azman Mohammad Taib**	**University of Malaya/MALAYSIA**
Productıon And Characterızatıon Of Carbon Nanotubes From Bıochar Under Mıcrowave Irradıatıon	**Faisal Nazir**	**THE UNIVERSITY OF AGRICULTURE**
The Mental Health Of Unıversıty Students	**Phạm Thu Hằng**	**People's Police Academy**
Statistical Analysis Of Extraction The Natural Red Dye Madder	**Dr:Rajaa.DIANY**	**Sultan Moulay Slimane University/ Chouaïb Doukkali University**
The Role Of Management Accountıng In Profıt-Makıng Organızatıons: A Case Study Of Ahman Pategı Unıversıty, Kwara State, Nıgerıa	**Umar Baba Shaaba**	**Ahman Pategi University**

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HEAD OF SESSION: ***Sunday Olorunlogbon Olorunnipa***

TOPIC TITLE	AUTHORS	AFFILIATION
Personalized Nutrition Using Gut Microbiome Profiling: A New Frontier in Optimizing Athletic Performance and Recovery	Mr Shiv Kumar Ms Teena Pangtey	Lecturer in Physical Education ,Directorate of Education GNCT
Transformıng The Taxpayer Complıance Program Wıth A Gamıfıcatıon And Dıgıtal Reward Approach To Optımıze Income Tax Receıpts	Sindi Karmila Putri Marshella Divva Zalfa Nazwa Kusuma Meisy Nabila Mutia Sari	Universitas Lampung
Multi-Omics Profiling Unveils UBE2C, MCM2, AURKA, And TP53 As Core Regulatory Hubs Of Interconnected Oncogenic Networks İn Women's Breast, Ovarian, And Endometrial Cancers	Md. Shafiqul Islam	University of Rajshahi
Mathematical Modelling of Contraceptive Use and Behavioral Dynamics in Population Growth Control	Agbo Christiana Ene Abah Roseline Toyin, Ayinde Muhammed Abdullahi and John Chuseh Ahmadu	University of Abuja, Nigeria
Green Synthesis of Zinc Oxide Nanoparticles and Their In Vitro Biological Activities	Kongara Gnaneswari A. Pavithra M. Bhargavi T.K. Padmaj	Sri Padmavathi Mahila Visvavidyalam, Tirupathi/ Apollo University
The Impact Of Income Tax Rates On Publıc Welfare And The Busıness World	Wayan Diana Anisa Nur Asyifa Salsyah Aura Fitri Reinjani Isadora Zonata	UNIVERSITY OF LAMPUNG
Design And Discovery Of Potent 1,2,4-Triazole Derivatives Against Hepg2 Cancer Cells	Zainib Razzaq Samreen Gul Khan Fozia Anjum Kiran Aftab Mehr un Nisa	Government College University/ University of Lahore,
Administrative Officers As Drivers Of Organizational Development: An Analysis Of Their Strategic Roles İn The Public Sector	Sunday Olorunlogbon Olorunnipa	Quintessential College,

27.12.2025 / Hall-26, Session-11			
	ANKARA LOCAL TIME		MEETING ID: 844 4053 5966
	13 ^{00} : 14 ^{45}		PASSCODE: 450687

HEAD OF SESSION: ***Palash Kumar Das***

TOPIC TITLE	AUTHORS	AFFILIATION
Empowering Women İn The Digital Age: Opportunities, Challenges, And Global Partnerships	Samina kouser	Ahlul-Bayt International University Tehran
An Application Of Mixed-İnteger Linear Programming To Minimize The Cost Of University Students Required Basic Nutritional Requirements	Palash Kumar Das	Hajee Mohammad Danesh Science and Technology University
A Thiophene-Modified Carbazole Monomer: Synthesis, Electrochemical Behavior, And Conjugated Polymer Formation	Assala Marir Mounia Guergouri Rafik Benseguenı	Frères Mentouri University/ Mohamed Cherif Messaadia University
"In Situ Preparation Of 3d Flower Like Biobr/Bi24o31br10 Composite By Annealing Hydrothermal Method For The Ciprofloxacin Degradation Under Simulated Sunlight İrradiation"	L. Mllaoiy , S. Bikerchalen B. Akhsassi B. Bakiz S. Villain A.Taoufyq F. Guinneton H.Hajjoulc J-R Gavarri b A. Benlhachemia	Université Ibn Zohr/ Université d' Aix Marseille/ Université de Toulon/FRANCE/MOROCCO
Bayesian Approaches To Flexible Hazard Modeling For Survival Data With Time-Varying Covariates İn Stan	Mohsin Khan Mohammad Parvej Athar Ali Khan	Aligarh Muslim University
Climate Dynamics and Territorial Vulnerabilities in Northeastern Algeria	Abderrahmane ZIARI Pr Abderrahmane MEDJRAB	University of Science and Technology Houari Boumedienne
On Sliding Window Statistical Convergence of Generalized Fractional Difference Sequences in Intuitionistic Fuzzy Normed Spaces	Dr. SK Ashadul Rahaman	VIT-AP University

27.12.2025 / Hall-27, Session-11			
	ANKARA LOCAL TIME		MEETING ID: 844 4053 5966
	13 ^{00} : 15 ^{00}		PASSCODE: 450687

HEAD OF SESSION: ***Bibi Sayeda Sayedi***

TOPIC TITLE	AUTHORS	AFFILIATION
Effectiveness Of The Government Internal Control System (SPIP) Through Inspectorate Supervision İn The Eastern Luwu District Government, Indonesia	Hilyatul Jannah Nuryanti Mustari 2 , Lukman Hakim 3 , Nur Suqya Rahma	Muhammadiyah University of Makassar
Synergizing DeepTech and Blockchain: Unlocking the Future of Decentralized Innovation	Mrs. Sujata Dhananjay Sathe, Dr. Sahebrao N.Shinde	Savitribai Phule Pune University
Mental Health Challenges of Badakhshan Women in Remote Areas	Bibi Sayeda Sayedi	Ahlul-Bayt International University
Assessing Land Use/Land Cover Dynamics and Their Effects on Ecosystem Service Values: A Spatio-Temporal Approach in Mila, Algeria (1994–2024)	Imane Souici Zakaria Zouak Chaouki Benabbas Benzid Yacine Faisel TOUT Abdallah LALMI	University of Constantine
The Role of Christian Religious Education Teachers in Shaping the Character of Junior High School Students in the Digital Era	Ivander Simanjuntak Kaleb Samalinggai	Universitas Kristen Indonesia
Cultural Influences on Pregnancy Care among Rural Women in Bangladesh: An Application of the Health Belief Model	Md Mostafizur Rahman Tohmina Nasrin Mitu Mst. masuma Shimu Nesar Ahmed	University of Rajshahi
Hyper-Decentralized AI Swarms for Exogalactic Surveying	B.DHARSHINI Dr.S.Selvam	Nadar College Nagamalai
First-Principles Insights İnto Double Perovskite Hydrides K 2 Mgcoh 6 And Rb 2 Mgcoh 6 For Next-Generation Hydrogen Storage	Hmad Fatihi Hakima Ouhenou Hamza Benaali Abderrahmane Abbassi Moha El Idrissi S. Taj B. Manaut	Sultan Moulay Slimane University/ Sidi Mohamed Ben Abdellah University

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HEAD OF SESSION: ***Dr. Anam Afzal***

TOPIC TITLE	AUTHORS	AFFILIATION
Maternal Care Risk Factors During Prenatal And Postnatal Conditions İn Pakistan: Challenges And Strategies	Dr. Anam Afzal Dr. Asma Seemi Malik Dr. Amjad Mahmood	Punjab College of Information Technology/Lahore College for Women University
Lethal Autonomous Weapons Systems (Laws) And State Sovereignty: Ethical And Legal Challenges	Dr. Tahir Qureshi Ms. Khanam Afreen Dr. Shaeyuq Ahmad Shah	Deemed University/Bihar University
Zinc İnfluence On Structural, Optical And Photoluminescence Properties Of Sno 2 Nanostructures Synthesized Via Solution Combustion Technique	Nishu Rani	Indira Gandhi University
Second-Law Analysis Of Magneto-Bioconvective Marangoni Maxwell Nanofluid Flow Over A Porous Rotating Disk	E. O. Fatunmbi S. A. Odunlami J. K. Odeyemi	Federal Polytechnic Ilaro
Desıgn And Fabrıcatıon Of Compressed Natural Gas (Cng) Powered Groundnut Shellıng Machıne	Samson A. Odunlami	Federal Polytechnic Ilaro
Sarcopenia And Cognitive Impairment: Mechanisms Of The “Muscle-Brain Axis” And Therapeutic Perspectives	Vince Fazekas-Pongor Andrea Lehoczki Eszter Pázmándi Mónika Fekete	Semmelweis University/Budapest
Biopharmaceuticals: Recent Advancements And Emerging Challenges	V.Ranjani Dr. R. Srinivasan Dr. R. Devi	Bharath Institute of Higher Education and Research
The Role of Probiotic Supplementation in Alcohol Craving: Behavioral and Neurochemical Correlates	Huma Ikram Darakhshan J. Haleem	University of Karachi

27.12.2025 / Hall-2, Session-1			
	ANKARA LOCAL TIME		**MEETING ID:** 844 4053 5966
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HEAD OF SESSION: ***Abubakar Umar Birnin-Yauri***

TOPIC TITLE	AUTHORS	AFFILIATION
Physics-Informed Neural Network–Enabled Design and Optimization of Borate Bioactive Glasses	Pavan Kumar Potuganti Rajani Indrakanti	VNR Vignana Jyothi Institute of Engineering and Technology
Impact Of Envıronmental Stress On Secondary Metabolıte Productıon: A Revıew	Ahmed Attahiru Abubakar Umar Birnin-Yauri Bashar Attahiru	Kebbi State University of Science and Technology/Federal College of Education
Clımate Change And Its Effects On Phytochemıcal Composıtıon Of Tropıcal Plants: A Revıew	Ahmed Attahiru Yusuf Haruna Bashar Attahiru	Kampala International University/ Kebbi State University of Science and Technology/Federal College of Education
Peran Pajak Penghasılan Dalam Sısıtem Perpajakan Modern	Zikry Ibnu Ariefandi Robi Ramadhan	Universitas Lampung
The Current Trend Of Tuberculosis İn The 21st Century: A Mini Review Study	Babatope Sunday Meduteni Adekola Saheed Ayodeji Musah Khadijat Toyin Bakare Mustapha Umar Sodiq Adetunji Adekola	University of Abuja
Synthesis And İndustrial Applications Of Bionanomaterials: An Update	Ghazala Yunus	University of Hail/SAUDI ARABIA
Predictive Modelling Of Soil Fertility Using Machine Learning And Wireless Sensor Networks	Amadi Oko Amadi Okpo Charles Nnanna Osita Ngozika Ann Akwu Idachaba Andrew	Electronic Engineering Technology Akanu Ibiam Federal Polytechnic
Analytical Solutions Of The Fuzzy Fractional Differential Generalized Bagley-Torvic Equation Via Ψ-Caputo Gh-Differntiability	Ghafari Aissam Aziz El Ghazouani M'hamed Elomari	Sultan Moulay Slimane University

27.12.2025 / Hall-3, Session-2			
	ANKARA LOCAL TIME		**MEETING ID:** 844 4053 5966
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HEAD OF SESSION: ***Dr. Qader VAZIFEH DAMIRCHI***

TOPIC TITLE	AUTHORS	AFFILIATION
Analytical Solutions Of The Fuzzy Fractional Differential Generalized Bagley-Torvic Equation Via Ψ-Caputo Gh-Differntiability	Ghafari Aissam Aziz El Ghazouani M'hamed Elomari	Sultan Moulay Slimane University
Analyzıng The Role Of Perceıved Organızatıonal Justıce In Strengthenıng Organızatıonal Commıtment Among Employees Of Small And Medıum-Sızed Enterprıses In Iran	Dr. Qader VAZIFEH DAMIRCHI Dr. Barad VAZIFEH	Tarbiat Modares University
Mathematıcal Modellıng On Waste Water Management Of An Oxıdatıon Pond	Sathisha A B, Ashwini M Rao K S Basavarajappa	Government First Grade College/ Bapuji Institute of Engineering and Technology
Evaluation Of The In Vitro Antioxidant And Antidiabetic Activities Of Quinoa (Chenopodium Quinoa Willd.) Seed Extracts And The Quantification Of Their Bioactive Compounds	Zaina Idir Rhizlane Abdnim Soukaina Terroufi Ilham Abidi Fatima Aouinti Nadia Gseyra	Mohammed First University/ Hassan II Institute of Agronomy and Veterinary sciences
Peran Penyuluh Kehutanan Dalam Mendukung Peningkatan Pendapatan Masyarakata Sekıtar Hutan (Study Kasus Taman Hutan Raya Wan Abdulrachman)	Farhad Maryan Saputra Christine Wulandari Pitojo Budiono Eny Puspasari	Universitas Lampung
Bacıllus Anthracıs; Implıcatıons As A Bıoweapon	OLUWASEUN GRACE OLADIPUPO EMMANUEL TOMISIN BELLO	KWARA STATE UNIVERSITY
Cırcular Economy-Based Constructıon Optımısatıon: Technology, Practıce, And Polıcy In Chına And Nıgerıa	Barau Amir Sulaiman Tongsheng Zhang Kazeem Ibraheem Ajadi	South China University of Technology/ Jiangsu University of Science and Technology/ Ahmadu Bello University/CHİNA/NİGERIA
Advancing Food Safety in Artificial Intelligence: Current Progress, Challenges, and Future Directions	Babita Gupta	Integral University

27.12.2025 / Hall-4, Session-2			
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	13:30 16:00		**PASSCODE:** 450687

HEAD OF SESSION: ***Prof. Dr. BANOUISSE El HABIB***

TOPIC TITLE	AUTHORS	AFFILIATION
Analysis Of Steady Mhd Mixed Convection With Streaming Potential İn Cu, Sno_2, And Sio_2 Nanofluids:	Usman S Rilwan Michael O Oni	Ahmadu Bello University
Climate-Responsive Selection Of Thermal Insulation Materials For Energy-Efficient Tertiary Buildings İn Meknes	Ayoub.Bouchark Hicham.Kaddouri M.C. EL BOUBAKRAOUI A. EL BAKKALI	Moulay Ismail University
An Ab-İnitio Study Of Physical Properties Of Bexh 3 (X = Pd, Ag, And Cd) Perovskites Hydrides For Hydrogen Storage Applications	Hamza BENAALI Hmad FATIHI Abdellah TAHIRI Mohamed NAJI	Sidi Mohamed Ben Abdellah University/ Sultan Moulay Slimane University
Study Of İnsulation Scenarios Using An Ecological Material As A Sustainable Solution For Comfortable And Efficient Buildings: The Case Of Moroccan Buildings	Hicham Kaddouri Ayoub Bouchark	Abdelmalek Essaadi University/ Moulay Ismail University
Machınıng Integrıty And Mechanıcal Performance Of Novel Kevlar-Pumıce Sandwıch Polymer Composıte	Vineet Tirth	King Khalid University/SAUDI ARABIA
Exıstence, Unıqueness, And Stabılıty Of Solutıons For Nonlınear Ψ-Caputo Fractıonal Dıfferentıal Equatıons	Prof. Dr. BANOUISSE El HABIB Prof. Dr. M'HAMED ELOMARI Prof. Dr. AZIZ EL GHAZOUANI	Sultan Moulay Slimane University
An Ambedkarite Analysis Of Dhadak 2 And The Politics Of Dalit Vulnerability İn Contemporary Hindi Cinema	Dr. Raf Raf Shakil Ansari	Sharda University
Investigation Of Quantum Confinement–Induced Band Gap Variations İn Synthesized Quantum Material	Rajani Indrakanti Poonam Upadhyay	VNR Vignana Jyothi Institute of Engineering and Technology/

27.12.2025 / Hall-5, Session-2			
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HEAD OF SESSION: *Prof. Dr. Imad Abed Hamza Al-Atabi*

TOPIC TITLE	AUTHORS	AFFILIATION
Extremism According And The Effectiveness Of Realistic Counseling To Reduce The Cognitive And Emotional Components	Prof. Dr. Imad Abed Hamza Al-Atabi	Al-Muthanna University
Effect Of Hydrostatic Pressure On The Radiative Current Density Of Algan/Gan Multiple Quantum Well Laser Diodes	Rajab Yahyazadeh Zahra Hashempour	Islamic Azad University
Copper-Catalyzed Synthesis, Bioactivity, and In Silico Study of 1,2,3-Triazole Hybrids	Muhammad Ibrahim Ummy Rubab Asma Parveen	Government College University
Nanoscale Synergy of Polymers and Metal Nanoparticles in Plant-Mediated Diabetic Wound Dressings	Saranya A Dr. T. G. Nithya Murugesan Kamaraj	SRM Institute of Science and Technology
Entrepreneurship or Employment? A Phenomenological Inquiry into the Lived Experiences of Entrepreneurship Students' Career Decision-Making	Mark Anthony N. Polinar Imie Jasmin L. Flores Christopher Z. Rodriguez Leah E. Aguas	Mabolo National High School
A Study of Clinical Reasoning of Medical Students of Fasa University of Medical Sciences in Clinical Environments and Its Relationship with Problem Solving in 2024-2025	Nasrin Shokrpour Shadab Moslehi Mahbubeh Pedram	Shiraz University
Adoptıon Of Artıfıcıal Intelligence Tools In Anımal And Veterınary Scıence In West Afrıca: Evıdence From Nıgerıa On Use, Barrıers, And Impacts	Dr. Emmanuel U. ANASO	Federal University of Agriculture
Factors Impact On Consumers' Onlıne Food Purchase Behavıor In Can Tho Cıty Vıetnam	Tien Dung KHONG Thuy Duong VU Do Nhu Loan NGUYEN	Can Tho University

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HEAD OF SESSION: ***Clementina Hashimu Bulus***

TOPIC TITLE	AUTHORS	AFFILIATION
Analysis Of The Implementation Of Final Income Tax Rates For Msmes On The Growth Of Micro, Small, And Medium Enterprises	Nadia Safira Meisyifa Nur Nabila Harry Fadilla Yusuf Meilisa Sarah	University of Lampung
Effect Of Feedback On Students' Achievement In Economics In Senior Secondary Schools In Jos North, Plateau State, Nigeria	Clementina Hashimu Bulus Buhari Garba	University of Jos
Effects Of Constructive Play Strategy On Primary Two Pupils' English Language Skills Achievement İn Maiduguri Metropolis, Borno State, Nigeria.	Hauwa Samaila Mary P. Haggai (PhD) Jacob Omede (PhD)	University of Jos
Diagnostic Pathology İn The Era Of Artificial Intelligence: The Pros And Cons	Ochuko Orakpoghenor	University of Abuja
Heritage Resources And Tourism Development In Southwestern Nigeria: Focussing On Challenges And The Way Forward	Dr. Akintunde John Oloidi Dr. Okechukwu O. Anozie Dr. Emmanuella U. Anozie	University of Nigeria
Biotechnological Potential Of Mentha Piperita L. Extract In Enhancing The Nutritional And Physicochemical Quality Of Postharvest Tomato	Houari Fatima Zohra Gaouar Naila Mechaala Sara Houari Hakima Yahia khelaf	University of Batna/University of Oran/ El Oued University
Effects Of Phenols, Flavonoids, And Saponins From Boss Yam Peels (Dioscorea Rotundata) On Aflatoxin Producing Fungi.	Odu Nwamaka Maureen Ganiyu N. Joan	Federal University of Technology
Technology Investment And Performance Of Banks İn Era Of Disruptions İn Nigeria	Mayah, Eunice (PhD) Onuigwe, Gladys Chiebonam (PhD)	Federal College of Education

27.12.2025 / Hall-7, Session-3			
	ANKARA LOCAL TIME		**MEETING ID:** 844 4053 5966
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HEAD OF SESSION: ***Dr. Mulikat Folashade Usman***

TOPIC TITLE	AUTHORS	AFFILIATION
Cultural Foundations And The Role Of Art İn Economic Development	Mobina Eskandari Diba Tanhaye Vash Mahdi Yousefi Gharamaleki	University of Tabriz
Synthesis And Characterization Of Thymol Derivatives As Corrosion Inhibitors For Carbon Steel İn Acidic Environments: Experimental And Computational Approaches	Hassan Haddouchy Saliha Loughmari Youness Tahiri Bendaoud Ahmed Salah Eddine El Qouatli	Moulay Ismail University
Comparatıve Analysıs Of The Effectıveness Of Envıronmental Awareness Formatıon Among Schoolchıldren In Belarus And The Uk Through Dıgıtal Educatıonal Resources	Anastasiya Grits Mariya Grigorovich Ekaterina Kaplinskaya Irina Kopytich	Baranovichi State University
Examining How E24 Steel Prevents Corrosion in Acidic Environments Using 1,4-Trans Plymyrcene and Myrcene-Lactide Block Copolymers: An In-Depth Analysis Combining Chemical, Electrochemical, and Theoretical Modeling Approaches	Hassan Haddouchy Saliha Loughmari Youness Tahiri Bendaoud Ahmed Salah Eddine El Qouatli	Moulay Ismail University
On The Factors Of Entrepreneurıal Faılure: A Study Of Causes And Consequences	Dr. Mulikat Folashade Usman Sani Fadilat Bello	Usmanu Danfodiyo University
A Study Of Irony And Satire As Stylistic Tools İn The Representation Of Race And Immigration İn Chimamanda Adichie's Americanah	Adesanmi, Moses Ademola	Federal University of Technology
The Impact Of Geopolitical Tensions On Blue Economy Supply Chains: A Comparative Analysis Of Major Trade Blocs	Sadiq, Mohammed Sanusi Singh, Invinder Paul Ahmad, Muhammad Makarfi Sani, Bashir Sanyinna Kumawat Subhita	Agricultural Economics and Agribusiness
Wearable Monopole Microstrip Antenna For Special Applications	J. Salai Thillai Thilagam	G. Pulla Reddy Engineering College
View On İmproving Recruitment Criteria For A University Entry-Level Student	RAHMOUNI Hanane	University of Oran 2 Mohamed Ben Ahmed
Adaptive Usability Model for E-Transportation Accessibility	Samar Jamal Hassan Mahmoud ,Prof Ts. Dr. Noor Maizura Binti Mohamad Noor Associate Prof. Ts. Dr. Zuriana Abu Bakar	Universiti Malaysia/MALAYSIA

27.12.2025 / Hall-8, Session-3			
	ANKARA LOCAL TIME		MEETING ID: 844 4053 5966
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HEAD OF SESSION: *Assoc. Prof. Gergana Gozanska*

TOPIC TITLE	AUTHORS	AFFILIATION
Study Of Crime And Deviation, Family Relations İn The City And Their Role İn The Spread Of Violence İn İt	Amara Sahraoui	School for the Deaf and Mute, Khenchela, Algeria
Charlson Comorbidity Index İn Endometrial Lesions	Loichita Mihai Petre Ion Suciu Oana Bobora Razvan Furau Alexandru-Marius Petre Izabella	"Victor Babes" University of Medicine and Pharmacy Timisoara/ROMANIA/"Vasile Goldiş" Western University of Arad
Study Of Tın Oxıde Thın Fılms Deposıted By Ultrasonıc Spray Pyrolysıs For Enhanced Photovoltaıc Applıcatıons	Sabrina Roguai	Abbes Laghrour university
The Impact Of Thrombocytopenıa In Pregnant Women Dıagnosed Wıth Thrombophılıa	Loichita Adrian Samfireag Miruna Oros Dacian Mirica Nicoleta Petre Izabella Petre Ion	University of Medicine and Pharmacy "Victor Babes"/ West university/ROMANIA
The Word "Communications" İn The International Human Rights Treaties Adopted By The UN General Assembly And Its Bulgarian Translation	Assoc. Prof. Gergana Gozanska	Plovdiv University/BULGARIA
Multisectoral Biotechnological Applications Of Bacteriophages İn Combating Antimicrobial Resistance	Harshita Marwal Dr. Swati Joshi R. Y. Hiranmai	Central University/
Behavıoural Patterns Of Internet Addıctıon Among Teenagers In Nıgerıa	Udevbure, Bola Khadijat Musah Khadijat Toyin Adekola S.A, Bakare Mustapha Umar Sodiq Adetunji Adekola.	University of Abuja.
Digital Humanities And The Changing Landscape Of English Literary Studies	Sadaf Mushtaq Nasti Yawer Ahmad Mir	University of Kashmir

27.12.2025 / Hall-9, Session-3			
	ANKARA LOCAL TIME		**MEETING ID:** 844 4053 5966
	13:30 16:00		**PASSCODE:** 450687

HEAD OF SESSION: ***Dr.Ardelean Maria Ioana***

TOPIC TITLE	AUTHORS	AFFILIATION
Rewriting Authorship: Artificial Intelligence And The Future Of Literary Imagination	Sadaf Mushtaq Nasti Yawer Ahmad Mir	University of Kashmir
In-Vitro Anticancer Potential Of Ethanolic Extract Of Camellia Sinensis Leaves On Cervical Cancer (Hela) Cells	Mrs.E.Elavarasi J.Jayadurka Ardhrasunil Sudharsan.C Karthik.S	Bharath Institute of Higher Education and Research
Human Resource Management As A Strategic Driver Of Sustainable Business Growth	Dr.Venet Shala Dr.Demir Lima Mr.sc.Halil Hasani	University of Prizren/KOSOVO
Development Of An Electrochemical Biosensor For The Treatment Of Scaling İn The Presence Of Herniaria Hirsuta	Youness Tahiri Hassan Haddouchy Mustapha Oukbab Salah Eddine El Qouatli Rachida Najih Abdelilah Chtaini	Sultan Moulay Slimane University
The Influence Of Price And Production Factors Of Damar Mata Kucing (Shorea Javanica) On Farmer Income İn Pesisir Barat Regency	Yuda Ferdiawan Christine Wulandari Dadang Trianahadi Hari Kaskoyo	University of Lampung
Reactive Solute Transport İn Semi-İnfinite Heterogeneous Aquifers: Analytical And Numerical Solutions With Peclet-Dependent Dispersion	Sanjay Kumar Pintu Das	Sarala Birla University
Evolution Of Augmentation İndex And Pulse Wave Velocity During Pregnancy İn Pregnant Women Who Practice Physical Activity	Dr.Ardelean Maria Ioana Iurciuc Stela Petre Ion Petre Izabella	University of Medicine and Pharmacy “Victor Babes” Timisoara /ROMANIA

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	ANKARA LOCAL TIME		**MEETING ID:** 844 4053 5966
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HEAD OF SESSION: ***Suganthi P***

TOPIC TITLE	AUTHORS	AFFILIATION
Role of Probability in Modern Computing Systems	**Suganthi P Aashish B L Aswin Sivakumar Balamurugan B**	**R.M.K. Engineering College**
Practical Use of Volume Integrals for Material Estimation in Engineering Systems	**Suganthi P Adarsh H Gokul V Jason Sathia**	**R.M.K. Engineering College**
Role of Matrices in Modern Computing Applications	**Suganthi P Aarthi I Agalya A Aishwarya S Ananya R**	**R.M.K. Engineering College**
Ordinary Differential Equations-Based Modeling for Real-Time Engineering and Computing Problems	**Suganthi P A Ayisathul Reshma Bayyapureddy Lakshana Bhuvaneshwari T Boggala Porkavi**	**R.M.K. Engineering College**
Analyzing Psychological Challenges and Socio-Cultural Dynamics in Badakhshan	**Bibi Sayeda Sayedi Nasrin Ziayee**	**Ahlul-Bayt International University Tehran**
Design of a Rectangular Microstrip Patch Antenna using HFSS	**V.V. Jahnavi Reddy G. Hima Bindu M. Mahitha C. Navya**	**G.Pulla Reddy Engineering College**
Design and Analysis of a Wideband Microstrip Patch Antenna for 5G Applications	**P C Praveen Kumar Paladi Manikanta Cirimala Hemanth Kumar B.Lakshmi Ranga Reddy B.Hari Rama Raju**	**G.Pulla Reddy Engineering College**
Design and Simulation of a Rectangular Microstrip Patch Antenna for Wi-Fi Communication	**P C Praveen Kumar, S. Swarna, K. Manasa, K. Meghana, Nandhini**	**G.Pulla Reddy Engineering College**

27.12.2025 / Hall-11, Session-3			
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HEAD OF SESSION: ***K.PRASANNA DEVI***

TOPIC TITLE	AUTHORS	AFFILIATION
Design and Simulation of a Rectangular Microstrip Patch Antenna for Wi-Fi Communication	P C Praveen Kumar, S. Swarna, K. Manasa, K. Meghana, Nandhini	G.Pulla Reddy Engineering College
Design and Performance Analysis of a Compact Microstrip Patch Antenna for 2.4 GHz Wi-Fi Applications	P C Praveen KumarS. Vishnu Priya, R. Udaya Bhanu, M. Indhu, J. Janaki	G.Pulla Reddy Engineering College
A Compact ECE-Shaped Microstrip Antenna for 5 GHz Wireless Applications	P C Praveen Kuamr,A Aliya Kousar, B Geetha , B Jahnavi ,B Gagana Tripura	G.Pulla Reddy Engineering College
HFSS-Based Design and Analysis of a Rectangular Monopole Antenna	P C Praveen Kumar , B.Uday Kumar Reddy , Gandla Roopeshwar	G.Pulla Reddy Engineering College
Design and Implementation of AI-Integrated Enterprise Systems	S. Reashmi Dr. S. Selvam	Kamaraj College of Engineering and Technology/S. Vellaichamy Nadar College Madurai
From Prompts to Programs: The Rise of Intelligent AI-Driven Coding Assistants”	DHARANI.M, KIRTHIKA.C Dr.S.Selvam	Nadar Mahajana Sangam S.Vellaichamy Nadar College
Urban Intelligence: AI-Driven Cognition For Adaptive Ci	K.PRASANNA DEVI B.KOPIKA Dr.S.Selvam	Nadar Mahajana Sangam S.Vellaichamy Nadar College
Challenges And Opportunities Of Virtual Classrooms İn Education: An Empirical Study	Dr.Rohi Rani Dr.yogita kamal	----------

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HEAD OF SESSION: ***ABDULLAH ABDULRHMAN AL-SARRAF***

TOPIC TITLE	AUTHORS	AFFILIATION
The Ecologıcal Rısk Of Contamınatıon Wıth Toxıc Metals In The Soıls, Waste And Ash, Around The Complex, The;Kosovo Thermal Power Plants And The New Ferronıckel Complex	MSc. Islam ZUZAKU Prof. Dr. Skender DEMAKU, MSc. Arbnorë ALIU MSc. Donika SYLEJMANI	University of Pristina
Prevalence And Psychosocial Impact Of Loneliness And Social Isolation On The Well-Being Of Older Adults: A Systematic Review	Bakut Janet Naman Musah Khadijat Toyin Dhikroh Oriyomi Adekola Adekola Saheed Ayodeji Obande Ifeoma Elizabeth Sodiq Adetunji Adekola	University of Abuja
Salary And Cost Of Lıvıng In Albanıa	PhD. Romina RADONSHIQI Msc. Bledar RADONSHIQI	University College LOGOS/ CEO Eventalb
Topıcal Sılver Nanopartıcles For Wound Healıng Mechanısms, Efficacy And Future Perspectıve	PARTHASARATHI.V DEVI.R SRIRAM.R	BHARATH INSTITUTE OF HIGHER EDUCATION AND RESEARCH CHENNAI INDIA
Urban Heritage As A Swarm System: The ASHL Framework For Emergent Urban Development And Decentralized Adaptation	Suhaib Abbas Ali ABDULLAH ABDULRHMAN AL-SARRAF	University of Karbala/ University of Mosul/IRAQ
Effect Of Adding Okra Calyx Powder On The Sensory Properties And Nutritional Value Of Wheat Biscuits	Zena Mahmod Abidmossa Mahmed Ashraq Monir	University Baghdad/Iraq
Studying The Chemical And Nutritional Properties Of Almond Flour And İts Use İn Laboratory Biscuit Manufacturing	Hasananain Hadi Fadhil Baidaa Hafidh Mohammed	University Baghdad/Iraq
A Weighted Triangular Approximation Method For Fuzzy Numbers	Mohamed AIT MOHAND Aziz EL GHAZOUANI Mhamed EL OMARI	Sultan Moulay Slimane University

27.12.2025 / Hall-13, Session-4			
	ANKARA LOCAL TIME		MEETING ID: 844 4053 5966
	13:30 16:00		PASSCODE: 450687

HEAD OF SESSION: ***Prof. Dr. BELAID L'KAIHAL***

TOPIC TITLE	AUTHORS	AFFILIATION
Pricing Financial Options under Uncertainty Using Fuzzy Fractional PDE Models: A Hybrid Analytical Approach	Mohamed OUALD-MOUNTI Aziz EL GHAZOUANI Hamid SADIKI	Sultan Moulay Slimane University
Mathematical Study of a Thermo-Viscoelastic Contact Problem Involving a Hemivariational Inequality	Prof. Dr. BELAID L'KAIHAL Prof. Dr. BOUALLALA MUSTAPHA Prof. Dr. ESSOUFI EL HASSAN	Hassan first University
Financial Performance Of Cryptocurrency-Enabled Tokenized Real Estate Assets: An Empirical Evaluation Of Liquidity, Participation, And Returns	Aminu Yakubu Boyi Sani Inusa Milala	Universiti Tun Hussein Onn Malaysia
Women İn Decision-Making Roles: From Structural Barriers To Leadership Expansion	Dr. Jayasree Krishnan	Vels Institute of Science, Technology and Advanced Studies
Methodology İn Research: Qualitative Data Analysis And Case Study	Dr Khalida Madoui	The Higher School of Teachers Assia Djebar Constantine Algeria
Advanced Physıco-Chemıcal Treatment Of Agro-Food Industry Effluents	Mohamed El Morsy Laila Afıa	Ibnou Zohr University
Effects Of Flipped Classroom Modes On The Retention Of Pre-Service Mathematics Teachers İn Colleges Of Education, North-Central	Job, S. J. Hassan, A. A. Prof. Gimba, R. W. Prof. Enagi, A. I.	Federal University of Technology
Strengthening Multisectoral Governance For Stunting Reduction İn Indonesia: A Comprehensive Policy Analysis And International Comparative Review	Syed Agung Afandi Muslim Afandi Rizki Erdayani	Universitas Islam Negeri Sultan Syarif Kasim/INDONESIA

27.12.2025 / Hall-15, Session-5			
	ANKARA LOCAL TIME		MEETING ID: 844 4053 5966
	13:30 16:00		PASSCODE: 450687

HEAD OF SESSION: ***Assoc. Prof.Svitlana MYSHKO***

TOPIC TITLE	AUTHORS	AFFILIATION
Vıtamın D Levels Correlated Wıth Hormonal Levels In Early Menopause	Burlica Sorin Ardelean Anamaria Furau Cristian Buleu Florina Burlica Adela Petre Izabella Petre Ion	University of Medicine and Pharmacy "Victor Babes"/ 2 Western University
Solo Song And Vocal Cycle In Ukrainian Music: Paths Of Genre Evolution And Stylistic Synthesis	Oksana Pysmenna Assoc. Prof.Svitlana MYSHKO	Mykola Lysenko Lviv National Music Academy/ Uzhhorod National University/UKRAINE
Promoting The Formation Of Solo Garlic At Low Altitude By Spraying Coumarin And Applying Liquid Fertilizer At Different Rates	Usman K.J. Suharjo T. Pamekas M. Simarmata H. Harioski1	Bengkulu University
5G Antenna Gain Enhancement Using A Novel Metasurface	P C Praveen Kumar,P. Keerthi, M. Lalitha, P. Lakshmi Deepthi, P. Sujitha, P. Rushitha	G. Pulla Reddy Engineering College
HFSS-Based Design And Performance Analysis Of A Rectangular Microstrip Patch Antenna For ISM Band Applications	P C Praveen Kumar 1 ,K. Nuthana1, K. Lakshmi Navya2, M. Geethanjali3, K. Mamatha4	G. Pulla Reddy Engineering College
Design Of An ECE-Shaped Microstrip Patch Antenna Using HFSS	P C Praveen Kumar,G.Sreeja, J.Sukanya, J.Rupa, M.Yeswitha	G. Pulla Reddy Engineering College
Design And Simulation Of A 2.4 Ghz Circular Microstrip Patch Antenna Using HFSS	P C Praveen Kumar,R. Naga Roshan , R. Ganesh Reddy, P. Chanakya, S.Hemanth	G. Pulla Reddy Engineering College
Design And Simulation Of A Dual-Frequency Wearable Antenna For Smart Watch Supporting NFC And Bluetooth Communication	P C Praveen Kumar,G. Tejaswini, G. Shirisha, G. Mamatha, J. Lakshitha	G. Pulla Reddy Engineering College

27.12.2025 / Hall-16, Session-5			
	ANKARA LOCAL TIME		MEETING ID: 844 4053 5966
	13:30 16:00		PASSCODE: 450687

HEAD OF SESSION: *Praveen Kumar*

TOPIC TITLE	AUTHORS	AFFILIATION
Design and Analysis of a Wearable Textile Antenna for a Biomedical Application	P C Praveen Kumar,B.Sowmya, D.Swathi, D.Dilshad, G.Reddy Hari Priya	G. Pulla Reddy Engineering College
Hexagonal Graphene Patch Antenna with CPW Feed for 5G Systems	P C Praveen Kumar , A.Nageshwari , B.Deepthi , C.Meghana , D.Varshini	G. Pulla Reddy Engineering College
Cross Shaped Microstrip Patch Antenna Using Hfss	P C Praveen Kumar, Kalamalla Naga Padmini Kalva Vishnu Priya,Kamle Indhu ,Karre Varshitha	G. Pulla Reddy Engineering College
Compact Infinity-Shaped Microstrip Antenna With Improved Impedance Matching For Wireless Communication	P C PRAVEEN KUMAR 1 ,A.DIVYA 2 , A.PRIYADARSHINI 3 , A .YASHASWINI 4 , R.BHARGHAVI 5	G. Pulla Reddy Engineering College
HFSS-Based Design And Performance Analysis Of A Rectangular Patch Antenna	P C Praveen Kumar, P.Maneesha, S.Hafizun, N.Wagdeevee, P.Pushpanjali	G. Pulla Reddy Engineering College
Design And Analysis Of A Star-Shaped Variable Microstrip Patch Antenna For 5G Wireless Communication Using Polystyrene Substrate	P C Praveen Kumar 1 ,Shaik Mahammad Fazil 2 ,T. Jay Simha S.Dheeraj Kumar 4 ,S.Abdul Nadeem	G. Pulla Reddy Engineering College
ANSYS HFSS–Based Design And Simulation Of An FR4 Epoxy Microstrip Patch Antenna Operating At 6.64 Ghz	P C Praveen Kumar 1 , G Shravya Sri 2 , S Nakshathra Bai	G. Pulla Reddy Engineering College
Electromagnetic Performance Analysis Of An E-Shaped Microstrip Patch Antenna	PC.Praveen Kumar 1 , G.Mahidhar Reddy 2 ,K.Vinil Sai Kumar Reddy 3 ,B.Jagan 4 ,D.Manideep	G. Pulla Reddy Engineering College

27.12.2025 / Hall-17, Session-5			
	ANKARA LOCAL TIME		MEETING ID: 844 4053 5966
	13:30 16:00		PASSCODE: 450687

HEAD OF SESSION: *MUHAMMAD FAISAL*

TOPIC TITLE	AUTHORS	AFFILIATION
Artificial Intelligence–Enabled Risk Management İn Pension Finance Under Population Aging: A Governance Perspective Based On A Life-Cycle Asset–Liability Framework	Dr. Li Zeng Prof. Wee-Yeap Lau	Henan Polytechnic University/CHINAUniversiti Malaya/MALAYSIA
Growth Assessment and Economic Indices of Clarias gariepinus cultured in a Clarias-Duckweed Aquaponics System	Isah M. C. Hamzat A. Olatunde, A. A. Ndana, T. K. Abdulmalik R. H. Ndaiji A.	University of Abuja/Ibrahim Badamasi Babangida University Lapai
Ethical Challenges And Bias Mitigation İn Artificial Intelligence Models	J.Jeyavarshana Dr S.SELVAM	S.Vellaichamy Nadar College
Strategic Revitalization Of Special Education Institutions İn Pakistan With Methodological Framework For Institutional Transformation	MUHAMMAD FAISAL	Allama Iqbal Open University
The İmportance Of Early Diagnosis And Treatment Of Types Of Malocclusions İn Children Collaboration Between General Dentist, Pedodontist And Orthodontist, A Literature Review	Doc. Elona Hasalla Prof.As. Dr. Celjana Toti Dr. Gerta Kacani, Ilda Taka Brandi Fahriu	University of Tirana/ “Aleksandër Xhuvani” University
Modern Dance In Tourısm Events: Strengthenıng Tourısm Experıences, Destınatıon Image, And The Value Of The Creatıve Economy	Ade Irma ANGGRAENI Marsya Amırah UFAIRAH Rezanto NURUDIN	Universitas Jenderal Soedirman/INDONESIA
Meta-Analysis Of Role Of 21st Century Skills İn The Filed Of Education	Dr. YOGITA KAMAL Dr. ROHI RANI	School of Education Davv Indore/ Jammu and Kashmir
The Effect Of Indoleacetıc Acıd And Indole-3-Butyrıc Acıd Concentratıons On The Rootıng And Growth Of Thymus Atlantıcus Cuttıngs	Ranya Hajjami Ahmed rida Hajjami Amine Oubrhou Chakib Alem	Prefectural University/ Sciences and Techniques, Errachidia, Moulay Ismail, Morocco/JAPAN

27.12.2025 / Hall-18, Session-5			
	ANKARA LOCAL TIME		MEETING ID: 844 4053 5966
	13:30 15:30		PASSCODE: 450687

HEAD OF SESSION: ***Talha Suhayeb Arko***

TOPIC TITLE	AUTHORS	AFFILIATION
Bindu - A Non-İnvasive Blood Group Detection System Using Fingerprint	Talha Suhayeb Arko Nusrhat Jahan Sarker	Daffodil Institute of IT/BANGLADESH
Yıeld And Qualıty Of Cucumber (Cucumis Sativus L.) As Influenzed By Stakıng Operatıon And The Sıze At Harvest In An Organıc System	AyanfeOluwa, O. E. Komolafe, A. F. Kayode, C. O.	Federal College of Agriculture
Recent Advances in Targeted Carbon Based Nanoparticles for Cancer Therapy : Concise Review - Groundwork for Applied Research	A.AZOUAGHE M. EL MAHAMDI W. DAOUDI A. EL AATIAOUI	Mohammed First University/ Hassan First University
Instıtutıonal Readıness For Aı Transformatıon In Educatıonal Management: A Mıxed-Methods Assessment	Moses Adeolu AGOI Oluwakemi Racheal OSHINOWO Samuel Olayiwola AJAGA Oluwanifemi Opeyemi AGOI	Lagos State University/ Obafemi Awolowo University
Renewable Energy And The Energy Transition İn Albania	Silvana Nakuci	Agricultural University of Tirana
The Applying Of Four-Dimensions Concurrent Engineering İn Iraqi Manufacturing Firms	Karrar Abdulellah Azeez Marwah Abdulkareem Mahmood, Sarah esaam hasan haider naama	University of Kufa
The Psychology Of Digital Spending: How E-Wallets Shape Impulsive Buying Among Young Consumers	Dr. Jayasree Krishnan	Vels Institute of Science Technology and Advanced Studies (VISTAS)
Tımes New Roman, 11 Pt, Bold	Abu Kowsar Mahatir Ahmed Tusher	Islamic Unisersity/VIT-AP University
Older Adults As Strategic Actors İn Community Development: From Social Service Beneficiaries To Active Resources For Social Cohesion And Sustainability	Sorina Corman Alin Croitoru	Lucian Blaga University/ROMANIA

27.12.2025 / Hall-19, Session-5			
	ANKARA LOCAL TIME		**MEETING ID:** 844 4053 5966
	13:30 15:30		**PASSCODE:** 450687

HEAD OF SESSION: ***Olga Berta Szabóné***

TOPIC TITLE	AUTHORS	AFFILIATION
Women In The Labour Market: Economıc Perspectıves On Equalıty And Barrıers	Olga Berta Szabóné PhD	University of Nyíregyháza
Fraud And Deposıt Money Banks' Performance Nexus In Nıgerıa	ACHUGAMONU Bede Uzoma NWANKWO Alexius Ndudi OMANKHANLEN Alexander Ehimare	Covenant University
The Methodology Of Imam Al-Nawawi İn Addressing Contradictory And Problematic Hadiths İn Al-Minhāj: A Critical Analysis	Fazirun Md Hanipah Mohd Farhan Md Ariffin	----------
Prevalence &Amp; Management Practices Of Food & Mouth Disease (Fmd) İn Cattle İn Chandpur Sadar, Chandpur	Musfikah Jannat Dr. Sajeda Sultana Dr. Sajedul Hayat	Sher-e-Bangla Agricultural University
Hybrıd Lstm–Gnn–Ppo Framework For Adaptıve Resource Allocatıon In Energy-Efficıent 5g Networks	Tanimu BALA Ibrahim ALHAJI LAWAN	Aliko Dangote University
Tımes New Roman, 11 Pt, Bold How To Localıze Efl Speakıng Lessons For Cambodıan Learners	Shally TOUN	Pannasastra University of Cambodia (PUC)
Therapeutic Potential Of Seagrass Bioactives İn Inflammation Management	Dr. Vani Mathakala P. Uma Maheswari Devi	Sri Padmavati Mahila university
Gender As A Determining Factor İn Albanian Political Leadership	Miranda Prifti	Tirana Business University College

27.12.2025 / Hall-20, Session-6			
	ANKARA LOCAL TIME		**MEETING ID:** 844 4053 5966
	13:30 15:30		**PASSCODE:** 450687

HEAD OF SESSION: *KHERRAB Mohamed*

TOPIC TITLE	AUTHORS	AFFILIATION
Genetic Algorithm–Optimized PID Control for 3R Robotic Manipulator Modeling and Simulation in MATLAB/Simulink	SATLA Zouaoui BENDINE Kouider KHERRAB Mohamed	Tissemsilt University/Djillali Liabes University
Artificial Intelligence Assisted Molecular Design in Chemical Sciences	GAAYATHRI DEVI R Dr. M. Meena	R.M.K. Engineering College
Agro-Waste Derived Bioplastics for Sustainable Packaging	VIJAY I Dr. M. Meena	R.M.K. Engineering College
Chemical Sensor Materials for IoT-Based Environmental Monitoring	GOKUL S Dr. M. Meena	R.M.K. Engineering College
ELECTROACTIVE POLYMERS FOR SOFT ROBOTICS	NAGA HARINI V K Dr. M. Meena	R.M.K. Engineering College
Carbon Capture Materials for Climate Change Mitigation	AVUGADDI HARIN RAJADITYA Dr. M. Meena	R.M.K. Engineering College
Parenting in a Contemporary Changing World: Lessons from the Epic Ramayana	Sadhna Jain	University of Delhi
A Systematic Literature Review Of Personal Branding On Social Media	Ade Irma ANGGRAENI Eka AGUSTINA	Universitas Jenderal Soedirman

27.12.2025 / Hall-21, Session-6			
	ANKARA LOCAL TIME		**MEETING ID:** 844 4053 5966
	13:30 16:00		**PASSCODE:** 450687

HEAD OF SESSION: ***Dr. M. Meena***

TOPIC TITLE	AUTHORS	AFFILIATION
Functional Nanomaterials for Cancer Diagnosis and Drug Delivery	**GAYATHRI D Dr. M. Meena**	**R.M.K. Engineering College**
Photocatalytic Materials for Wastewater Treatment and Pollution Control	**K GOKUL SURYA Dr. M. Meena**	**R.M.K. Engineering College**
Green Hydrogen Production via Advanced Catalytic Materials	**GANESH BAABU S Dr. M. Meena**	**R.M.K. Engineering College**
Nanomaterials For Food Preservation And Safety	**LOKINA JYOTHI Dr. M. Meena**	**R.M.K. Engineering College**
Smart Biodegradable Polymers for Environmental and Biomedical Sustainability	**GANDAVARAPU KAMALANI SRI DR. M. MEENA**	**R.M.K. Engineering College**
Sustainable Construction Materials from Industrial Waste	**NASHITHA M S Dr. M. Meena**	**R.M.K. Engineering College**
Sustainable Polymer Nanocomposites for Next-Generation Packaging Applications	**FENY CHRISTOPHER J S DR. M. MEENA**	**R.M.K. Engineering College**
Wearable Polymer-Based Biosensors for Healthcare	**VIJAY SUNDAR V Dr. M. Meena**	**R.M.K. Engineering College**
Addressing and Normalizing Chemical Misconceptions Through Technology-Enhanced Instructional Strategies in the 21st-Century Chemistry Classroom	**Hassan Aliyu**	**Sokoto State University**

27.12.2025 / Hall-22, Session-6			
	ANKARA LOCAL TIME		**MEETING ID:** 844 4053 5966
	13:30 15:15		**PASSCODE:** 450687

HEAD OF SESSION: ***Ourida BENOUAMANE***

TOPIC TITLE	AUTHORS	AFFILIATION
Statutory Removal And Contractual Protection Of Directors Under CAMA 2020: A Comparative Analysis Of Uk And South African Company Law	Tarms Kagbala Esq	Federal Polytechnic Ekowe
Sustainable Nitrogen Management For Reducing Environmental Impacts İn Agriculture	ELABBARI Chaimaa Pr. Labjar Najoua Pr.EL Hajjaji souad	Mohammed V University
Physıcal And Mechanıcal Performance Of A Sustaınable Geopolymer Mortar Produced From Algerıan Ggbfs	Zineb Abeoub Samira djaknoun	Houari Boumediene University of Science and Technology
Isolation, Identification and Phenotypic Analysis of the Oral Bacterial Species from Supragingival Dental Plaque and Their Association with Different Factors	Dr. Mehwash Kashif Prof. Dr. Mehmooda Kazmi Prof. Dr. Farzeen Tanwir Prof. Dr. Shazia Akbar Fatima Mujtaba	Bahria University of Health Sciences/Jinnah University for Women/Dow Dental College/Karachi Medical and Dental College/ Karachi Metropolitan University
Valorızatıon Of Agrıcultural By-Products Through Small-Scale Productıon Unıts: A Case Study On Red Beer Wıth Rosehıp Waste	Andrei Borşa Alexandra Raluca Borşa (Bogdan) Cristina Anamaria Semenıuc Salanta Liana Farcas Anca Mircea Valentin Muntean	University of Agricultural/ROMANIA
Mutagenıc Effects Of Ethyl Methane Sulfonate (Ems) On Agromorphologıcal Parameters And Oıl Qualıty On Groundnut (Arachıs Hypogaea L.) In North Central Nıgerıa	DANGANA, M.C. DAUDU, O.A.Y. ABDULLAHI, A	Federal University//Nigeria
Phytochemical Study and Valorization of Date Seeds	Ourida BENOUAMANE	Scientific and Technical Research Center on Aride Areas /ALGERIA

27.12.2025 / Hall-23, Session-6			
	ANKARA LOCAL TIME		**MEETING ID:** 844 4053 5966
	13:30 16:00		**PASSCODE:** 450687

HEAD OF SESSION: ***Prof. Dr. Syed Ali Raza NAQVI***

TOPIC TITLE	AUTHORS	AFFILIATION
Effect Of Lipid-Based Multiple Micronutrients Supplementation In Underweight Primigravida Pre-Eclamptic Women On Maternal And Pregnancy Outcomes: Randomized Clinical Trial	**Dr. Kalsoom TARIQ Dr. Nabila SHER Hashim KHAN**	**----------**
Demographıc Dıfferences In The Seroprevelance Of Co-Infectıon Of Hcv Hbv In Hıv Patıents In Peshawar	**Bela Inayat Kalsoom Tariq Ayesha Jameel**	**Khyber Girls Medical College**
Towards Agile Auditing: How Digital Transformation Redefines Practices In Morocco	**Fatine BENKIRANE Mohamed AIT OUDRA Samir ERRABIH Salma LAKHSSASSI Mimoun BENALI**	**Mohamed Ben Abdellah University/MOROCCO**
Automation Of The Audit Process : Between Technological Revolution And Employment mj0*Challenges	**Fatine BENKIRANE Mohamed AIT OUDRA Samir ERRABIH Salma LAKHSSASSI Mimoun BENALI**	**Mohamed Ben Abdellah University/MOROCCO**
Antioxidant, Enzyme Inhibition And Toxicology Studies Of Methanol Extracts Of Selected Medicinal Plants	**Hiba Shahid Prof. Dr. Syed Ali Raza NAQVI**	**Government College University**
Agroecology and Indian Farming: Towards a Sustainable Agricultural Revolution	**Dr. Sanchita RAY Dr. Preeti RANI**	**ShardaUniversity /INDIA**

28.12.2025 / Hall-1, Session-1			
	ANKARA LOCAL TIME		MEETING ID: 844 4053 5966
	11 ^{00} : 13 ^{00}		PASSCODE: 450687
HEAD OF SESSION: *Assoc. Prof. Dr. Hüseyin ALKIŞ*			

TOPIC TITLE	AUTHORS	AFFILIATION
Theoretical Examination Of The Relationship Of Accounting Information System With Sustainable Development Goals	Assist. Prof. Dr. Abdulrezzak İKVAN	Adıyaman University
Multi-Criteria Decision Making (MCDM) Methods In Digital Markeıng Research: A Systematic Review Based On Web Of Science Database	Yunus AKTAŞ Assoc. Prof. Dr. Ömer Faruk RENÇBER	Gaziantep University
A Bibliographic Analysis Of Postgraduate Theses Published In Türkiye On The Topic Of The Glass Ceiling Syndrome	Assist. Prof. Dr. Aydın ÖZDEMİR Ece CİGAL Mehmet Ercan BALTALI	Adiyaman University/Gaziantep Islam Science and Technology University
Bıblıometrıc Analysıs Of Doctoral Theses On Strategy Prepared In Turkey Usıng Data Envelopment Analysıs	Assoc. Prof. Dr. Hüseyin ALKIŞ Assist. Prof. Dr. Aydın ÖZDEMİR Ece CİGAL	Adiyaman University
Retro Marketing In Azerbaıjan Technology Retailing: The Impact Of Kontakt Home's Nostalgic Advertisements On Consumers	Mahammad MAMMADLI Assist. Prof. Dr. Abdulkadir ŞENCAN	İstanbul Ticaret Üniversitesi/İstanbul Kent Üniversitesi
The Concept Of Sustainable Fashion	Assoc. Prof. Dr. Onur ÇETİN	Trakya University
The Future Layer By Layer: 3d Printing Technologies	Hilal UCAK	Süleyman Demirel University
The Context Of Workplace Inclusion And Business Model Innovation	Assist. Prof. Dr. Mustafa ŞENYÜCEL	Haliç University

28.12.2025 / Hall-2, Session-1			
	ANKARA LOCAL TIME		MEETING ID: 844 4053 5966
	11 00 : 13 15		PASSCODE: 450687

HEAD OF SESSION: *Prof. Dr. Mustafa METE*

TOPIC TITLE	AUTHORS	AFFILIATION
Health Financing Models	Meryem YAĞMUR	Aksaray Üniversitesi
Asgari Ücretli Çalışanlarda Yoksulluk Ve Sosyal Dışlanma İlişkisi	İpek ERGÜLEÇ Assoc. Prof. Dr. Ali Kemal NURDOĞAN	Süleyman Demirel Üniversitesi
The Effects Of Maritime Transportation On Economic Growth And International Trade	Melike ÖZDEMİR Prof. Dr. Mustafa METE	Gaziantep University
Dumping Margin Effects: Applications Of Market Economy Classification For Chinese Imports Into Turkey Between 2015 And 2025	Veliburak KAHRAMANOĞLU Abdulrazak SAYED DARWISH Prof. Dr. Mustafa METE	Gaziantep University
Global Income Inequality, International Trade And Purchasing Power Parity (Ppp)	Hamide Nur YAZAR Prof. Dr. Mustafa METE	Gaziantep University
International Trade Policies And The Environment: An Analysis Within The GATT/WTO Framework	Muhsin Çağlar ASLAN Mustafa METE	Gaziantep University
International Trade And Global Currency Wars: A Theoretical And Factual Perspective	Prof. Dr. İlhan EROĞLU Assoc. Prof. Dr. Nalan KANGAL EROĞLU Dr. Esra KANGAL	Tokat Gaziosmanpaşa University/Sivas Cumhuriyet University
Next-Generation Service In Call Centers: AI-Assisted Customer Representative	Dr. Tuğkan ARICI Emre KAYACI	Gebze Technical University/Turkcell Global Bilgi
Lebanon In The Light Of Global And Regional Competitions In The 20th Century	Ph.D. Student, Canan EFE Prof. Dr. Sibel TURAN	Trakya University

28.12.2025 / Hall-3, Session-2			
	ANKARA LOCAL TIME		MEETING ID: 844 4053 5966
	11 [30] : 13 [15]		PASSCODE: 450687

HEAD OF SESSION: *Assist. Prof. Dr. Andaç Kutay SAKA*

TOPIC TITLE	AUTHORS	AFFILIATION
Determination Of Biochemical Properties In Some Hot Pepper (*Capsicum Annuum* L.) Genotypes Collected From Ordu Province	**Assist. Prof. Dr. Andaç Kutay SAKA Adnan UĞUR**	**Ordu University**
The Role Of Artificial Intelligence–Enabled Personalization In Digital Marketing On Shopping Well-Being And Shopping Ill-Being: A Conceptual Approach İn The Context Of Emerging Economies	**Nazlı TIĞLI**	**Van Yuzuncu Yıl University**
The Relationship Between Country Image, Digital Trust, And Marketing In International E-Commerce: A Theoretical Review	**Nazlı TIĞLI**	**Van Yuzuncu Yıl University**
An Analyasis Of Opportunities And Challenges For Reconstruction In A Fragmented Political Landscape: A Case Of Syria	**Tamam DUBEL Pelin ALİYEV**	**Hasan Kalyoncu University**
Constraints On Afghan Repatriation: Push And Pull Factors Shaping Return Decisions	**Abdulwareth ALKASEM Pelin ALİYEV**	**Hasan Kalyoncu University**

28.12.2025 / Hall-4, Session-2			
	ANKARA LOCAL TIME		MEETING ID: 844 4053 5966
	11 30 : 13 30		PASSCODE: 450687

HEAD OF SESSION: *Uzm. Yasemin AĞAOĞLU*

TOPIC TITLE	AUTHORS	AFFILIATION
Türkiye'de Belediyelere Kayyum Atanması Uygulamaları	Fatih ACAR Prof. Dr. Çiğdem AKMAN	Süleyman Demirel University
(Brand Silence In Times Of Crisis And War: The Effects Of Digital Silence Strategies On Consumer Perception And Brand Loyalty)	Dönüş ELRİ Assoc. Prof. Dr. Cihat KARTAL Prof. Dr. Tülin DURUKAN Assist. Prof. Dr. Serhat KARAOĞLAN Yunus Emre BENLİ	Kırıkkale University
The Impact Of Sustainable Marketing Strategies And Ethical Communication On Brand Reputation In Health Tourism	Yunus Emre BENLİ Dönüş ELRİ Assoc. Prof. Dr. Cihat KARTAL Prof. Dr. Tülin DURUKAN Assist. Prof. Dr. Serhat KARAOĞLAN	Kırıkkale University
Designing A Module For Developing Critical Thinking Skills Of Candidate Teachers	Prof. Dr. Sevilay ŞAHİN Zahir ATTAL	Gaziantep University
The Impact Of Artificial Intelligence And Digital Transformation On Service Employees' Perceptions And Job Roles	Nurgül KARAÇAM Şemseddin GÜNDÜZ	Necmettin Erbakan University
The Role Of Cooperatives In Financing The Agricultural Sector In Turkey And Accounting Practices	İbrahim UYSAL Assoc. Prof Dr. Ferhat BİTLİSLİ	Burdur Mehmet Akif Ersoy University
Katilim Bankalarinin Sorunlu Kredilerini Varlik Yönetim Şirketlerine Satişina Yönelik Bir İnceleme	Cemil BALKANLI	Sakarya Uygulamalı Bilimler University
A Two-Dimensional Examination Of Customer Satisfaction In Turkish Airlines: An Analysis Of Internal And External Customer Reviews	Res. Assist. Ayçe YILMAZ Res. Assist. Gülnur YAĞICI	Yeditepe University

28.12.2025 / Hall-5, Session-2			
	ANKARA LOCAL TIME		MEETING ID: 844 4053 5966
	11 ^{30} : 13 ^{30}		PASSCODE: 450687

HEAD OF SESSION: *Prof. Dr. İshak KESKİN*

TOPIC TITLE	AUTHORS	AFFILIATION
Interest In Homemade Food Within Out-Of-Home Consumption: Motivations Behind Consumers' Purchases Of Home-Cooked Meals	Assist. Prof. Dr. Çiğdem ALİÇAVUŞOĞLU	Tokat Gaziosmanpaşa University
Unifying Voices: Why Teachers And School Leaders Join Education Unions	Dr. Suna UTAR ÖZKAN Serdar DEMIR Sevilay ŞAHIN	Gaziantep Islam Science & Technology University/Gaziantep University
Management Of Logistics Operations According To The Characteristics Of Incoterms In International Trade	Metin KETBOĞA	Malatya Turgut Ozal University
The Importance Of Contracts In International Trade: Legal Protection And Commercial Sustainability	Metin KETBOĞA	Malatya Turgut Ozal University
The Role Of The Economic Development Foundation (IKV) In Türkiye–Eu Relatıons	Ekrem Yaşar AKÇAY	Suleyman Demirel University
Türkiye–Eu Relatıons In The Electıon Manıfestos Of Polıtıcal Partıes In The 2023 General Elections	Ekrem Yaşar AKÇAY	Suleyman Demirel University
Preserving The Document, Neglecting The Body: The Historical Transformation Of Archival Working Conditions	Prof. Dr. İshak KESKİN	İstanbul University
Within The Context Of Fundamental Political Ideologies: The Western Perception Of Ismet Özel And Ali Shariati	Sema AYDIN Assoc. Prof. Dr. Emre SAVUT	Mehmet Akif Ersoy University

28.12.2025 / Hall-6, Session-3			
	ANKARA LOCAL TIME		MEETING ID: 844 4053 5966
	12 ^{00} : 14 ^{00}		PASSCODE: 450687
HEAD OF SESSION: *Assoc. Prof. Dr. Selim KANAT*			

TOPIC TITLE	AUTHORS	AFFILIATION
The Nexus Between Climate-Induced Food Insecurity And Irregular Migration: A Multidimensional Analysis	Assoc. Prof. Dr. Selim KANAT	Suleyman Demirel University
The Impact Of The European Green Deal On The 'Climate Adjustment' Of Türkiye-Eu Relations	Assoc. Prof. Dr. Selim KANAT	Suleyman Demirel University
Sustainability Of The Current Account Deficit In Türkiye: An ADF And Fractional Frequency Fourier ADF Approach	Ali Rauf KARATAŞ	Karabuk University
An Analysis Of Macroeconomıc Factors Affectıng Private Automobile Demand In Türkiye	Sefa ERKUŞ Ali Rauf KARATAŞ	Karabuk University
Digital Nomadism: A Conceptual Framework, Work Practices, And Economic Impacts	Res. Assist.Adnan SOYSAL Prof. Dr. Müslüme NARİN	Ankara Hacı Bayram Veli University
The Impact Of Syrian Refugees On Social Life And Crime Rates In Turkey: A Research Design On Kilis And Bayburt Natural Experiment	Res. Assist.Adnan SOYSAL	Ankara Hacı Bayram Veli University
Türkiye's Comparative Advantages In The Foreign Trade Of Beverages (Alcoholic/Non-Alcoholic) And Tobacco Products (1996-2025)	Cansu ÇÖĞÜRCÜ Kazım SARIÇOBAN	Burdur Mehmet Akif Ersoy University
The Level Of Specialization In Türkiye's Sunflower Foreign Trade (2002-2024)	Cansu ÇÖĞÜRCÜ Kazım SARIÇOBAN	Burdur Mehmet Akif Ersoy University

28.12.2025 / Hall-7, Session-3			
	ANKARA LOCAL TIME		MEETING ID: 844 4053 5966
	12 00 : 13 45		PASSCODE: 450687

HEAD OF SESSION: *Resc. Assist. Dr. Kaan YİĞENOĞLU*

TOPIC TITLE	AUTHORS	AFFILIATION
An Empirical Examination Of Inflation Hedging Abilities Of Oecd Stock Markets	Prof. Dr. Önder BÜBERKÖKÜ Resc. Assist. Dr. Kaan YİĞENOĞLU	Van Yuzuncu Yil University
Examining The Impacts Of The Level Of Financial Development On Income Distribution Inequality	Prof. Dr. Önder BÜBERKÖKÜ Resc. Assist. Dr. Kaan YİĞENOĞLU	Van Yuzuncu Yil University
The Contribution Of Expenditure Components To Economic Growth İn Türkiye (2010–2023)	Prof. Dr. Savaş ERDOĞAN Betül BAYRAM	Selçuk Üniversitesi
Financial Transfers On The Egyptian Economy During The Period 2005–2023	Habib Elfahd Mahmoud Abdelsamie Badr Aly Habib Prof. Dr. Mehmet ALAGÖZ	Selçuk University
Emotion Based Analysis In Financial Markets: The Theoretical Relationship Between Information, Perception, And Decision Making	Şafak Sönmez SOYDAŞ	Gumushane University
Climate Migrants Under The Convention Relating To The Status Of Refugees	Assoc. Prof. Dr. Emre CENGİZ Prof. Dr. Ömer UĞUR Prof. Dr. Metin AKSOY	Gumushane University
Rethinking Displacement In The Context Of The Climate Crisis	Assoc. PRof. Dr. Emre CENGİZ Prof. Dr. Metin AKSOY Prof. Dr. Ömer UĞUR	Gumushane University

28.12.2025 / Hall-8, Session-3			
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HEAD OF SESSION: *Levent KOÇER*			

TOPIC TITLE	AUTHORS	AFFILIATION
Evaluation Of The "Nature Journey For A Barrier-Free Life" Project Carried Out With Students Diagnosed With Mild Intellectual Disability Within The Scope Of The Tübitak 4008 Program	**Eser TEMİZ Fatih ORÇAN Arzu TANRIVERDİ Hasan KIZILKAYA Ahsen Ela KIZILKAYA**	**Kahramanmaraş Provincial Directorate of National Education, R&D/ Kahramanmaraş Sütçü İmam University/ Afyon Kocatepe University/İnönü University**
Evaluation Of The ''Heroic City Celebrates Science With Festivals – 2'' Project, Implemented Within The Scope Of The Tübitak 4007 Science Festivals Support Program	**Eser TEMİZ Emre ARICI**	**Kahramanmaraş Provincial Directorate of National Education**
Determination Of Aggregate Spillage On Belt Conveyors Using Discrete Element Method (Dem) Analysis	**Levent KOÇER**	**Teknomak İmalat San. ve Tic. A.Ş.**
Optimization Of A Mixing Tank Using The Dem-Sph Method	**Levent KOÇER**	**Teknomak İmalat San. ve Tic. A.Ş.**
The Effect Of Nozzle Angles On Pressure Losses In Diesel Burners	**Nur ARTUÇ**	**Teknomak İmalat San. ve Tic. A.Ş.**
Stress And Deformation Characteristics Of A Dust Collection Filter System Under Seismic And Wind Loads According To Eurocode Standards	**Nur ARTUÇ**	**Teknomak İmalat San. ve Tic. A.Ş.**

28.12.2025 / Hall-9, Session-3			
	ANKARA LOCAL TIME		MEETING ID: 844 4053 5966
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HEAD OF SESSION: *Lect. Çisil ÇAMLI PULAT*

TOPIC TITLE	AUTHORS	AFFILIATION
Creating Analytical Decision Structures In The Energy Sector Using Hierarchical Clustering Methods	Ahmet GÜRGAŞİN	Astor Enerji A.Ş., AR-GE Merkezi
Supplier Performance Evaluation Using Vikor, Edas, And Topsis Methods: An Application In The Energy Sect	Ahmet GÜRGAŞİN	Astor Enerji A.Ş., AR-GE Merkezi
An Analysis Of The Production Of Aluminum Transmission Mounts Using Additive Manufacturing Methods	Beyzanur BAŞAR Osman ALINAK	Kentpar Otomotiv A.Ş, AR-GE Merkezi
Investigation Of The Hydraulic Rebound Stop (Hrs) System In Conventional Passenger Vehicle Shock Absorbers	Tuncay ALPAR Abdurrahim ARKAN	Maysan Mando, Demirtaş Dumlupınar
Dose- And Time-Dependent Cytotoxic Effects And Detection Of Its Volatile Components By Gc-Ms Of Equisetum Arvense L. In Human And Murine Triple-Negative Breast Cancer Cells	Lect. Çisil ÇAMLI PULAT Lect. Fatma DOYUK	Manisa Celal Bayar University
Phytochemical And Cytotoxic Assessment Of Resurrection Plant (Anastatica Hierochuntica) In Pc3 And Du145 Cells	Lect. Çisil ÇAMLI PULAT Lect. Fatma DOYUK	Manisa Celal Bayar University

28.12.2025 / Hall-10, Session-3			
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	12 30 : 14 30		PASSCODE: 450687
HEAD OF SESSION: *Prof. Dr. Rıfat ATAY*			

TOPIC TITLE	AUTHORS	AFFILIATION
Ijazahs From The Ottoman Perıod To The Present: A Study Of Three Examples From The 18th, 19th, And 20th Centuries	Berkan ÇIRPAN Assoc. Prof. Dr. Ömer MÜFTÜOĞLU	Eskişehir Osmangazi University
The Doctrine Of Kant's Morality (Moralitat) Versus Hegel's Idea Of Ethical Life (Sittlichkeit)	Tuba İLHAN DALAR	Kilis 7 Aralık University
The Future World: Posthumanism, Feminism, And The Changing Roles Of The Father	Süleyman GÜMÜŞ Resul SUÇİN	Kırklareli Provincial Office of the Mufti / Kırklareli University
The Concept Of Adab In Islamic Educational Thought	Assist. Prof. Dr. Ahmet BEKEN	Çukurova University
The Concept Of Tarbiyah And Its Fundamental Dimensions	Assist. Prof. Dr. Ahmet BEKEN	Çukurova University
The Impact Of Taʿrīż (Indirect Expression) Style On Learning Processes In The Qur'an	Assoc. Prof. Dr. Servet DEMİRBAŞ	Ankara Yıldırım Beyazıt University
The Concept Of Reason In Necıp Fazıl Kısakürek In The Context Of The Relationship Between Reason And Faith	Prof. Dr. Rıfat ATAY Nesuh KAYA	Akdeniz University
Maturidi Readings In The Context Of Religious Diversity	Prof. Dr. Rıfat ATAY Berat TIRAŞ	Akdeniz University

28.12.2025 / Hall-11, Session-4			
	ANKARA LOCAL TIME		MEETING ID: 844 4053 5966
	12 30 : 14 15		PASSCODE: 450687

HEAD OF SESSION: *Assoc. Prof. Dr. Berna DUMAN AYDIN*

TOPIC TITLE	AUTHORS	AFFILIATION
Detection Of B-Sitosterol, Gelatin, And Starch In Dairy Products Sold In Diyarbakır And Determination Of Adulteration	Serap AKÇADAĞ YILDIZ Assoc. Prof. Dr. Berna DUMAN AYDIN	Tarım ve Orman Bakanlığı/Dicle Üniversitesi
The Advancement Of Digital Agriculture And Smart/Intelligent Production Systems	Wahidullah HILAL Assoc. Prof. Dr. Seyit HAYRAN	Cukurova University
Rutin As A Natural Flavonoid: Chemical Properties, Biological Activity, And Therapeutic Perspectives	Mehmet BAŞEĞMEZ Lect Dr. Senem TÜFEKÇİ	Pamukkale University
Genome-Wide Association Studies In Farm Animals	Eda KÖRLÜK Fatma İLHAN	Selcuk University
Optimization Of Sweetness Flour Formulation And Production Process	Nuri Serdar GÜNDOĞAN Ceyda KAÇMAZ GÜMÜŞ	Tellioğlu Yem Gıda Entegre Tesisleri San. ve Tic. A.Ş.
Some Economically Valuable And Endemic Plants Naturally Growing Around Yaylakonak Town (Adıyaman)	Dr. Talip ŞAHİN Prof. Dr. Ömer KILIÇ Şinasi YILDIRIMLI	Adıyaman University/Hacettepe University
Fumigant Resistance In Stored-Product Insects And Sustainable Fumigation Strategies	Assist. Prof. Dr. Fatma Nur ELMA Hüseyin ÇETİN	Selçuk University

28.12.2025 / Hall-12, Session-4			
	ANKARA LOCAL TIME		MEETING ID: 844 4053 5966
	12 30 : 14 30		PASSCODE: 450687

HEAD OF SESSION: *Assoc. Prof. Dr. Nacide KIZILDAĞ ÖZDAL*

TOPIC TITLE	AUTHORS	AFFILIATION
Tarla Tarımında Twin-Row Ekim Yöntemiyle Yüksek Verim Potansiyeli	Prof. Dr. Erkan BOYDAK Selim ÖZDEMİR	Bingöl University
New Findings On The Transmission Of Plant Diseases By Insect Vectors And Studies On Vector Behavior	Lect. Nagihan KILIÇ Assist. Prof. Dr. Murat GÜVEN	Iğdır University
New Generation Formulations In Pheromone-Based Biotechnical Pest Control	Lect. Nagihan KILIÇ Res. Assist. Dilek Doğan AKDAĞ Assoc. Prof. Dr. İsmail ALASERHAT	Iğdır University
Relationships Between Somatic Cell Count And Some Milk Quality Traits İn Bafra Sheep Milk	Ömer Faruk YILMAZ Prof. Dr. Mehmet Akif ÇAM	Ondokuz Mayıs University
The Impact Of Plant, Animal, And Microbial Fertilizers On The Sustainability Of Agriculture	Merve Nur EKTİREN Prof. Dr. Erkan BOYDAK Assoc. Prof. Dr. Zeynep DUMANOĞLU	Bingol University
Evaluation Of The Growth Performance Of Different Ornamental Plants Under Heavy Metal Stress	Fatma Nur KILIÇ Sude Nur ÖZCİHAN Osman SÖNMEZ	Erciyes University
Nanoparticle Production From Waste Biomass	Assoc. Prof. Dr. Nacide KIZILDAĞ ÖZDAL	Çukurova University
Influence Of Nanotechnology-Enabled Fungicides On Enzyme Activity	Assoc. Prof. Dr. Nacide KIZILDAĞ ÖZDAL	Çukurova University

28.12.2025 / Hall-13, Session-4			
	ANKARA LOCAL TIME		MEETING ID: 844 4053 5966
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HEAD OF SESSION: *Assist. Prof. Dr. Ali Fuat YALÇIN*

TOPIC TITLE	AUTHORS	AFFILIATION
Students' Views On The Design Of An In-School Science Street: A Phenomenological Study	Sibel DEMİRTAŞ Bilge ÖZTÜRK Betül KÜÇÜK DEMİR	Milli Eğitim Vakfı Konursu İmam Hatip Ortaokulu/ Bayburt University
An Examination Of Students' Views On The Implementation Of The Harezmi Education Model	Sibel DEMİRTAŞ Bilge ÖZTÜRK Betül KÜÇÜK DEMİR	Milli Eğitim Vakfı Konursu İmam Hatip Ortaokulu/ Bayburt University
A Review Of Postgraduate Theses On Different Approaches Used In Preschool Education In Türkiye	Fatma ÇALIŞANDEMİR Elif Nihan KURT Özge ÖZEL	Mehmet Akif Ersoy University
An Examination Of Postgraduate Theses On Father-Child Communication /Interaction In The Preschool Period	Fatma ÇALIŞANDEMİR Elif Nihan KURT Özge ÖZEL	Mehmet Akif Ersoy University
Ortaokul Matematik Öğretiminde Yapay Zekâ Kullanımına İlişkin Öğretmen Görüş, Deneyim Ve Önerileri	Prof. Dr. Necdet KONAN Esma CİCİ	İnönü University
The Mediating Role Of Perceived Social Support In The Effect Of Psychological Rigidity On The Meaning Of Life	Assist. Prof. Dr. Ali Fuat YALÇIN Serdar ABBAS Gülfidan BUĞDAY Hatice GÖRGÜLÜ	Necmettin Erbakan University
The Importance Of Envıronmental Educatıon In Early Chıldhood And Examples Of Some Effectıve Practıces	Fatih KURT Assist. Prof. Dr. Mürşet Çakmak	Mardin Artuklu Üniversitesi
Teachers' Evaluations Regarding In-Service Training	Bayram GÖKBULUT Pınar ÇUKDAR Beyza KORKMAZ	Zonguldak Bülent Ecevit University
A Study On The Opinions Of 8th Grade Middle School Students Regarding Writing Motivation	Prof. Dr. Hasan BAĞCI Y. L. Öğrencisi Ahsen SAVAŞER	Burdur MAKÜ

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	ANKARA LOCAL TIME		MEETING ID: 844 4053 5966
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HEAD OF SESSION: *Assoc. Prof. Dr. Aysel KOCAKÜLAH*			

TOPIC TITLE	AUTHORS	AFFILIATION
The Peer Mediation System From The Perspective Of Teachers And Students	Prof. Dr. Şenay Sezgin NARTGÜN Eray METİN	Bolu Abant İzzet Baysal Üniversitesi
Animal Embriyo Production And Transfer Worldwide	Tahir KARAŞAHİN	Aksaray University
The Effect Of Zero Waste-Based Environmental Education On Environmental Awareness In Elementary School Students	Canan OKUMUŞ Rukiye Kübra ARTUNÇ KARA Gökhan UYANIK	Kastamonu University
An Examination Of Primary School Students' And Prospective Classroom Teachers' Metaphorical Perceptions Of Science Lessons: A Systematic Review	Rukiye Kübra ARTUNÇ KARA Canan OKUMUŞ Ahmet ÜNAL	Kastamonu University
Uncontrolled Use Of Dietary Supplements And Potential Health Risks	Elif Ebru ALKAN	Van Yüzüncü Yıl Üniversitesi
Use Of Probiotics In Some Cancer Types	Elif Ebru ALKAN	Van Yüzüncü Yıl Üniversitesi
Teaching The ''Propagation Of Light And Shadow'' Unit Through The Context-Based Approach	Assoc. Prof. Dr. Aysel KOCAKÜLAH Esra KARAMAN	Balıkesir University/Ministry of National Education, Science Teacher
Meaning Making And Classroom Discourse In The Teaching Of Electromagnetic Induction	M. Sabri KOCAKÜLAH Assoc. Prof. Dr. Aysel KOCAKÜLAH	Balıkesir University

28.12.2025 / Hall-15, Session-4			
	ANKARA LOCAL TIME		MEETING ID: 844 4053 5966
	13 ^{00} : 14 ^{15}		PASSCODE: 450687
HEAD OF SESSION: *Assoc. Prof. Dr. Tolga AKTÜRK*			

TOPIC TITLE	AUTHORS	AFFILIATION
Traveling Wave Solutions Of The Nonlinear Benney–Luke Equation	Assoc. Prof. Dr. Tolga AKTÜRK	Ordu University
Obtaining The Complete Solutions Of A Non-Linear Mathematical Model Using The Modified Exponential Function Method	Assoc. Prof. Dr. Tolga AKTÜRK	Ordu University
Approximate Solutions Of Differential Equations By Using The Runga-Kutta Method	Ömer FIRAT Ebru YILDIRIM	Kilis 7 Aralık University
An Overview Of Hausdorff Measure And Hausdorff Dimension	Assist. Prof. Dr. Yasin KAYA	Dicle University
An Overview Of Elliptic Integrals And Elliptic Functions	Assist. Prof. Dr. Yasin KAYA	Dicle University

28.12.2025 / Hall-16, Session-4			
	ANKARA LOCAL TIME		MEETING ID: 844 4053 5966
	13 ^{00} : 14 ^{15}		PASSCODE: 450687
HEAD OF SESSION: *Assoc. Prof. Dr. Murat POLAT*			

TOPIC TITLE	AUTHORS	AFFILIATION
An Investigation Of Pre-Service Teachers' Sustainable Development Awareness According To Gender And Academic Department	Simge KOÇ ÖZGÜR AY Şeyda KARŞIYAKA	Dokuz Eylül University
The Effect Of Modules Developed For Sustainable Development Goals In Science Education On Students' Awareness	Gülşah ÇETIN SİMGE KOÇ	Dokuz Eylül University
Education And Steam: A Comprehensive Analysis Of Postgraduate Theses Incorporating Steam Implementations In Turkey	Deniz KILIÇ Gizem Nur ÖZÜPEK Gökhan UYANIK	Kastamonu University
Middle School 7th Grade Students' Views On Geogebra-Supported Instruction Of The Topic 'Views Of Three-Dimensional Objects	Pınar KARATAŞ GÜL Prof.Dr. Gül KALELİ YILMAZ Prof.Dr. Menekşe Seden TAPAN BROUTİN	Bursa Uludağ University
Chen--Ricci Inequalities For (Almost) H-Semi-Invariant Riemannian Submersions From Quaternionic Space Forms	Assoc. Prof. Dr. Murat POLAT	Dicle University

28.12.2025 / Hall-17, Session-5			
	ANKARA LOCAL TIME		MEETING ID: 844 4053 5966
	13 ^{00} : 14 ^{30}		PASSCODE: 450687
HEAD OF SESSION: *Prof. Dr. Gülay BEDIR*			
TOPIC TITLE		**AUTHORS**	**AFFILIATION**
The & Recognized Teacher& Model In The Minds Of Prospective Teachers: A Qualitative Analysis Of Teacher Characteristics That Leave A Lifelong Mark		Lect. Zeynep ERMEYDAN Prof. Dr. Gülay BEDIR	Kahramanmaraş Sütçü İmam University
Preschool Teachers' Perspectives on Universal Design for Learning (UDL) Practices in Early Childhood Education		Prof. Dr. Gülay BEDIR Lect. ZEYNEP ERMEYDAN	Kahramanmaraş Sütçü İmam University
An Analysis Of Tuğba Coşkuner's Last People Of The Earth Book Series In Terms Of Values Education		Emine SAÇIKARALI	Adıyaman University
Koray Avcı Çakman's Work Titled "Red Feather" And The Enneagram Personality Types		Asuman ULUSOY Assoc. Prof. Dr. Semih ZEKA	Erciyes University
Cultural Foundations Of Language Education: The Educational Function Of The Müeddeb Daye		Bilal UYSAL Zeynep YİĞİT	Afyon Kocatepe University
Turkish Education In Sibyan Schools In The Ottoman Empire And The Educators Involved In This Education		Bilal UYSAL Zeynep YİĞİT	Afyon Kocatepe University

28.12.2025 / Hall-18, Session-5			
	ANKARA LOCAL TIME		MEETING ID: 844 4053 5966
	13 30 : 15 00		PASSCODE: 450687

HEAD OF SESSION: *Prof. Dr. Memet ŞAHİN*

TOPIC TITLE	AUTHORS	AFFILIATION
A New Metric On Uncertainty: Fuzzy Partial G-Metric Space	Prof. Dr. Memet ŞAHİN Tuğçe KÜÇÜKLER	Gaziantep Univeersity
Fuzzy Partial b-Metric Spaces	Prof. Dr. Memet ŞAHİN Özkan AYTEKİN	Gaziantep Univeersity
Neutro b-Metric Spaces	Prof. Dr. Memet ŞAHİN Teheni KABİRİ	Gaziantep Univeersity
Neutro-Normed Spaces	Prof. Dr. Memet ŞAHİN Safaa HALLAK	Gaziantep Univeersity
5.Sınıf İstatistiksel Araştırma Süreci Teması Kapsamında Purdue Modeline Dayalı Öğretim Materyali Geliştirilmesi	Büşra YÜKSAL SARAY Prof. Dr. Esra ALTINTAŞ	Aydın Adnan Menderes University
Türkiye Ve Japonya'da Okutulan 5. Sınıf Matematik Ders Kitaplarında Yer Alan Görevlerin Karşılaştırmalı İncelemesi	Zehra TAŞPINAR ŞENER Büşra DİKCE BENZEK	Yıldız Teknik Univeersity

28.12.2025 / Hall-19, Session-5			
	ANKARA LOCAL TIME		MEETING ID: 844 4053 5966
	13 30 : 14 45		PASSCODE: 450687
HEAD OF SESSION: *Assoc. Prof. Dr. Zehra ÖZDEMİR*			
TOPIC TITLE		**AUTHORS**	**AFFILIATION**
Investigation Of 9th Grade Students' Opinions On Practices In The Mathematics Textbook Prepared According To The Turkey Century Education Mode		**Selin TÜRKCAN Prof. Dr. Gül KALELİ YILMAZ Prof. Dr. Dilek SEZGİN MEMNUN**	**Bursa Uludağ University**
An Investigation Of Middle School Mathematics Teachers' Views On The Use Of Geogebra		**Selin TÜRKCAN Prof. Dr. Gül KALELİ YILMAZ Prof. Dr. Dilek SEZGİN MEMNUN**	**Bursa Uludağ University**
Multiplicative Geometric Analysis Of Quaternion-Based Space–Time Curves In Minkowski Multiplicative Space		**Assoc. Prof. Dr. Zehra ÖZDEMİR**	**Amasya University**
Quaternionic Surfaces In Minkowski Multiplicative Space		**Assoc. Prof. Dr. Zehra ÖZDEMİR**	**Amasya University**
Vector-Like Quark Research		**İlkay TÜRK ÇAKIR**	**Ankara University**

28.12.2025 / Hall-20, Session-5			
	ANKARA LOCAL TIME		**MEETING ID:** 844 4053 5966
	13 ^{30} : 15 ^{00}		**PASSCODE:** 450687
HEAD OF SESSION: *Assoc. Prof. Dr. Muzaffer DENİZ*			
TOPIC TITLE		**AUTHORS**	**AFFILIATION**
The Role Of National Holidays In The Construction Of National Identity During The Single-Party Period		**Assoc. Prof. Dr. Muzaffer DENİZ**	**Van Yüzüncü Yıl University**
The Reflection Of Germany's Policies Toward The Regions And Nations Captured From The Soviet Union During The Second World War In Turkish Diplomatic Archival Documents		**Assist. Prof. Dr. Nurettin ÇAKICI**	**Trabzon University**
President Cevdet Sunay's Visit To West Germany		**Bahattin DEMİRTAŞ**	**Ankara Hacı Bayram Veli University**
Riyaziyyatda Laplas Çevrilməsinin Əsas Rolu		**Abbaslı Leyla Fərman**	**Naxçıvan Dövlət Universiteti/AZERBAIJAN**
President Kenan Evren's Visit To West Germany		**Bahattin DEMİRTAŞ**	**Ankara Hacı Bayram Veli University**
The Corrosion Of Social Bonds: From Historic Antep Houses To Apartments		**Ümran AÇIKGÖZ**	**Gaziantep University**

28.12.2025 / Hall-21, Session-5			
	ANKARA LOCAL TIME		MEETING ID: 844 4053 5966
	13 30 : 15 00		PASSCODE: 450687

HEAD OF SESSION: *Prof. Dr. Hüseyin Vehbi İMAMOĞLU*

TOPIC TITLE	AUTHORS	AFFILIATION
Unemployment Anxiety Among University Students: The Example Of Bayburt University	Abdurrahman KESKİN Zeynep GÜNGÖR	Bayburt University
Üniversite Öğrencilerinin Sekülerleşmeye İlişkin Tutumları	Zülal YILMAZ Assoc. Prof. Dr. Fatih ARSLAN	Sivas Cumhuriyet Universty
An Evaluation Of The Codification Movements In The Tanzimat Period In The First Half Of The Nineteenth Century	Prof. Dr. Hüseyin Vehbi İMAMOĞLU	Sinop University
An Evaluation Of The Penal Code Of 1840 In The Context Of The Modernization Of Ottoman Law	Prof. Dr. Hüseyin Vehbi İMAMOĞLU	Sinop University
Psychological Meaning In Internal Speech	Farzaliyeva Turkan Jalil qizi	Azerbaijan State Pedagogical University/AZERBAIJAN
The Mediating Role Of Meaning In Life In The Relationship Between Emotional Regulation And Mental Well-Being In Adolescents	Assist. Prof. Dr. Cihangir KAÇMAZ Mehmet Akif KAY	Kayseri Üniversitesi/Batman University

28.12.2025 / Hall-22, Session-6			
	ANKARA LOCAL TIME		MEETING ID: 844 4053 5966
	13 30 : 15 15		PASSCODE: 450687

HEAD OF SESSION: *Assist. Prof. Dr. Hakan TURAN*

TOPIC TITLE	AUTHORS	AFFILIATION
Kamu Yararı Gerekçesiyle Kamulaştırma: Hukuksal Meşruiyet Ve Toplumsal Etki Çerçevesinde Bir Değerlendirme	Assist. Prof. Dr. Hakan TURAN	Hitit University
Denetimli Serbestlik Görevlilerine İlişkin Araştırmaların İncelenmesi	Assist. Prof. Dr. Hakan TURAN	Hitit University
The Role Of Artıfıcıal Intellıgence In Enhancıng Cybersecurıty: A Proactıve Defense Approach	Gaini MUKHANOVA Aruzhan ABDYBAEYVA	Astana IT Üniversitesi/Kalkınma ve Uluslararası İşbirliği Dairesi/KAZAKİSTAN
Determınants Of The Aversıon To Loss Trend On Investor Reactıons	Msc Candidate Ali KÖSELER Prof. Dr. Fatih KONAK	Hitit University
The Impact Of Clımate Rısks On Fınancıal Performance: A Conceptual Framework For Turkey	Msc Candidate Ali KÖSELER Prof. Dr. Fatih KONAK	Hitit University
Kamu Yönetimi Ve Politika Geliştirme Süreçlerinde Zorunlu Göç Olgusu	Assist Prof. Dr. Galip USTA Lect. Dr. Kemal TORPUŞ	Trabzon University Artvin Çoruh University
Evaluation Of The Effect Of Family Planning Education Provided To Adolescent Fertile Women Among Syrian Refugees On Their Family Plannng Attitudes	Kafaa ALSHEİKH Adile NEŞE	Gaziantep University

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	ANKARA LOCAL TIME		**MEETING ID:** 844 4053 5966
	13 [30] : 14 [45]		**PASSCODE:** 450687
HEAD OF SESSION: *Lect. Dr. Yasemin GEZER TUĞRUL*			

TOPIC TITLE	AUTHORS	AFFILIATION
Türkiye'de Cumhuriyet Dönemi'nde Yaşanan Kitlesel Göçlerin Ve Uygulanan Politikaların Değerlendirilmesi	**Fatma Buse İYİDİKER DOĞAN** **Dr. Atik ASLAN**	**Gaziantep University**
1980'lerde Yaşanan Balkan Göçü İle 2010'larda Yaşanan Suriye Göçüne İlişkin Politikaların Kamu Politikası Ve Siyasal Söylemler Açısından Değerlendirilmesi	**Burak Alp DOĞAN** **Dr. Onur TÜRKÖLMEZ**	**Gaziantep University**
Syrian Transnational Families: The Case Of Türkiye	**Songül ÖĞÜT** **Lect. Dr. Yasemin GEZER TUĞRUL**	**Van Yuzuncu Yıl University**
Alternative Models And Family Roles In Elderly Care: Social And Gender-Based Changes	**Lect. Dr. Yasemin GEZER TUĞRUL** **Mina Nur USLU**	**Van Yuzuncu Yıl University**

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HEAD OF SESSION: *Prof. Dr. Doğan AYDIN*

TOPIC TITLE	AUTHORS	AFFILIATION
The Impact Of Smote-Based Resampling On KNN For Automated Sleep Staging: A Comparison With MLP	Ahmet Sertol KÖKSAL Mehmet BAKIR Enes Eren SÜZGEN	Yozgat Bozok University
Integrating Prompt Engineering Into Software Development Education In Vocational High Schools: A Step Toward AI-Supported Learning	Sezgin ÇEKEREKLİ Gül Fatma TÜRKER AKKAŞ	Suleyman Demirel University
Determination Of Matching Rates Of University Publications With Yök Research Subject Headings Using Machine Learning Techniques	Murat RESULOĞULLARI Prof. Dr. Doğan AYDIN	İzmir Katip Çelebi University
The Effect Of Cognitive Disorder On The Volume Of Short-Term Visual And Auditory Memory In Schoolchildren	Ass. Prof. E. J. HUSEYNOVA F. H. GULIYEVA	Gandja State University/AZERBAIJAN
Optimal Production Schedule Design In Cable Manufacturing Using Composite Genetic Algorithm	Hilal ÖNLER Prof. Dr. Doğan AYDIN	İzmir Katip Çelebi University
A Prototype Study For An Artificial Intelligence–Based Video Summarization And Learning Support System	Tuğçe DURMAZ Birim BALCI	Manisa Celal Bayar Üniversitesi
Creative Training And Its Pedagogical Foundations	Prof. Dr. Anvar ABBASOV	Baku Slavic University/AZERBAIJAN

28.12.2025 / Hall-25, Session-6			
	ANKARA LOCAL TIME		MEETING ID: 844 4053 5966
	14 00 : 16 00		PASSCODE: 450687

HEAD OF SESSION: *Assist. Prof. Dr. Müslüm ÖZTÜRK*

TOPIC TITLE	AUTHORS	AFFILIATION
Insulin Dosage Detection Using Random Forest Algorithm With Ovo Strategy	Fahriye GEMCİ	Kahramanmaras Sutcu Imam University
A Comparative Analysis Of Classical Image Processing Methods And Deep Learning–Based Approaches On Small-Scale Face Datasets	Lect. Dr. Yasin SANCAR	Ataturk University
Analysing The Relationship Between Art Therapy And Art Education: Mask Therapy Application Example	Cansu BEYHAN Prof. Dr. Aylin GÜRBÜZ	Trakya University
Creativity In Individuals With Special Needs: An Activity Example On Recycling With Buttons In The Field Of Visual Arts	Semanur ÇAKMIŞ Prof. Dr. Aylin GÜRBÜZ	Trakya University
Multi-Criteria Decision Making For The Evaluation Of Artificial Intelligence Models Using Fuzzy Cobra Method	Assist. Prof. Dr. Müslüm ÖZTÜRK	Kilis 7 Aralık University
The Role Of The Steam Approach In Informatics Education	Ayten MEMMEDOVA	Lankaran State University/AZERBEYCAN
In The Name Of Algorithms, The Power Is Mine: The Test Of Education And Democracy With Artificial Intelligence	Feyzullah ELAGÖZ Prof. Dr. Bülent ALAGÖZ	Gaziantep University
Laboratory Conditions In Science Education In Primary Schools: The Southeast Anatolia Region Example	Memet ŞAHAN Pelin METE	Atatürk University

28.12.2025 / Hall-26, Session-6			
	ANKARA LOCAL TIME		**MEETING ID:** 844 4053 5966
	14 ^{00} : 16 ^{00}		**PASSCODE:** 450687
HEAD OF SESSION: *Prof. Dr. Serdar Ethem HAMAMCI*			

TOPIC TITLE	AUTHORS	AFFILIATION
Objective Criteria Weighting And Compromise Ranking In End-Of-Life Tire Recycling: A Critic–Marcos Approach	Gülçin CANBULUT	Nuh Naci Yazgan University
The Use Of Phase Change Materials In Cooling Thermoelectric Modules	Perihan ÇULUN	Bingöl University
Comparative Analysis Of Modern Deep Learning Architectures For Disease Classification In Retinal Oct Images	Hasan ULUTAŞ Assoc. Prof. Dr. M. Emin SAHIN	Yozgat Bozok University/ Izmir Bakircay University
Design Of Pid Controller Based On Transient Response Control For Non-Minimum Phase Systems	Prof. Dr. Serdar Ethem HAMAMCI	İnönü University
Optimization Of Processing Parameters For Nanoclay-Reinforced E-Glass /Epoxy Composites İn Terms Of Chip Formation	Assist. Prof. Dr. Sakine KIRATLI Hüseyin GÖKÇE	Çankırı Karatekin University
Economic Impact Of State-Of-Charge Estimation In Pv–Bess Hybrid Systems	Dr. Kübra Nur AKPINAR	Marmara University
Economic Performance Analysis Of Photovoltaic–Battery Energy Storage Systems	Dr. Kübra Nur AKPINAR	Marmara University
Multi-Stage Axial Compressor Performance Mapping: Parametric Scan Of Back Pressure, Speed, And Input Temperature	Mehmet Ali ÖZTÜRK Ahmet YAPICI	Iskenderun Technical University

28.12.2025 / Hall-27, Session-6			
	ANKARA LOCAL TIME		MEETING ID: 844 4053 5966
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HEAD OF SESSION: *Assoc. Prof. Dr. Asuman SAVAŞCIHABEŞ*

TOPIC TITLE	AUTHORS	AFFILIATION
Cnts-Based Inorganic Hole Transport Material Enabling High Efficiency And Enhanced Stability In Perovskite Solar Cells	Fahriye SARI, Mahmut KUŞ Faruk ÖZEL	Konya Technical University/Recep Tayyip Erdogan University
Classification Of Laryngeal Lesions Using Artificial Intelligence-Based Deep Learning Methods	Orçun ORUÇ Prof. Dr. Ahmet ALKAN Kubilay Muhammed SÜNNETCİ	Kahramanmaraş Sütçü İmam University
Detection And Grading Of Periapical Lesions In Dental Tomography Images: Performance Analysis Of Densenet201 In The Sagittal Plane	Mahmut Nedim EKERSULAR Assist. Prof. Dr. Emine ARARAT Prof. Dr. Ahmet ALKAN Assist. Prof. Dr. Emre CULHA Lect. Oğuz Burhan ÇETİNKAYA	Kahramanmaraş Sütçü İmam University/Gaziantep University
Machine Learning–Enabled Resource And Network Optimization For 5g Networks	Assoc. Prof. Dr. Asuman SAVAŞCIHABEŞ	Nuh Naci Yazgan University
Comparison Of Refrigeration Systems Using R290 As An Alternative To R404a Based On Cop, Tewı And Lccp	Rayyan Ahmad Mahmoud ALHASHASH Abdullah DAĞDEVİREN Şafak ATAŞ	Karabuk University
The Effect Of Battery Storage Systems On Power System Frequency In Primary Frequency Control	Prof. Dr. Ahmet KARAARSLAN Mehmet Emrah ŞEKER	Ankara Yıldırım Beyazıt University
A Secure Landing System For Autonomous Uavs Based On Deep Learning And Slope Analysis With Thermal Sensor Support	Sercan KÖSE Alperen SARI Mustafa NAMDAR Arif BAŞGÜMÜŞ	Kutahya Dumlupinar University/Bursa Uludağ University
Smart Walking Stick For An Inclusive Life	Emir KARA Uğur KARABIÇAK Mustafa NAMDAR Arif BAŞGÜMÜŞ	Kutahya Dumlupinar University/Bursa Uludağ University

28.12.2025 / Hall-28, Session-7			
	ANKARA LOCAL TIME		MEETING ID: 844 4053 5966
	14 30 : 16 15		PASSCODE: 450687

HEAD OF SESSION: *Prof. Dr. Cenk YAVUZ*

TOPIC TITLE	AUTHORS	AFFILIATION
Production And Characterization Of Walnut Shell Reinforced Pvc Matrix Composites	Merve AKÇAKAYA Assoc. Dr. Eser YARAR Assoc.Prof. Dr. Fevzi Cakmak BOLAT Assoc. Prof. Dr. Emel KURAM Assoc. Prof. Dr.Alp Eren ŞAHİN	Kocaeli University/Gebze Techncal University
A Study Of Structural Parameters On The Vibration Characteristics Of Sandwich Plates With Tetrachiral Core And Functionally Graded Face Sheets	Fatih PEHLİVAN Kerim Gökhan AKTAŞ	Karabük University
Material Selections In Multifunctional Headlight Design For Commercial Vehicles	Hamdi YILDIZ Prof. Dr. Cenk YAVUZ	SANEL Sanayi Elektroniği İmalat ve Ticaret A.Ş./ Sakarya University /Sakarya Innovation Center (SAYMER)
The Framework Of Off-Grid Energy Systems Legislation In Türkiye And A Comparative Assessment With The Eu	Prof. Dr. Cenk YAVUZ	Sakarya University
Keystream Generation In RNA Space And Statistical Validation	Alev KAYA İbrahim TÜRKOĞLU	Fırat University
RNA-Based Image Encryption And Lossless Decryption Implementation	Alev KAYA İbrahim TÜRKOĞLU	Fırat University
An Assessment Of Wind Energy Potential And Current Status Within The Scope Of Türkiye's Renewable Energy Vision	Tamer ÖZKAVUKCU Salih SÖZER	Akdeniz University

28.12.2025 / Hall-29, Session-7			
	ANKARA LOCAL TIME		MEETING ID: 844 4053 5966
	14 30 : 16 00		PASSCODE: 450687
HEAD OF SESSION: *Assoc. Prof. Dr. Bora ÇEKYAY*			

TOPIC TITLE	AUTHORS	AFFILIATION
A Multi-Criteria Decision-Making Approach For The Selection Of New Product Development Projects In Generic Pharmaceutical Companies	Assoc. Prof. Dr. Bora ÇEKYAY Özge KÖSEM	Yıldız Technical University
Expertimental Investigation Of The Effects Of Oil Change On Seal-Piston Rod Friction Force And NVH Performance In Twin-Tube Telescopic Shock Absorbers For C-SUV Vehicles	Hasan Can KARAKAŞ	Bursa Uludağ University
Pid Velocity Control Of The Arm Slider Mechanism	Muhammet AYDIN	Firat University
Pid Position Control Of The Arm-Slider Mechanism	Muhammet AYDIN	Firat University
Ruled Surfaces With Smarandache Adjoint Base Curves Generated By Linear Combinations Of Bishop Frame Vectors	Esra DAMAR	Hitit University
Ruled Surfaces With A Smarandache Curve Derived From The Bishop Frame	Esra DAMAR	Hitit University

28.12.2025 / Hall-30, Session-7			
	ANKARA LOCAL TIME		MEETING ID: 844 4053 5966
	14 30 : 16 30		PASSCODE: 450687

HEAD OF SESSION: *Prof. Dr. Zülfü GÜROCAK*

TOPIC TITLE	AUTHORS	AFFILIATION
Parking Site Selection Using Gis-Based Location–Allocation Modeling: A Case Study Of Gtu Campus	Ali Doğan GÜMÜŞSOY Prof. Dr. Arif Çağdaş AYDINOĞLU	Gebze Teknik Üniversitesi Ulaşım Teknolojileri Enstitüsü
Gis-Based Analysis Of Spatial Density And Pedestrian Accessibility: A Smart City Approach Through The Gtu Campus Case Study	Ali Doğan GÜMÜŞSOY Prof. Dr. Arif Çağdaş AYDINOĞLU	Gebze Teknik Üniversitesi Ulaşım Teknolojileri Enstitüsü
The Excavability Characteristics Of Basalts Along The Route Of The Yoncalı Dam (Malatya) Water Transmission Tunnel	Prof. Dr. Zülfü GÜROCAK	Firat University
The Use Of Empirical Methods In Determining The Shear Strength Of Discontinuitions	Prof. Dr. Zülfü GÜROCAK	Firat University
Enhancing RT-DETR For Small Object Detection In Aerial Imagery Via Adaptive Feature Fusion	Ahmet ARAPOĞLU Assoc. Prof. Dr. Fatih ÖZYURT	Fırat University
Utilizing Unmanned Aerial Vehicles (Drones) For Enhanced Security Surveillance In Sensitive Areas	Abdurrahman El NECCAR Sohayb ABDULKERİM	Gaziantep University
Full Dynamic Modeling Of Coupled Dynamics And Energy Harvesting In A Gımbaled Pendulum System	Asaad Fawzy DARIJ Ghaida Ghaiath Al-SMAEIL Sohayb ABDULKERIM	Alsham University, Al-Sham University/ Gaziantep University/SYRIA
Performance Analysis Of Recurrent Neural Network Architectures In Classifying Tennis Strokes	İbrahim Cem BALCI Rana GÜRSOY İrem SAYIN Serkan SALTÜRK Hüseyin ÜVET	Yildiz Technical University

28.12.2025 / Hall-31, Session-7			
	ANKARA LOCAL TIME		MEETING ID: 844 4053 5966
	14 30 : 15 45		PASSCODE: 450687

HEAD OF SESSION: *Assoc. Prof. Dr. Alp Eren ŞAHİN*

TOPIC TITLE	AUTHORS	AFFILIATION
Effect Of Chestnut Shell And Hybrid Inorganic Fillers On The Mechanical Behavior Of Polypropylene Biocomposites	Osman GÜNER Tuana ORHUN Harun SEPETÇİOĞLU İdris KARAGÖZ	Yalova University/Konya Selçuk University
Production Optımization Of Pa Filament In 3d Printers	Yılmaz ALBUNAR Assoc. Prof. Dr. Alp Eren ŞAHİN	Kocaeli University
The Effects Of Lean Production Techniques On Reducing Carbon Footprint	Şahika GÜVENÇLİ Nuşin UNCU Neşe YALÇIN	Adana Alparslan Türkeş Science and Technology University
A Climate Application Aimed At Reducing The Carbon Footprint For The Purpose Of Protecting Nature	Uğurhan ÇOLAK Ali ERDEM Arif Kaan BOLEL Efe GENÇ	Sivas Cumhuriyet Üniversitesi/Karabük University
Explainable Machine Learning Models: A Case Study On Airline Ticket Price Prediction	Yasemin OKAN Gülhayat GÖLBAŞI ŞİMŞEK	Yıldız Technical University

28.12.2025 / Hall-32, Session-7			
	ANKARA LOCAL TIME		MEETING ID: 844 4053 5966
	14 [30] : 15 [45]		PASSCODE: 450687

HEAD OF SESSION: *Resc. Assist. Dr. Hasan Kıvanç YEŞİLTAŞ*

TOPIC TITLE	AUTHORS	AFFILIATION
Nanopartikül İlavesi İle Kompozit Zırh Yeleklerin Geliştirilmesi	Recep ÖZDAL Nazım KUNDURACI	Zonguldak Bülent Ecevit Üniversitesi/ZSR PATLAYICI SAN A.Ş.
Effect Of Pre-Turning Workpiece Surface Roughness On Post-Turning Surface Roughness And Power Consumption	Aslan AKDULUM	Hacettepe University
Numerical Investigation Of Airflow Rate Performance In Pyramid Type Cooker Hoods	Merih GÜLEN Abdullah Emre DEMİR Doğukan GÜNEŞ Öncel DİLBAZ Prof. Dr. İ. Etem SAKLAKOĞLU	Franke Mutfak ve Banyo Sistemleri San. Tic. A.Ş./ Ege University
Biological Importance Of Phosphorus, Environmental Risks And Removal Technologies	Resc. Assist. Dr. Hasan Kıvanç YEŞİLTAŞ Prof. Dr. Güray KILINÇÇEKER	Cukurova University
Water Footprint Management And Mitigating Strategies In Industrial Facilities	Resc. Assist. Dr. Hasan Kıvanç YEŞİLTAŞ Prof. Dr. Behzat BALCI	Cukurova University

28.12.2025 / Hall-1, Session-8			
	ANKARA LOCAL TIME		MEETING ID: 844 4053 5966
	14 30 : 16 00		PASSCODE: 450687

HEAD OF SESSION: *Prof. Dr. Ali OKATAN*

TOPIC TITLE	AUTHORS	AFFILIATION
Determine Load Capasity Of Polymer Ball Bearing With Different Ball Count	Assist. Prof. Dr. Burcu KÜÇÜKOĞLU DOĞAN Abdurrahim DAL Tuncay KARAÇAY	Muş Alparslan University/Adana Alparslan Türkeş Science and Technology University/Gazi University
Blood Test Aı: An Artificial Intelligence Based System For Disease Prediction Using Blood Test Analysis	Prof. Dr. Ali OKATAN Burak BAYRAKTAR	İstanbul Aydın Üniversitesi
Production, Microstructural And Thermal Characterization Of Carbon Nanotube Reinforced Pla Filaments For Additive Manufacturing	Aykut ÇANAKÇI Muzaffer BAKİ Müslim Çelebi Sedat Alper TUNÇ	Karadeniz Technical University
Fabrication And Characterization Of Cnt-Reinforced Pla Composites Via Fff/Fdm	Aykut ÇANAKÇI Muzaffer BAKİ Müslim Çelebi Sedat Alper TUNÇ	Karadeniz Technical University
Exergy Prediction For A Dual Ranque–Hilsch Vortex Tube Using Machine Learning With Brass Nozzles	Dr. Ayhan DOĞAN Dr. Murat KORKMAZ Prof. Dr. Volkan KIRMACI	Hacettepe University/Bartın University
Comparative Analysis Of Machine Learning Regression Models For Predicting Exergy Efficiency In A Dual Vortex Tube With Aluminum Nozzles	Dr. Murat KORKMAZ Dr. Ayhan DOĞAN Prof. Dr. Volkan KIRMACI	Hacettepe University/Bartın University

28.12.2025 / Hall-2, Session-8			
	ANKARA LOCAL TIME		MEETING ID: 844 4053 5966
	15 [00] : 16 [45]		PASSCODE: 450687

HEAD OF SESSION: *Assist. Prof. Dr. Süreyya NUR*

TOPIC TITLE	AUTHORS	AFFILIATION
The Relationship Between Dexa And Bone Mineral Density In Senile Osteoporosis	Lect.Narin KÜÇÜK Assist. Prof. Dr. Süreyya NUR	Hatay Mustafa Kemal University /Muğla Sıtkı Koçman University
Molecular Power Against Senile Osteoporozis: Sırt-3	Lect. Narin KÜÇÜK	Hatay Mustafa Kemal University /Muğla Sıtkı Koçman University
Can Chatgpt Provide Reliable Answers To Frequently Asked Questions About Tinnitus?	Tuba YEŞİL Abdullah ŞEYLAN Bayram Sönmez ÜNÜVAR	KTO Karatay Üniversitesi
Primary Health Care Approach To Diyabetic Foot	Gülsüm TOZLU BİNDAL	Isparta City Hospital
Clinical Application Of The Midkine Parameter In Human Medicine And Its Potential In Veterinary Medicine	Buğra Çağrı SANLI Assist. Prof. Dr. Yasin PARLATIR	Vetprime Animal Hospital/Kırıkkale University
Diagnostic Performance Of MRCP In Isolated Pancreatic Duct Dilatation: Assessing Bening And Malignant Causes	Ayşe KEVEN	Akdeniz University
Psychological Resilience Among University Students: A Theoretical Review Of Individual Risk Factors	Sibel TORUNOĞLU Prof. Dr.Ömer Faruk ERDOĞAN	Kütahya Dumlupınar University

28.12.2025 / Hall-3, Session-8

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HEAD OF SESSION: *Assist. Prof. Dr. Yasemin ŞİMŞEK TÜRKER*

TOPIC TITLE	AUTHORS	AFFILIATION
Comparative Research Of Lvl And Clt In Wood-Concrete Composite Systems	Assist. Prof. Dr. Yasemin ŞİMŞEK TÜRKER	Suleyman Demirel University
Investigation Of Lvl-Concrete Composites Behavior	Assist. Prof. Dr. Yasemin ŞİMŞEK TÜRKER	Suleyman Demirel University
Monthly Streamflow Prediction Using Era5-Land Reanalysis Data In Data-Scarce Basıns	Dr. Abdulhadi PALA	Gaziantep University
Monthly Precipitation Prediction Using Merra-2 Reanalysis Data In Data-Scarce Basıns	Dr. Abdulhadi PALA	Gaziantep University
Statıc Structural Analysıs Of Fdm Parts Wıth Honeycomb Internal Structure Usıng Fınıte Element Method	Mehmet Safa BODUR Assoc. Prof. Dr.Ali AVCI	Yildiz Technical University/Hakkari University
The Effect Of Annealıng Poly(Lactıc Acıd) Produced By Addıtıve Manufacturıng At Dıfferent Temperatures On Its Mechanıcal Properties	Mehmet Safa BODUR Assoc. Prof. Dr.Ali AVCI	Yildiz Technical University/Hakkari University
Examınatıon Of The Advantages And Dısadvantages Of Crawler And Truck-Mounted Drıllıng Rıgs In Open-Pıt Mınes	Mürsel ORAK Savaş KOÇ	Gumushane University/Bentaş Bentonit A.Ş
PLC-Controlled Dual Roll Fluting Machine: Performance Comparison With Conventional Systems	Abdullah Zekai KIVRIM Ahmet BOZDEMİR Prof. Dr. Mehmet BAĞCI	Konya Teknik Üniversitesi/Yenar Döküm A.Ş.
Experımental Investıgatıon Of Backwash Wastewater Recovery In Swımmıng Pools	Ahmet Burak GÜLBUDAK Hasbi KIZILHAN	Suleyman Demirel University

28.12.2025 / Hall-4, Session-8			
	ANKARA LOCAL TIME		MEETING ID: 844 4053 5966
	15 ^{00} : 17 ^{00}		PASSCODE: 450687

HEAD OF SESSION: *Assist. Prof. Dr. Neslihan ÇELİK*

TOPIC TITLE	AUTHORS	AFFILIATION
Graduate Theses Related To The Field Of Visual Arts In Early Childhood In Turkiye	Lect. Dr. Hasan Uğur SERDAROĞLU	Tokat Gaziosmanpaşa University
The Rise Of Green Sukuk In The Global Sukuk Market: A Comparative Analysis With Traditional Sukuk	Muhammed Hadin ÖNER	Aksaray University
The Relationship Between Liquidity And Profitability In Islamic Banks: Panel Data Findings	Muhammed Hadin ÖNER	Aksaray University
From Compliance To Competence: A Longitudinal Content Analysis Of Aviation English Research In The Turkish Efl Context (2008–2025)	Lect. Dr. Mihriban ÖZGÜN	University of Turkish Aeronautical Association
We Speak, Therefore We Exist… Small Talks Among White-Collar Workers At The Workplace	Berna TURAK KAPLAN Assoc. Prof. Dr. Mehmet KAPLAN	Isparta University Of Applied Sciences
Working In A Shared Office: Expectations And Challenges	Berna TURAK KAPLAN Assoc. Prof. Dr. Mehmet KAPLAN	Isparta University Of Applied Sciences
The Logistics Sector In The Global Economy And In Türkiye: The Role Of Smart Contracts	Assist. Prof. Dr. Neslihan ÇELİK	Marmara University
Challenges Experienced By Individuals With Disabled Siblings: The Diyarbakır Example	Muhlise CANLI	Gumushane University

28.12.2025 / Hall-5, Session-8			
	ANKARA LOCAL TIME		MEETING ID: 844 4053 5966
	15 [30] : 17:[15]		PASSCODE: 450687

HEAD OF SESSION: *Prof. Dr. Gonca BÜYÜKMIHÇI*

TOPIC TITLE	AUTHORS	AFFILIATION
Examination Of The Use Of Contemporary Additions In Historic Buildings Within The Context Of Ago Modena's Kinetic Roof Application	Deniz DEMİR Prof. Dr. Gonca BÜYÜKMIHÇI	Erciyes University
An Evaluation Of The Beşiktaş / Dolmabahçe Stadium Road Within The Framework Of Universal Design Principles	Begüm NİZAM	Işık University
The Psychological Reflections Of Space: A Comparative Period Analysis Of Seating Area Furnishing Arrangements From Past To Present	Zeynep Semanur USTACAN Assist. Prof. Dr Hüseyin ZÜLFİKAR	Istanbul Sabahattin Zaim University
Analysis Of Traditional Houses In Uzuntaş Village, Hizan District, From An Ecological Perspective	Mizgin GÖKÇE SALIK	Ağrı İbrahim Çeçen University
The Transformation Of Squatted Spaces In The Context Of Architectural Design Paradigms: An Examination Through The Phenomenon Of Squatter Settlements	Mizgin GÖKÇE SALIK	Ağrı İbrahim Çeçen University
Farklı Şehir İklimlerinin Ofis Binalarında Isı Kaybı ve Kazancı Üzerindeki Etkisi: 6 cm Yalıtım Kalınlığı İçin Karşılaştırmalı Bir Analiz	Mustafa Safa ORAKÇI Hatice Elif Beytekin Salih COŞKUN	Bursa Uludağ University
Yalıs In Istanbul Residential Architecture	Özgü AYDOĞDU	Fatih Sultan Mehmet Vakıf Üniversitesi

28.12.2025 / Hall-6, Session-8

	ANKARA LOCAL TIME		**MEETING ID:** 844 4053 5966
	15 [30] : 18 [00]		**PASSCODE:** 450687

HEAD OF SESSION: *Assist. Prof. Dr. Sevde Gülizar DİNÇER*

TOPIC TITLE	AUTHORS	AFFILIATION
Artificial Intelligence In Interior Design Education: An Evaluation Of Current Research	Halil Yasin DİLEK Rabia KÖSE DOĞAN	Konya Food and Agriculture University/Selçuk University
A Bibliographic Analysis On The Interdisciplinary Use Of Eye Tracking Technology	Havva ÖZKAN Prof. Dr. Zeynep Yeşim İLERİSOY	Gazi University
Hourly $PM_{2.5}$ Prediction Using Air Quality And Meteorological Data: A Deep Learning Approach	Assist. Prof. Dr. Erdem ÇOBAN	Haliç University
The Relatıonshıp Between Occupatıonal Health And Safety In The Constructıon Sector And Dıgıtalısatıon: A Bıblıographıc Analysıs In The Context Of Industry 4.0	Elif AYGÜN Prof. Dr. Zeynep Yeşim İLERİSOY	Gazi University
Urban Memory As Phantom Pain: The Space–Place Tension In Nusret Köklü's Maps	Lect. Dr. Fatma Sinem Akbulut	Celal Bayar University
Pasif Ev Kriterleri Ve Geleneksel Konut Plan Morfolojisi: Form Faktörü Odaklı Bir Değerlendirme	Assist. Prof. Dr. Sevde Gülizar DİNÇER	Konya Food and Agriculture University
Issues Of Developıng The Infrastructure Of The Real Estate Market In Uzbekıstan	Turdibekov Yusuf Ibragimovich	Samarkand State University/UZBEKISTAN
Preservıng Identıty In Hıstorıcal Buıldıngs: The Interıor Desıgn Of The Amsterdam Rıjksmuseum	Assoc.Prof.Dr.Elif ÖZDOĞLAR Assoc.Prof.Dr.Çağrı YALÇIN	Dumlupınar University
A Spatıal Exhıbıtıon Of Musıcal Memory: The Museum-Inspıred Interıor Desıgn Concept Of Hard Rock Café	Assoc.Prof.Elif ÖZDOĞLAR Assoc.Prof.Dr.Çağrı YALÇIN	Dumlupınar University

28.12.2025 / Hall-7, Session-8			
	ANKARA LOCAL TIME		MEETING ID: 844 4053 5966
	15 [30] : 17 [15]		PASSCODE: 450687
HEAD OF SESSION: *Assoc. Prof. Dr. Eda ÖZ ÇELİKBAŞ*			

TOPIC TITLE	AUTHORS	AFFILIATION
Constructing Masculinity In Daytime Cooking Shows: The Case Of Zuhal Topal'la Yemekteyiz	Res. Assist. Dr. Sumru YILDIRIM	Aydın Adnan Menderes University
New Representation Order: Artificial Intelligence And Hyperreality In Documentary Film	Res. Assist. Dr. Sumru YILDIRIM	Aydın Adnan Menderes University
Violin–Piano Arrangement of Joseph Haydn's Op. 3 No. 5 Work, "Andante Cantabile" Movement: A Transcription Study in Structural and Performance Dimensions	Assoc. Prof. Dr. M. Güneş Açıkgöz Assoc. Prof. Dr. Hayri Akbudak	Inönü University
A Descriptive Examination Of Opera Vocal Competitions Organized In Turkey	Assist. Prof. Dr. Cemalettin BAYDAĞ	Zonguldak Bülent Ecevit Üniversitesi
Archaeo-Therapy As Witnessing The Moment: A Multicultural State Of Being In The Here And Now	Assoc. Prof. Dr. Eda ÖZ ÇELİKBAŞ	Karabuk University
Art Therapy In Education: Dewey, Naumburg, Kramer, Malchiodi, Steiner, Stern	Assoc. Prof. Dr. Eda ÖZ ÇELİKBAŞ	Karabuk University
A Review On Use Of Uav's In Postal Services	Lect.Özer Deniz ÇETİNTAŞ Ahmet ÖZCAN Mehmet KONAR	Kapadokya University/Erciyes Universty

28.12.2025 / Hall-8, Session-8			
	ANKARA LOCAL TIME		MEETING ID: 844 4053 5966
	16 ^{00} : 18 ^{00}		PASSCODE: 450687

HEAD OF SESSION: *Lect. Vildan KAVŞUT KAPLANOĞLU*

TOPIC TITLE	AUTHORS	AFFILIATION
Determination Of Problems Of Businesses Operating In Jewelry Sector In Midyat District Of Mardin Province	Lect.Vildan KAVŞUT KAPLANOĞLU Elif İNCİ, Edanur İLBAŞ Pınar IŞIKLI, Şerif ARSLAN Ömer GELEN	Mardin Artuklu University
Hazardous Area Classification And Its Impact On HVAC Design: A Case Study Of A Gas Engine Generator Enclosure	M. Bilgehan ŞAHİN Yusuf SAYAN	Rönesans Endüstri Tesisleri Tasarım Merkezi
Designing An Error Prediction Algorithm For Intelligent Coding Education Platforms	Lect. Sevinç PARLAK	Doğuş University
The Metaphor Of Control And Surveillance In Advertisements: An Examination Of The Panopticon Concept Through Apple's Advertising Campaign	Lect. Şule ÖZEL Prof. Dr. Erhun ŞENGÜL	Muğla Sıtkı Koçman University/Isparta University of Applied Sciences
The Relationship Between Video Games And Violence: A Comparative Analysis Of The Movies "Playing Columbine" And "Elephant"	Leyla ULUÇAM Prof. Dr. Ali M. BAYRAKTAROĞLU	Trakya University
Comparison Of Natural Ventilation Methods According To Different Climate Zones In High-Rise Buildings	Res. Assist. Emine Şeyma ERKAN Assist. Prof. Dr. Fazilet TUĞRUL OKBAZ	Istanbul Rumeli University/Gebze Technical University
Symbolism And Aesthetic Perception Of Qızılbash In The Tabriz School Of Miniature Painting	Sabina NAMAZOVA	Azerbaijan State University of Culture and Arts/AZERBAIJAN
Symbiogenisis; Evolution Through Symbiosis: Conceptualizing A Third Space For Employee Well-Being	Zoha Rafi Rimsha Imran	Lahore College for Women University/PAKİSTAN

28.12.2025 / Hall-9, Session-8			
	ANKARA LOCAL TIME		MEETING ID: 844 4053 5966
	16 ^{00} : 18 ^{00}		PASSCODE: 450687

HEAD OF SESSION: *Professor Dr. Remus RUNCAN*

TOPIC TITLE	AUTHORS	AFFILIATION
The Mediating Role Of Job Commitment In The Effect Of Job Satisfaction On Cyberloafing Behaviors: A Study On Hotel Employees	Yaren GÜNDOĞAN Assist. Prof. Dr. Saadet ÖZTÜRK	Hasan Kalyoncu Üniversitesi
Examining The Relationships Between Adhd Symptoms, Binge Eating Behavior And Emotion Regulation Difficulties In Woman	Şule Sıla TANIŞLAR Assist. Prof. Dr. Nilgün ONNAR	İstanbul Arel University
Examining The Mediating Role Of Cognitive Flexibility In The Relationship Between Mindfulness And Thought–Action Fusion	Ayşem BAHŞİ Assist. Prof. Dr.Gökhan ÖZCAN	Haliç University
Experiences Of Elderly Residents İn Residential Care Homes	Costan Ana-Maria-Otilia Professor Dr. Remus RUNCAN	Aurel Vlaicu University/ROMANIA
Investigation Of Psycho-Cognitive Performance In Married And Divorced Parents	Gizemay AKKIRIK SARIDEDE Assist. Prof.Dr. Zeynep KÜÇÜK	Işık University
Role Of Empathy İn The Relationship Between Pets Attachment And Mental Health Among Pet Owners	Bakhtawar Fakhar Umm Eman Syed	RAWALPINDI WOMEN UNIVERSITY
A Study Of Life Orientation Among Individuals Affected By War	Assoc. Prof. Dr. Ina Shanava Prof. Dr. Eliso Kereselidze Assoc. Prof. Dr. Mariam Gvilava	Georgian International University /GEORGIA
An Analysis Of Japan's Example In Disaster Preparedness And The Importance Of Self-Help	Assoc. Prof. Dr. Feyza Çağla ORAN	Tekirdağ Namık Kemal Üniversitesi

28.12.2025 / Hall-10, Session-9			
	ANKARA LOCAL TIME		**MEETING ID:** 844 4053 5966
	16 [00] : 17 [15]		**PASSCODE:** 450687
HEAD OF SESSION: *Assoc. Prof. Dr. Hasan Hüseyin MUTLU*			

TOPIC TITLE	AUTHORS	AFFILIATION
The Body's Fınal Destınatıon: 'Earth/Grave' In The Gülzâr-I İrfân	Res. Assist. Dilek YALÇIN	Gümüşhane University
Desıgnıng A Professıonal Development Program For In-Servıce Efl Teachers On 21st-Century Skılls	Dr. Şeyda SAVRAN ÇELİK	SDÜ
Burhan Arpad's Theatre Crıtıcısm	Assist. Prof.Dr. Zeynep ŞENER	AHBV University
Current Issues In Teachıng Turkısh As A Foreıgn Language: An Evaluatıon From The Perspectıve Of Currıculum, Materıals, And Implementatıon.	Assoc. Prof. Dr. Hasan Hüseyin MUTLU	Ordu University
Current Issues In Teachıng Turkısh As A Natıve Language: Currıculum, Materıals, And Implementatıon Dımensıons	Assoc. Prof. Dr. Hasan Hüseyin MUTLU	Ordu University

28.12.2025 / Hall-11, Session-9			
	ANKARA LOCAL TIME		MEETING ID: 844 4053 5966
	16 00 : 18 15		PASSCODE: 450687

HEAD OF SESSION: *Assoc. Prof. Dr. Hikmet AKYOL*

TOPIC TITLE	AUTHORS	AFFILIATION
Disaster Risk Reduction And Natural Disasters In Asean Countries	Assoc. Prof. Dr. Hikmet AKYOL Lect. Lokman ODABAŞ Res. Assist. Zümral ERDEM	Gümüşhane Üniversitesi/Trabzon Üniversitesi/Erzurum Teknik Üniversitesi
The Relationship Between Digitalization And Gender-Based Wage Inequality In G20 Countries	Assoc. Prof. Dr. Hikmet AKYOL Assoc. Prof. Dr. Melahat BATU AĞIRKAYA	Iğdır Üniversitesi/Gümüşhane Üniversitesi
Artificial Intelligence In Nursing Education	Kübra AYMELEK HACIOSMANOĞLU	Yüksek İhtisas Üniversitesi
Telehealth Applications And Nursing In The Management Of Chronic Diseases	Kübra AYMELEK HACIOSMANOĞLU	Yüksek İhtisas Üniversitesi
Artificial Intelligence Based Clinical Decision Support Systems In Psychiatric Care: A Systematic Review From The Perspective Of Psychiatric Nursing Practice	Assist. Prof. Dr. Tuba ÇÖMEZ İKİCAN	Istanbul University
The Relationship Between Health Concern And Self-Efficacy In Individuals Diagnosed With Chronic Obstructive Pulmonary Disease	Zeliha BÜYÜKBAYRAM GENÇ Assoc. PRof. Dr.Leyla ZENGİN AYDIN	Siirt University/Dicle University
Cultural Sensitivity In Patient-Centred Care And Its Reflections In Cinical Practice	Assoc. Prof. Dr.Leyla ZENGİN AYDIN	Dicle University
Determination Of Thirst-Related Discomfort During The Surgical Period In Patients Undergoing Neurosurgery	Mehmet Furkan KILIÇ	Gaziantep University
Trochanter Tertius: A Variation Of The Femur	Uzm. Dr. Melike TAŞCİ Assist. Prof. Dr. Burhan YARAR	Ataturk University

28.12.2025 / Hall-12, Session-9			
	ANKARA LOCAL TIME		MEETING ID: 844 4053 5966
	16 ^{00} : 17 ^{45}		PASSCODE: 450687

HEAD OF SESSION: ***Abdurrahman AKDAG***

TOPIC TITLE	AUTHORS	AFFILIATION
Corrosion Behaviour Of Poly(Aniline-Co-N-Methypyrrole) Film On Znni Plated Electrode	Abdurrahman AKDAG	Harran University
Poly(N-Methypyrrole-Co-N-Methylaniline) On Znfe Plated Carbon Steel	Abdurrahman AKDAG	Harran University
Flipped Learning Approach In Health Education: A Literature Review	Dr. Sümeyra DAMSARSAN Res. Assist. Gizem AYDEMİR	University of Health Sciences
Structured Instructional Approaches In Clinical Skills Training: Peyton's Four-Step Teaching Model	Res. Assist. Gizem AYDEMİR Dr. Sümeyra DAMSARSAN	University of Health Sciences
A Study On The Effect Of Covıd-19 Fear On Stress, Depressıon, And Anxıety Levels	Fethiye YAKAR Assoc. Prof. Dr. Zülkif YALÇIN	Munzur University
A Research On The Applıcatıon Of Actıvıty-Based Costıng Method	Gülcan ZENGİN Assoc. Prof..Dr. Zülkif YALÇIN	Munzur University
The Relationship Between Perceived Spouse Support And Depression, Anxiety, And Stress	Beyzanur YILMAZ ÖZTÜRK Res. Assist.Merve İBRAHİMOĞLU Prof. Dr. Ercümend ERSANLI	Ondokuz Mayıs University

28.12.2025 / Hall-13, Session-9			
	ANKARA LOCAL TIME		MEETING ID: 844 4053 5966
	16 30 : 17 45		PASSCODE: 450687
HEAD OF SESSION: *Prof. Dr. Elvettin AKMAN*			

TOPIC TITLE	AUTHORS	AFFILIATION
An Analysis Of Postgraduate Theses On Fomo In Turkey	Prof. Dr. Elvettin AKMAN	Süleyman Demirel University
An Analysis Of Postgraduate Theses On Policy Boards	Prof. Dr. Elvettin AKMAN	Süleyman Demirel University
The Impact Of Sustainability In The Services Sector On The Capital Structure Of Eu Countries	Muhammed DEDE Prof. Dr. Ersan ERSOY	İnönü Üniversitesi/Uşak University
The Impact Of ESG Scores On The Capital Structure Of Manufacturing Industry Companies In European Union Countries	Muhammed DEDE Prof. Dr. Ersan ERSOY	İnönü Üniversitesi/Uşak University
Macro-Financial Drivers Of Bitcoin Monthly Returns: Evidence From U.S. Policy, Inflation, Term Structure, And Risk Sentiment	Çağlar SÖZEN	Giresun University

28.12.2025 / Hall-14, Session-9			
	ANKARA LOCAL TIME		MEETING ID: 844 4053 5966
	16 30 : 17 15		PASSCODE: 450687

HEAD OF SESSION: *Assist. Prof. Dr.Mustafa Furkan KESKENLER*

TOPIC TITLE	AUTHORS	AFFILIATION
Predıctıng Dıvorce Probabılıty Usıng Artıfıcıal Intellıgence-Based Models: A Machıne Learnıng Approach	Assist. Prof. Dr.Mustafa Furkan KESKENLER Eyüp Fahri KESKENLER	Atatürk University/ Bayburt University
Analytıcal Modelıng And Parametrıc Optımızatıon Of Abrasıve Water Jet (Awj) Machınıng Process Based On Hydrodynamıc And Trıbologıcal Prıncıples	Arslan KAPTAN Fuat KARTAL	Sivas Cumhuriyet University/Kastamonu University
Mathematıcal Modelıng Of Turnıng Operatıon Wıth Abrasıve Water Jet (Awj)	Arslan KAPTAN Fuat KARTAL	Sivas Cumhuriyet University/Kastamonu University
Analysıs Of The Mechanıcal Performance Of Dıfferent Auxetıc Patterns	C. Oktay AZELOGLU Metehan KARDELEN Hamit KENAN	Yildiz Technical University/Antalya Bilim University
The Role Of Actıve Rfıd Systems In The Healthcare Sector	İlknur DÜNDAR ÖZÇELİK İlkay SARAÇOĞLU	Haliç University
Economıc Comparıson And Evaluatıon Of The Forecastıng Challenge In The Energy Market Caused By Wınd Power Generatıon Imbalances Wıth Storage Systems	Simge ACAR	İstanbul Teknik Üniversitesi
Determınıng The Cleanıng Perıod Of Pv Solar Panels Usıng Image Processıng And Sımulatıon	MALİK CEBRAİL Assoc. Prof. Dr. Ceyda AKSOY TIRMIKÇI	Sakarya University

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	ANKARA LOCAL TIME		MEETING ID: 844 4053 5966
	16 30 : 17 45		PASSCODE: 450687

HEAD OF SESSION: *Uzm. Dr. Muhammed KORKMAZ*

TOPIC TITLE	AUTHORS	AFFILIATION
Feedback Approaches In Psychomotor Skill Instruction: A Literature Review Based On The Field Of Sports Sciences	Kürşat SENGER	Kars Kafkas University
Rare Cause Of Chronic Left Shoulder Pain And Upper Extremity Paresthesia: Cervical Intradural-Extramedullary Mass	Uzm. Dr. Muhammed KORKMAZ	Elazig Fethi Sekin City Hospital
Examination Of Adolescents' Body Perceptions In Terms Of Various Variables	Ali DOĞAN Prof. Dr. Bekir MENDEŞ	Gaziantep University
A Research On The Legal Processes Of Sports Enterprises	Lect. Dr. Zafer GAYRETLİ Prof. Dr. İlker ÖZMUTLU	Karadeniz Technical University Tekirdağ Namık Kemal University
The Role Of Sponsorship Laws In Sports Clubs: A Legal And Financial Analysis	Lect Dr. Zafer GAYRETLİ Prof. Dr. İlker ÖZMUTLU	Karadeniz Technical University Tekirdağ Namık Kemal University

28.12.2025 / Hall-16, Session-9			
	ANKARA LOCAL TIME		MEETING ID: 844 4053 5966
	16 30 : 17 45		PASSCODE: 450687

HEAD OF SESSION: *Assoc. Prof. Dr.Gülsüm KORKUT*

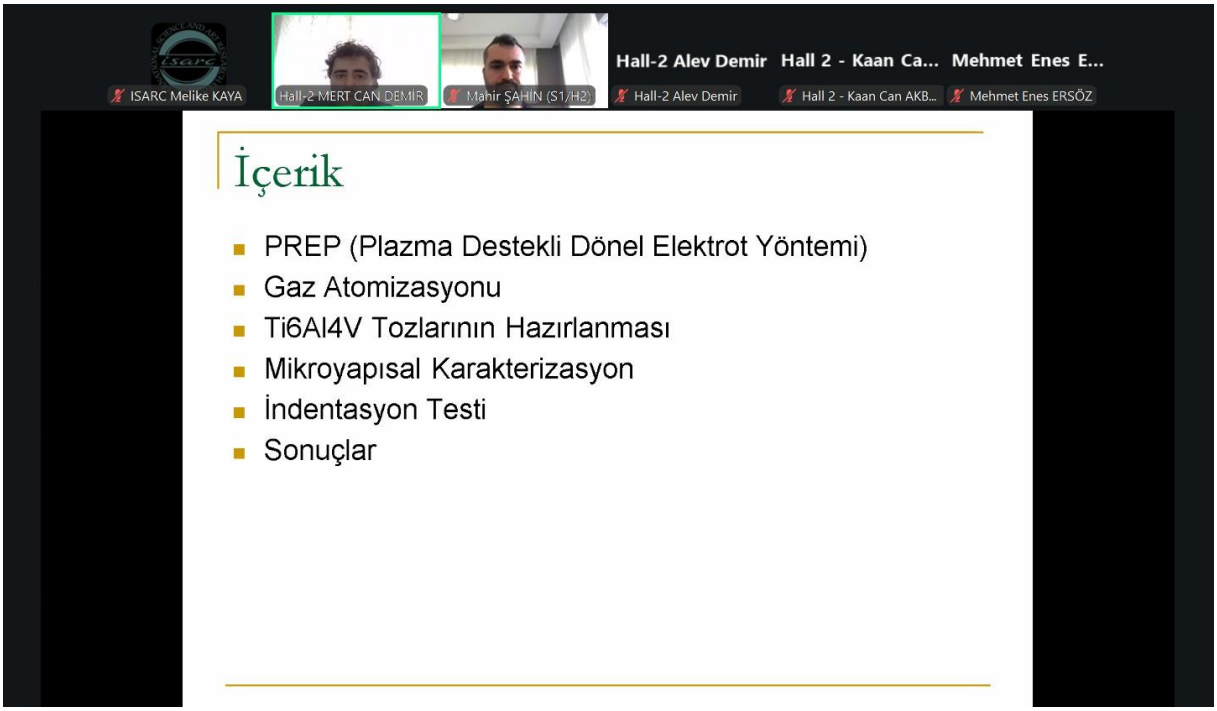
TOPIC TITLE	AUTHORS	AFFILIATION
An Examınatıon Of Graduate Theses And Tr Dizın Artıcles Wrıtten On Aged-Frıendly Cıtıes In Turkey	Şirin KILIÇDOĞAN Prof. Dr. Harun CEYLAN	Yalova University
An Analysıs Of Postgraduate Theses Wrıtten On Socıal Support For People Wıth Dısabılıtıes In Turkıye	Res. Assist.Rümeysa ÇETİNKAYA Prof. Dr.Harun CEYLAN	Yalova University
Assessıng Populatıon Agıng In Terms Of The Sustaınabılıty Of Socıal Securıty Systems	Assoc. Prof. Dr.Gülsüm KORKUT	Burdur Mehmet Akif Ersoy Üniversitesi
Old Age As A Socıal Problem	Assoc. Prof. Dr.Gülsüm KORKUT	Burdur Mehmet Akif Ersoy Üniversitesi
The Dynamics Of Conflict, Power, And Violence In Marital Relationships	Zülal ŞAHİN	Yalova University

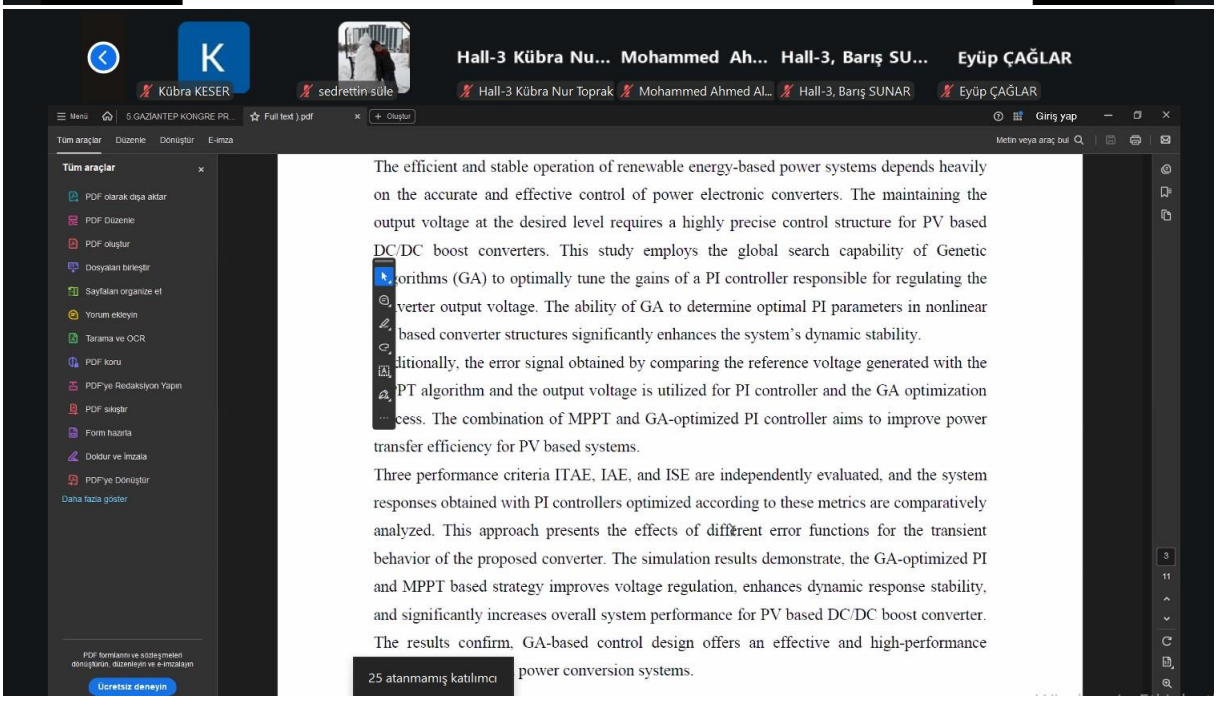
28.12.2025 / Hall-17, Session-9			
	ANKARA LOCAL TIME		MEETING ID: 844 4053 5966
	16 30 : 17 45		PASSCODE: 450687

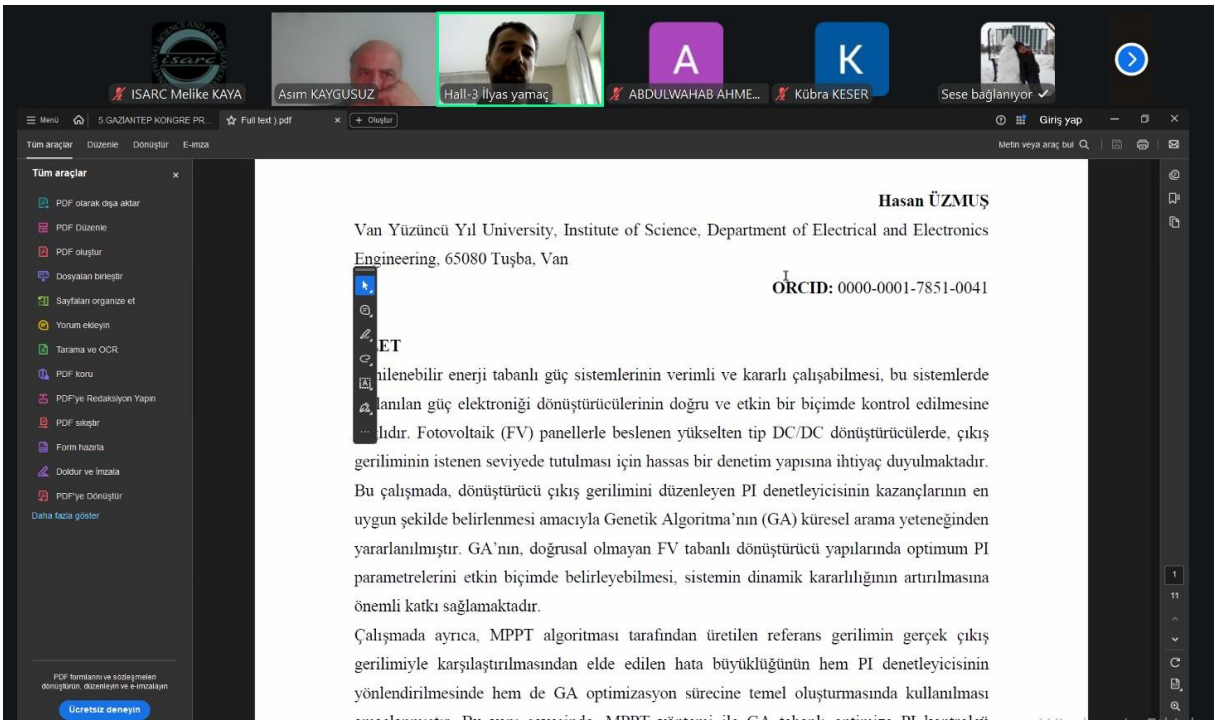
HEAD OF SESSION: *Dr. Süleyman DEMİR*

TOPIC TITLE	AUTHORS	AFFILIATION
Auditory And Visual Attention Deficits And Language Development In Children With Cerebral Palsy	Sinan ÖZYURT	Gaziantep Islam Science and Technology University
Emotional Regulation And Bipolar Vulnerability In The Early Language Acquisition Process	Sinan ÖZYURT	Gaziantep Islam Science and Technology University
The Transformatıon Of Namıng Practıces In Turkey Between 2003-2022: A Socıo-Onomastıc Assessment	Lect. Abdurrahman SEVER	Adıyaman University
The Constructıon Of Cultural Meanıngs Through Vırtual Proverbs: Chatgpt's Language Generatıon	Dr. Süleyman DEMİR	Gümüşhane University
The Evaluatıon Of Turkısh Course Currıculums Dated 2019 And 2024 In The Context Of Phılosophy For Chıldren (P4c)	Kübra SARAÇOĞLU Prof. Dr. Latif BEYRELİ	Marmara University

PHOTO GALERY







Hasan ÜZMUŞ

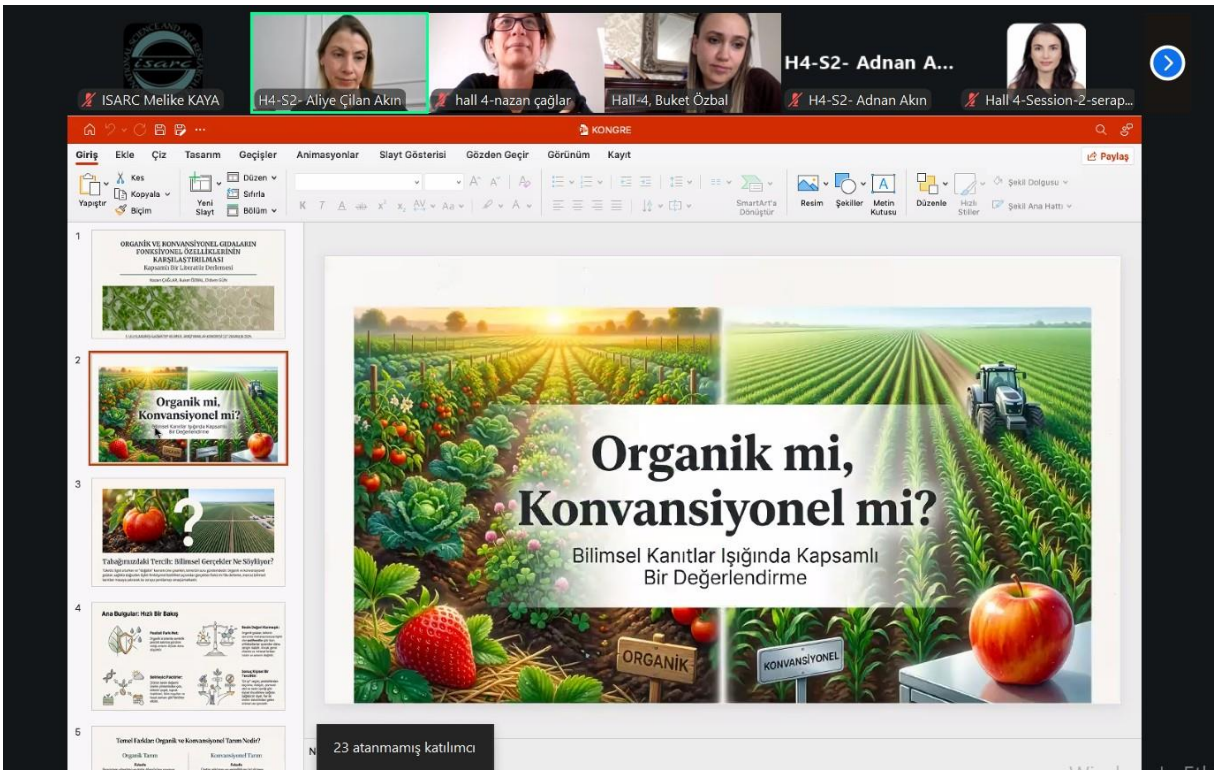
Van Yüzüncü Yıl University, Institute of Science, Department of Electrical and Electronics Engineering, 65080 Tuşba, Van

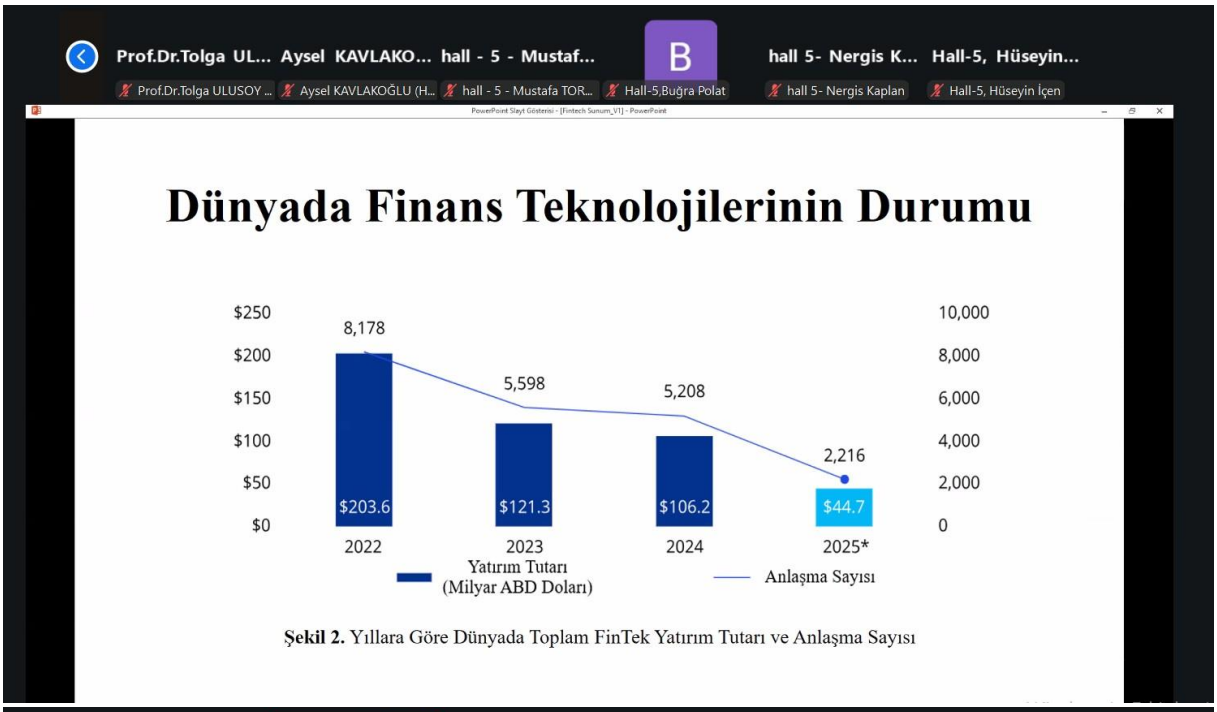
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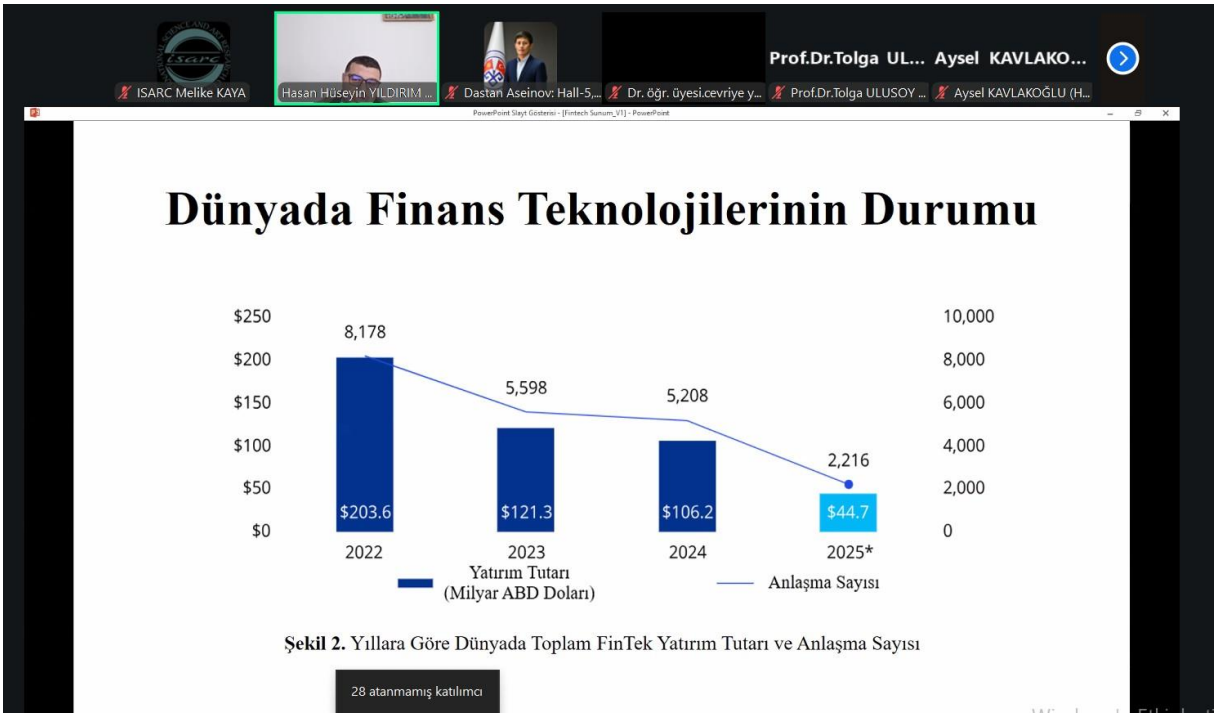
ilenebilir enerji tabanlı güç sistemlerinin verimli ve kararlı çalışabilmesi, bu sistemlerde lanılan güç elektroniği dönüştürücülerinin doğru ve etkin bir biçimde kontrol edilmesine lıdır. Fotovoltaik (FV) panellerle beslenen yükselten tip DC/DC dönüştürücülerde, çıkış geriliminin istenen seviyede tutulması için hassas bir denetim yapısına ihtiyaç duyulmaktadır. Bu çalışmada, dönüştürücü çıkış gerilimini düzenleyen PI denetleyicisinin kazançlarının en uygun şekilde belirlenmesi amacıyla Genetik Algoritma'nın (GA) küresel arama yeteneğinden yararlanılmıştır. GA'nın, doğrusal olmayan FV tabanlı dönüştürücü yapılarında optimum PI parametrelerini etkin biçimde belirleyebilmesi, sistemin dinamik kararlılığının artırılmasına önemli katkı sağlamaktadır.

Çalışmada ayrıca, MPPT algoritması tarafından üretilen referans gerilimin gerçek çıkış gerilimiyle karşılaştırılmasından elde edilen hata büyüklüğünün hem PI denetleyicisinin yönlendirilmesinde hem de GA optimizasyon sürecine temel oluşturmasında kullanılması



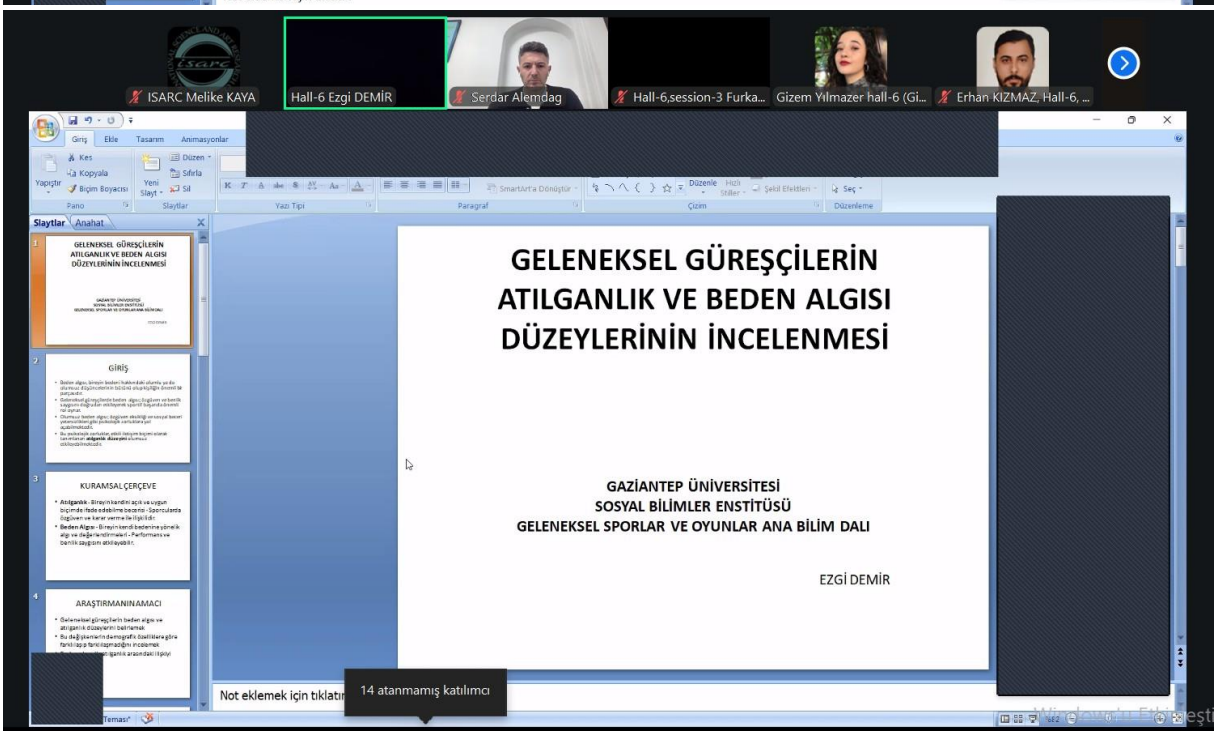


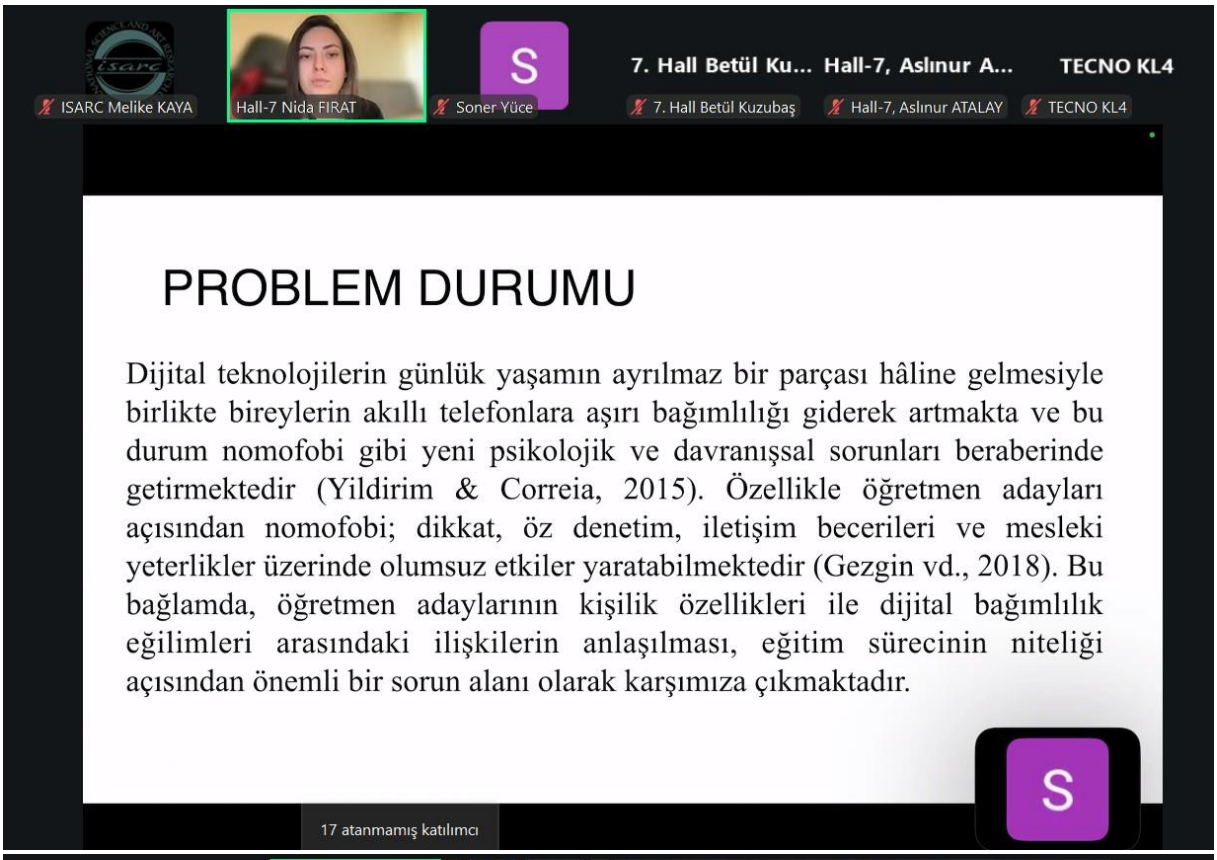
Şekil 2. Yıllara Göre Dünyada Toplam FinTek Yatırım Tutarı ve Anlaşma Sayısı

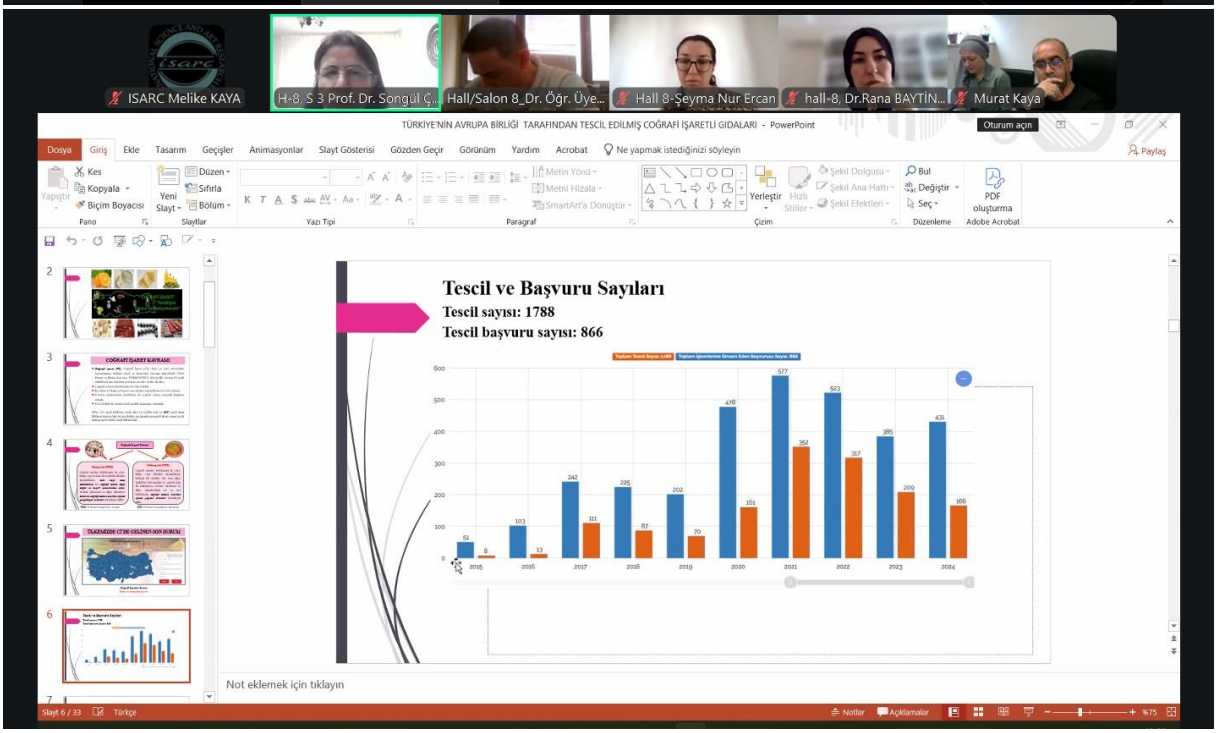


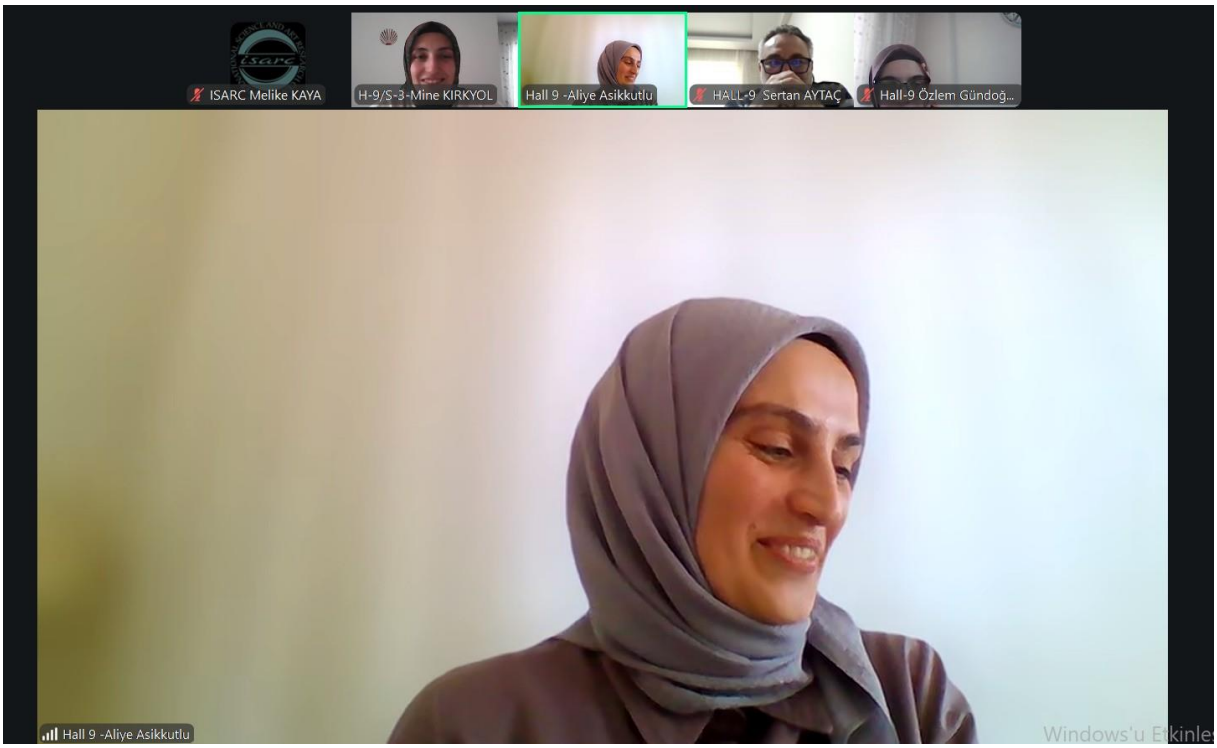
Şekil 2. Yıllara Göre Dünyada Toplam FinTek Yatırım Tutarı ve Anlaşma Sayısı


Gizem Yılmazer hall-6 (Gi...
Erhan KIZMAZ, Hall-6, ...
hall 6 Şule Bens...
hall 6 Şule Bensu Kara...
Hall 6-Kübra Aymelek ...
Ezgi Ergin
Hall-3, Session-...
Hall-3, Session-6- Are...
Giriş
Ekle
Tasarım
Animasyonlar
Slaytlar
Anahat
GELENEKSEL GÜREŞÇİLERİN ATILGANLIK VE BEDEN ALGISI DÜZEYLERİNİN İNCELENMESİ
GİRİŞ
KURAMSAL ÇERÇEVE
ARAŞTIRMANIN AMACI
GİRİŞ
Beden algısı, bireyin bedeni hakkındaki olumlu ya da olumsuz düşüncelerinin bütünü olup kişiliğin önemli bir parçasıdır.
Geleneksel güreşçilerde beden algısı; özgüven ve benlik saygısını doğrudan etkileyerek sportif başarıda önemli rol oynar.
Olumsuz beden algısı; özgüven eksikliği ve sosyal beceri yetersizlikleri gibi psikolojik zorluklara yol açabilmektedir.
Bu psikolojik zorluklar, etkili iletişim biçimi olarak tanımlanan atılganlık düzeyini olumsuz etkileyebilmektedir.
Not eklemek için tıklatın

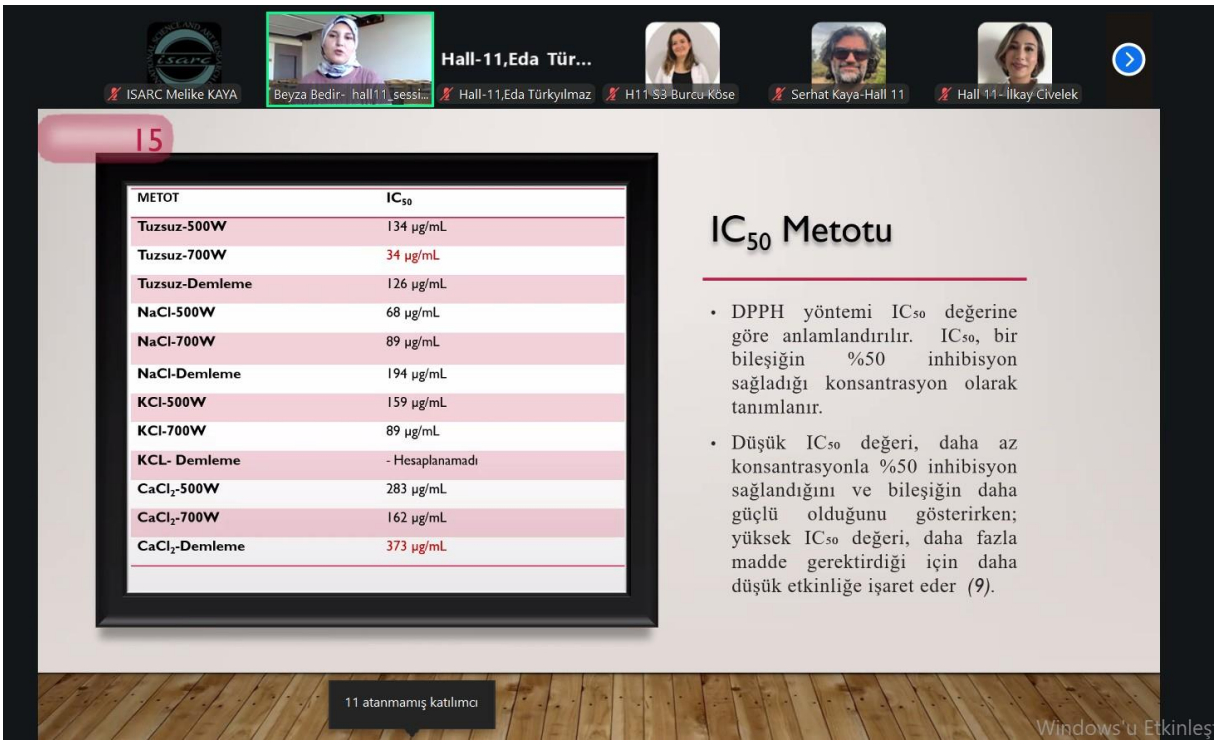

ISARC Melike KAYA
Hall-6 Ezgi DEMİR
Serdar Alemdag
Hall-6,session-3 Furka...
Gizem Yılmazer hall-6 (Gi...
Erhan KIZMAZ, Hall-6, ...
Giriş
Ekle
Tasarım
Animasyonlar
Slaytlar
Anahat
GELENEKSEL GÜREŞÇİLERİN ATILGANLIK VE BEDEN ALGISI DÜZEYLERİNİN İNCELENMESİ
GİRİŞ
KURAMSAL ÇERÇEVE
ARAŞTIRMANIN AMACI
GELENEKSEL GÜREŞÇİLERİN ATILGANLIK VE BEDEN ALGISI DÜZEYLERİNİN İNCELENMESİ
GAZİANTEP ÜNİVERSİTESİ
SOSYAL BİLİMLER ENSTİTÜSÜ
GELENEKSEL SPORLAR VE OYUNLAR ANA BİLİM DALI
EZGİ DEMİR
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14 atanmamış katılımcı

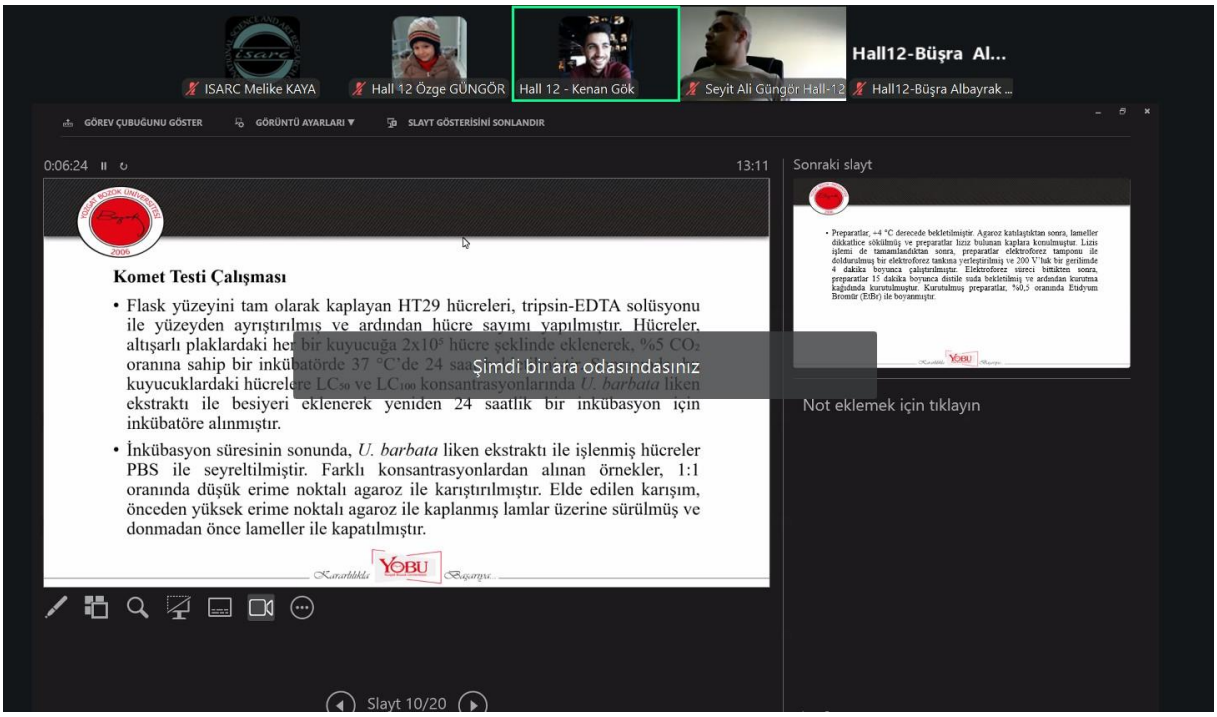

ISARC Melike KAYA
Hall-7 Nida FIRAT
Soner Yüce
7. Hall Betül Ku... Hall-7, Aslınur A... TECNO KL4
7. Hall Betül Kuzubaş
Hall-7, Aslınur ATALAY
TECNO KL4
PROBLEM DURUMU
Dijital teknolojilerin günlük yaşamın ayrılmaz bir parçası hâline gelmesiyle birlikte bireylerin akıllı telefonlara aşırı bağımlılığı giderek artmakta ve bu durum nomofobi gibi yeni psikolojik ve davranışsal sorunları beraberinde getirmektedir (Yildirim & Correia, 2015). Özellikle öğretmen adayları açısından nomofobi; dikkat, öz denetim, iletişim becerileri ve mesleki yeterlikler üzerinde olumsuz etkiler yaratabilmektedir (Gezgin vd., 2018). Bu bağlamda, öğretmen adaylarının kişilik özellikleri ile dijital bağımlılık eğilimleri arasındaki ilişkilerin anlaşılması, eğitim sürecinin niteliği açısından önemli bir sorun alanı olarak karşımıza çıkmaktadır.
17 atanmamış katılımcı

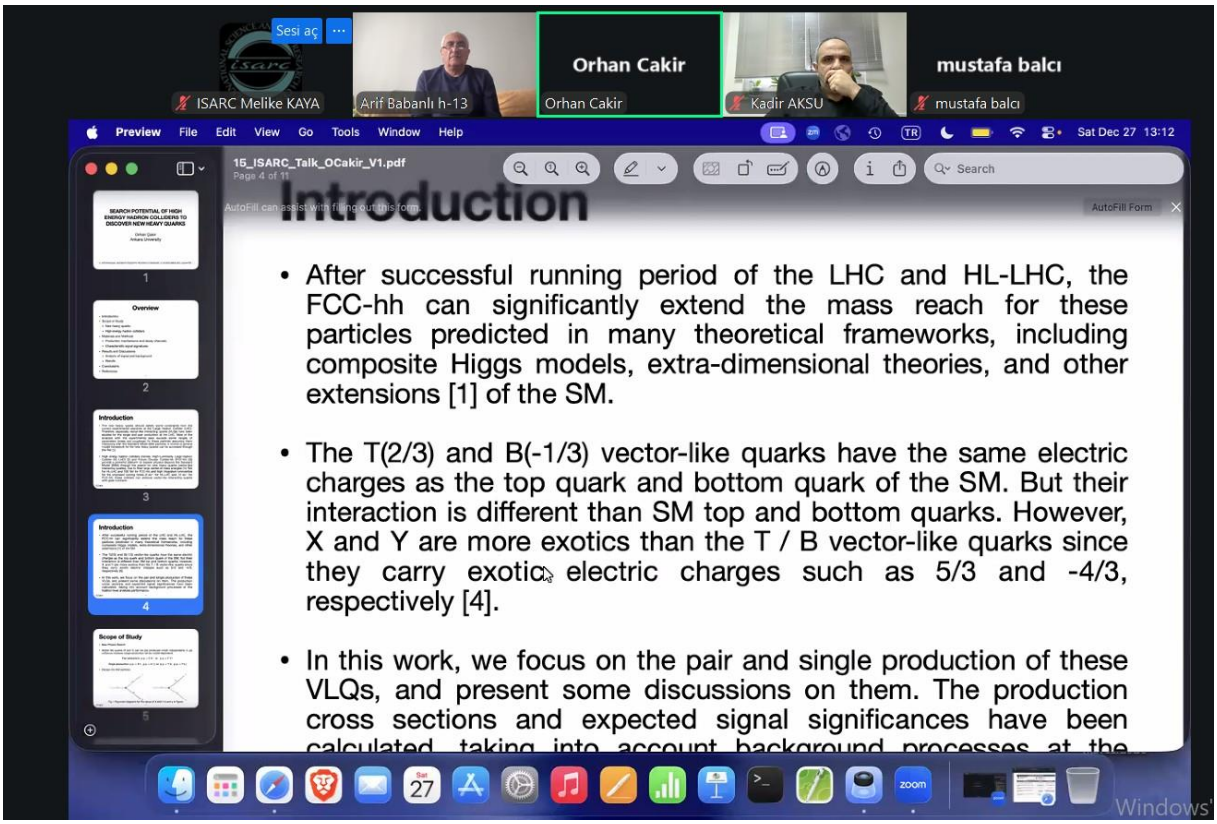

ISARC Melike KAYA
H-8, S 3 Prof. Dr. Songül Ç...
Hall/Salon 8_Dr. Öğr. Üye...
Hall 8-Şeyma Nur Ercan
hall-8, Dr.Rana BAYTİN...
Murat Kaya
TÜRKİYE'NİN AVRUPA BİRLİĞİ TARAFINDAN TESCİL EDİLMİŞ COĞRAFİ İŞARETLİ GIDALARI - PowerPoint
Tescil ve Başvuru Sayıları
Tescil sayısı: 1788
Tescil başvuru sayısı: 866
Not eklemek için tıklayın

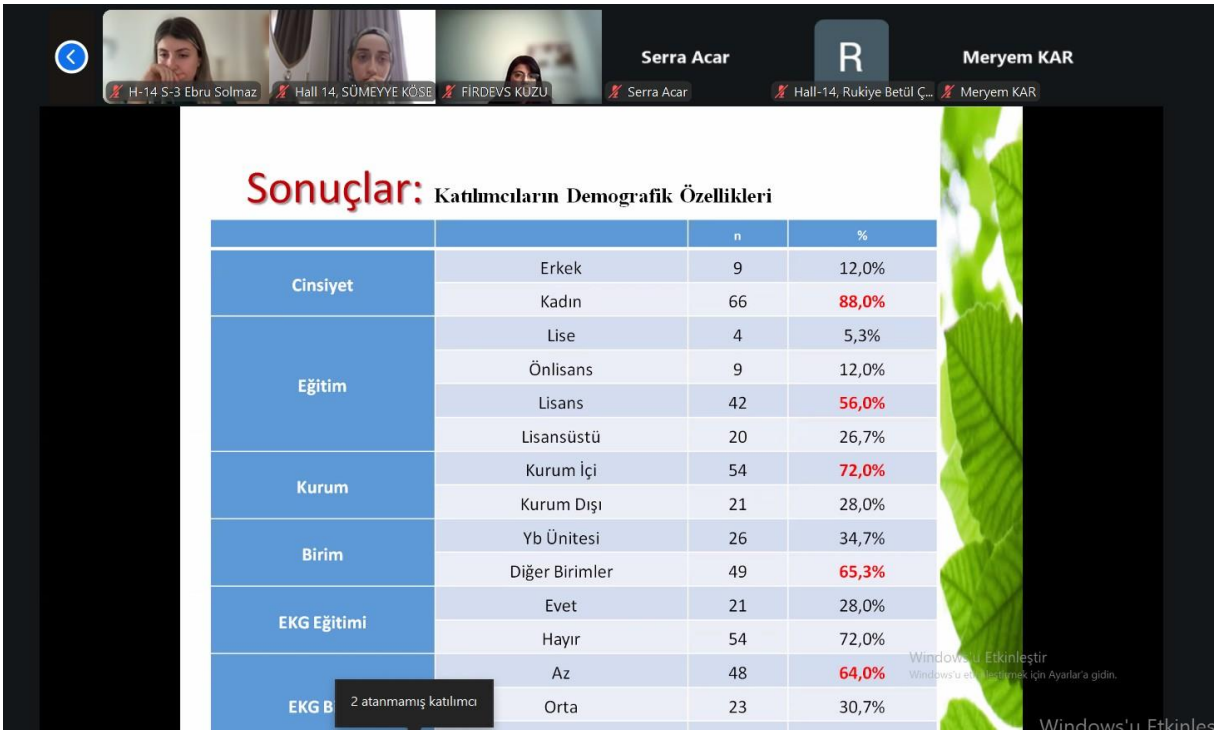

ISARC Melike KAYA
H-9/S-3-Mine KIRKYOL
Hall 9 -Aliye Asikkutlu
HALL-9 Sertan AYTAÇ
Hall-9 Özlem Gündoğ...
Hall 9 -Aliye Asikkutlu

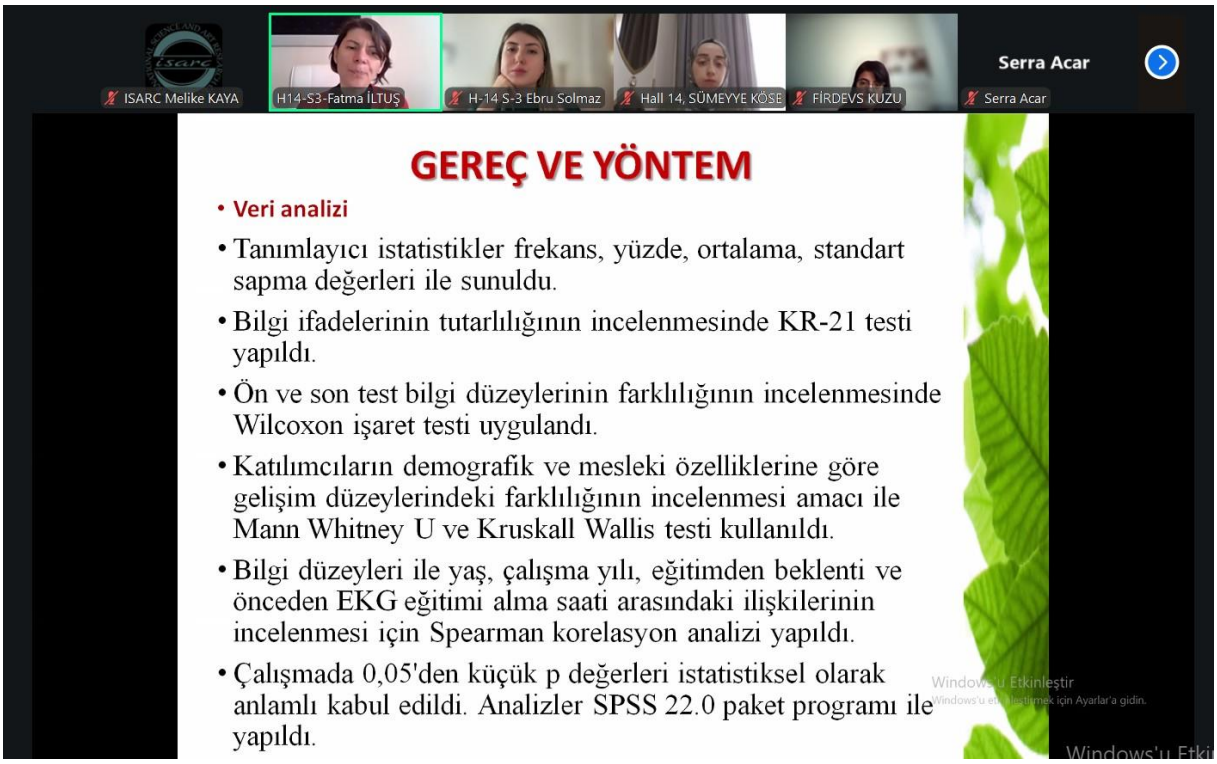

ISARC Melike KAYA
Hall-10, Session-3 Ayhan I...
H-10 Se-3 Dr.Ahmet AKIL
hall-10 session -3
v.ünverdi hall 10
v.ünverdi hall 10
10 atanmamış katılımcı
Hall-10, Session-3 Ayhan Işık

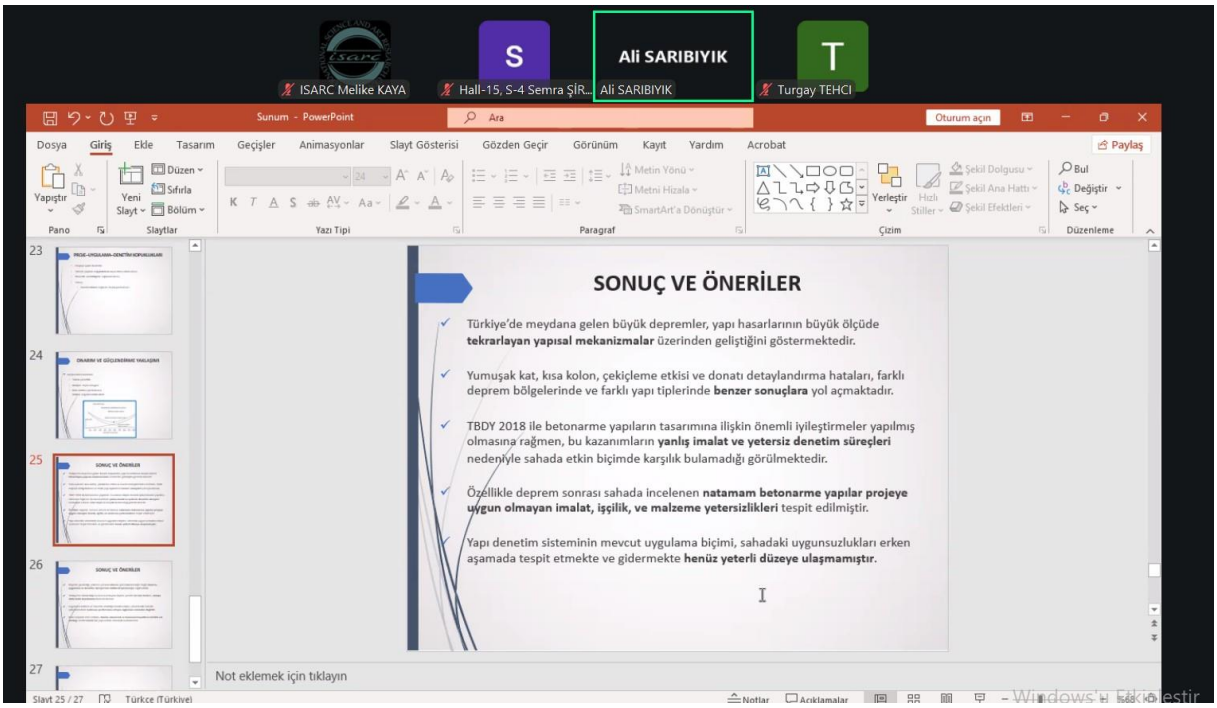

ISARC Melike KAYA
Beyza Bedir- hall11 sessi...
Hall-11,Eda Tür...
Hall-11,Eda Türkyılmaz
H11 S3 Burcu Köse
Serhat Kaya-Hall 11
Hall 11 - İlkay Civelek
15
METOT
IC50
Tuzsuz-500W
134 µg/mL
Tuzsuz-700W
34 µg/mL
Tuzsuz-Demleme
126 µg/mL
NaCl-500W
68 µg/mL
NaCl-700W
89 µg/mL
NaCl-Demleme
194 µg/mL
KCl-500W
159 µg/mL
KCl-700W
89 µg/mL
KCL- Demleme
- Hesaplanamadı
CaCl2-500W
283 µg/mL
CaCl2-700W
162 µg/mL
CaCl2-Demleme
373 µg/mL
IC50 Metotu
• DPPH yöntemi IC50 değerine göre anlamlandırılır. IC50, bir bileşiğin %50 inhibisyon sağladığı konsantrasyon olarak tanımlanır.
• Düşük IC50 değeri, daha az konsantrasyonla %50 inhibisyon sağlandığını ve bileşiğin daha güçlü olduğunu gösterirken; yüksek IC50 değeri, daha fazla madde gerektirdiği için daha düşük etkinliğe işaret eder (9).
11 atanmamış katılımcı
Windows'u Etkinleş

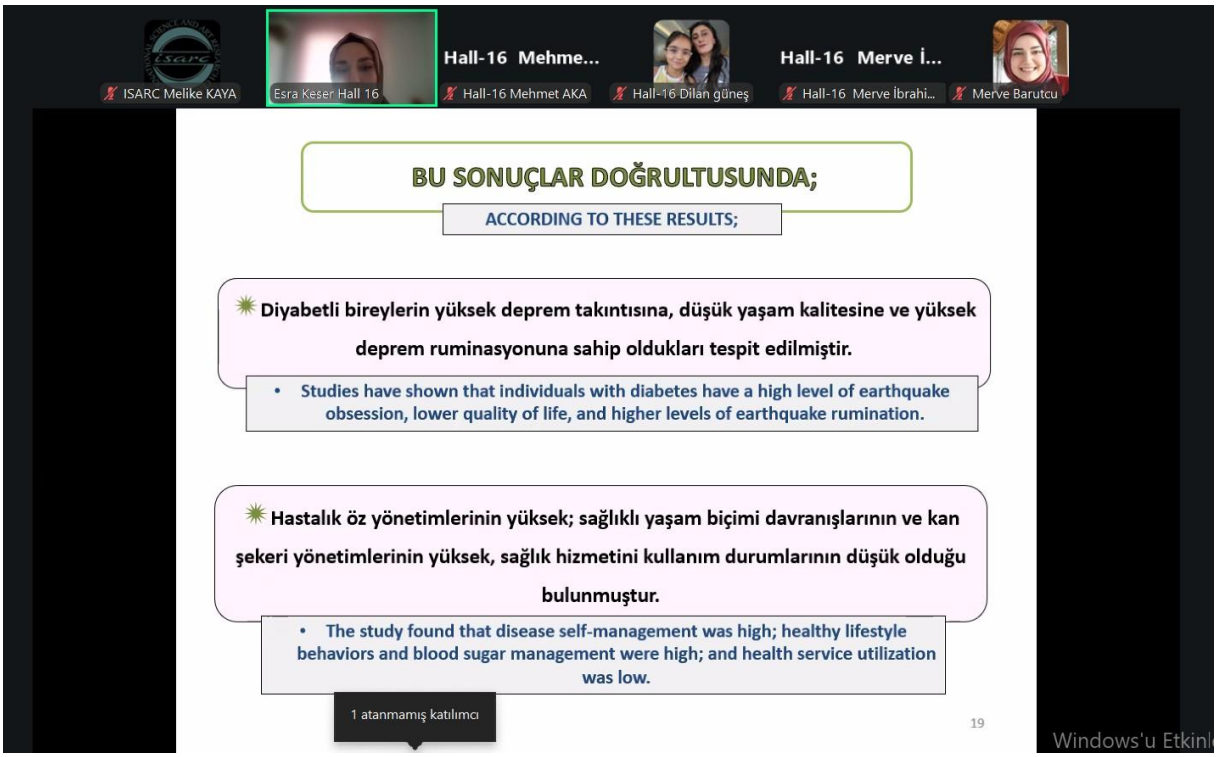

ISARC Melike KAYA
Hall 12 Özge GÜNGÖR
Hall 12 - Kenan Gök
Seyit Ali Güngör Hall-12
Hall12-Büşra Al...
Hall12-Büşra Albayrak ...
GÖREV ÇUBUĞUNU GÖSTER
GÖRÜNTÜ AYARLARI
SLAYT GÖSTERİSİNİ SONLANDIR
0:06:24
13:11
Komet Testi Çalışması
• Flask yüzeyini tam olarak kaplayan HT29 hücreleri, tripsin-EDTA solüsyonu ile yüzeyden ayrıştırılmış ve ardından hücre sayımı yapılmıştır. Hücreler, altışarlı plaklardaki her bir kuyucuğa 2x10⁵ hücre şeklinde eklenerek, %5 CO2 oranına sahip bir inkübatörde 37 °C'de 24 saat
kuyucuklardaki hücrelere LC50 ve LC100 konsantrasyonlarında U. barbata liken ekstraktı ile besiyeri eklenerek yeniden 24 saatlik bir inkübasyon için inkübatöre alınmıştır.
• İnkübasyon süresinin sonunda, U. barbata liken ekstraktı ile işlenmiş hücreler PBS ile seyreltilmiştir. Farklı konsantrasyonlardan alınan örnekler, 1:1 oranında düşük erime noktalı agaroz ile karıştırılmıştır. Elde edilen karışım, önceden yüksek erime noktalı agaroz ile kaplanmış lamlar üzerine sürülmüş ve donmadan önce lameller ile kapatılmıştır.
Karanlıkta YOBU Başarıya
Slayt 10/20
Sonraki slayt
Şimdi bir ara odasındasınız
Not eklemek için tıklayın

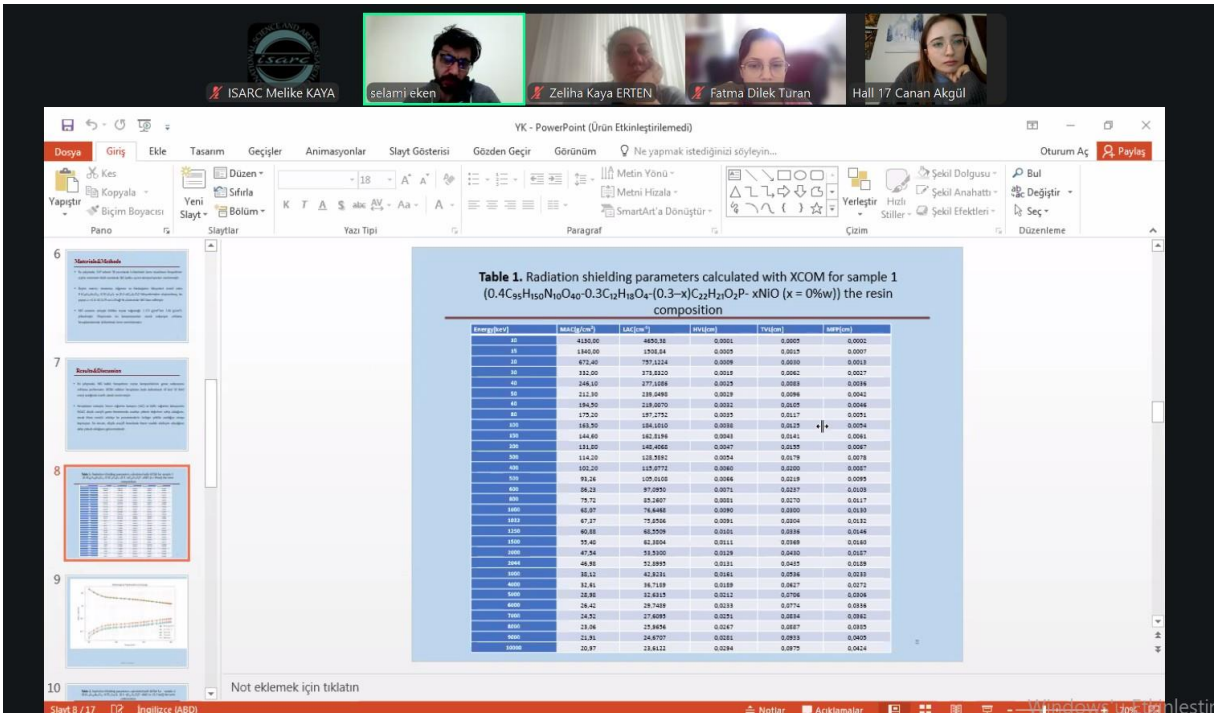

Sesi aç
ISARC Melike KAYA
Arif Babanlı h-13
Orhan Cakir
Orhan Cakir
Kadir AKSU
mustafa balcı
mustafa balcı
Preview File Edit View Go Tools Window Help
Sat Dec 27 13:12
15_ISARC_Talk_OCakir_V1.pdf
Page 4 of 11
Search
AutoFill can assist with filling out this form.
AutoFill Form
Introduction
• After successful running period of the LHC and HL-LHC, the FCC-hh can significantly extend the mass reach for these particles predicted in many theoretical frameworks, including composite Higgs models, extra-dimensional theories, and other extensions [1] of the SM.
• The T(2/3) and B(-1/3) vector-like quarks have the same electric charges as the top quark and bottom quark of the SM. But their interaction is different than SM top and bottom quarks. However, X and Y are more exotics than the T / B vector-like quarks since they carry exotic electric charges such as 5/3 and -4/3, respectively [4].
• In this work, we focus on the pair and single production of these VLQs, and present some discussions on them. The production cross sections and expected signal significances have been calculated, taking into account background processes at the
Windows'


H-14 S-3 Ebru Solmaz
Hall 14, SÜMEYYE KÖSE
FİRDEVS KUZU
Serra Acar
Serra Acar
Hall-14, Rukiye Betül Ç...
Meryem KAR
Meryem KAR
Sonuçlar: Katılımcıların Demografik Özellikleri
n
%
Cinsiyet
Erkek 9 12,0%
Kadın 66 88,0%
Eğitim
Lise 4 5,3%
Önlisans 9 12,0%
Lisans 42 56,0%
Lisansüstü 20 26,7%
Kurum
Kurum İçi 54 72,0%
Kurum Dışı 21 28,0%
Birim
Yb Ünitesi 26 34,7%
Diğer Birimler 49 65,3%
EKG Eğitimi
Evet 21 28,0%
Hayır 54 72,0%
Az 48 64,0%
EKG B
Orta 23 30,7%
2 atanmamış katılımcı
Windows'u Etkinleştir
Windows'u etkinleştirmek için Ayarlar'a gidin.
Windows'u Etkinles


ISARC Melike KAYA
H14-S3-Fatma İLTUŞ
H-14 S-3 Ebru Solmaz
Hall 14, SÜMEYYE KÖSE
FİRDEVS KUZU
Serra Acar
Serra Acar
GEREÇ VE YÖNTEM
• Veri analizi
• Tanımlayıcı istatistikler frekans, yüzde, ortalama, standart sapma değerleri ile sunuldu.
• Bilgi ifadelerinin tutarlılığının incelenmesinde KR-21 testi yapıldı.
• Ön ve son test bilgi düzeylerinin farklılığının incelenmesinde Wilcoxon işaret testi uygulandı.
• Katılımcıların demografik ve mesleki özelliklerine göre gelişim düzeylerindeki farklılığının incelenmesi amacı ile Mann Whitney U ve Kruskall Wallis testi kullanıldı.
• Bilgi düzeyleri ile yaş, çalışma yılı, eğitimden beklenti ve önceden EKG eğitimi alma saati arasındaki ilişkilerinin incelenmesi için Spearman korelasyon analizi yapıldı.
• Çalışmada 0,05'den küçük p değerleri istatistiksel olarak anlamlı kabul edildi. Analizler SPSS 22.0 paket programı ile yapıldı.
Windows'u Etkinleştir


ISARC Melike KAYA
Hall-15, S-4 Semra ŞİR...
Ali SARIBIYIK
Ali SARIBIYIK
Turgay TEHCI
Sunum - PowerPoint
SONUÇ VE ÖNERİLER
Türkiye'de meydana gelen büyük depremler, yapı hasarlarının büyük ölçüde tekrarlayan yapısal mekanizmalar üzerinden geliştiğini göstermektedir.
Yumuşak kat, kısa kolon, çekiçleme etkisi ve donatı detaylandırma hataları, farklı deprem bölgelerinde ve farklı yapı tiplerinde benzer sonuçlara yol açmaktadır.
TBDY 2018 ile betonarme yapıların tasarımına ilişkin önemli iyileştirmeler yapılmış olmasına rağmen, bu kazanımların yanlış imalat ve yetersiz denetim süreçleri nedeniyle sahada etkin biçimde karşılık bulamadığı görülmektedir.
Özellikle deprem sonrası sahada incelenen natamam betonarme yapılar projeye uygun olmayan imalat, işçilik, ve malzeme yetersizlikleri tespit edilmiştir.
Yapı denetim sisteminin mevcut uygulama biçimi, sahadaki uygunsuzlukları erken aşamada tespit etmekte ve gidermekte henüz yeterli düzeye ulaşmamıştır.
Not eklemek için tıklayın
Windows'u Etkinleştir


ISARC Melike KAYA
Esra Keser Hall 16
Hall-16 Mehme...
Hall-16 Mehmet AKA
Hall-16 Dilan güneş
Hall-16 Merve İ...
Hall-16 Merve İbrahi...
Merve Barutcu
BU SONUÇLAR DOĞRULTUSUNDA;
ACCORDING TO THESE RESULTS;
Diyabetli bireylerin yüksek deprem takıntısına, düşük yaşam kalitesine ve yüksek deprem ruminasyonuna sahip oldukları tespit edilmiştir.
• Studies have shown that individuals with diabetes have a high level of earthquake obsession, lower quality of life, and higher levels of earthquake rumination.
Hastalık öz yönetimlerinin yüksek; sağlıklı yaşam biçimi davranışlarının ve kan şekeri yönetimlerinin yüksek, sağlık hizmetini kullanım durumlarının düşük olduğu bulunmuştur.
• The study found that disease self-management was high; healthy lifestyle behaviors and blood sugar management were high; and health service utilization was low.
1 atanmamış katılımcı
19
Windows'u Etkinl


ISARC Melike KAYA
selami eken
Zeliha Kaya ERTEN
Fatma Dilek Turan
Hall 17 Canan Akgül
YK - PowerPoint (Ürün Etkinleştirilemedi)
Table 1. Radiation shielding parameters calculated with XCOM for sample 1 (0.4C95H150N10O40-0.3C12H18O4-(0.3–x)C22H21O2P- xNiO (x = 0%w)) the resin composition
Not eklemek için tıklatın

ISARC Melike KAYA | Hall-18, Zehra MERİÇ | Hall-18, Arzu KARABA... | Maşide HURMANLI | AYDIN SEVER | HALL-17 ECE ALAGÖZ

CONCLUSION

Cancer is a complex disease that affects the physical, psychological and social living areas of individuals in a multidimensional way. The management of the disease is not limited to medical treatment applications; It requires comprehensive and holistic care approaches in order to effectively control symptoms and improve quality of life. Fatigue, which is frequently observed in cancer patients, is directly related to the progression of the disease and the side effects of the treatments applied; This situation negatively affects patients' daily living activities and general well-being.

1 atanmamış katılımcı

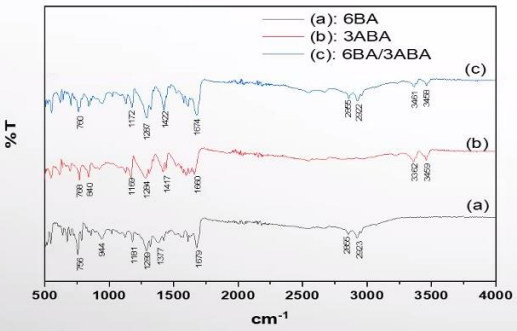
karabag.aydin@gmail.com

19

Windows'u Etkinl

ISARC Melike KAYA | Hall-19 Beyza NACAR | Hall-19 Zafer EKER | Hamdi DAĞISTANLI H... | Kadir Sinan Aslan, Hall... | Büşra Aydan Durak, Ha...

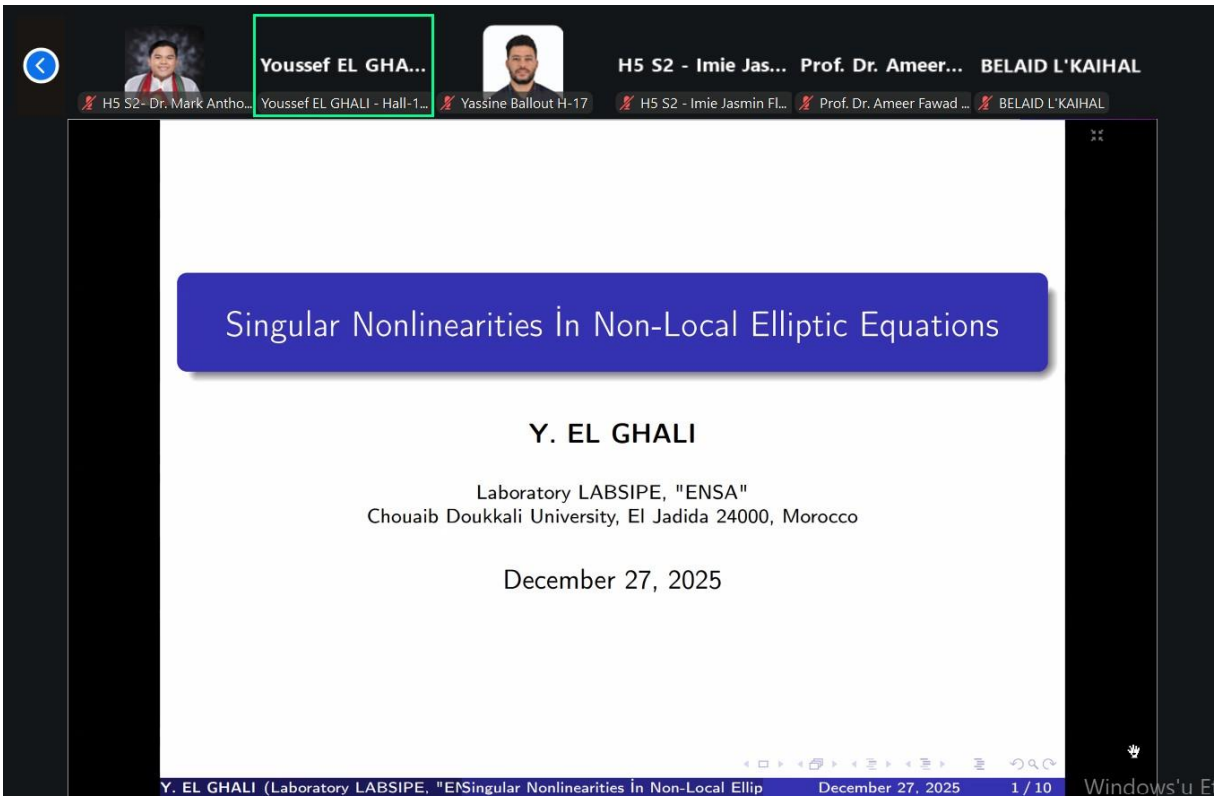
FTIR ANALİZİ

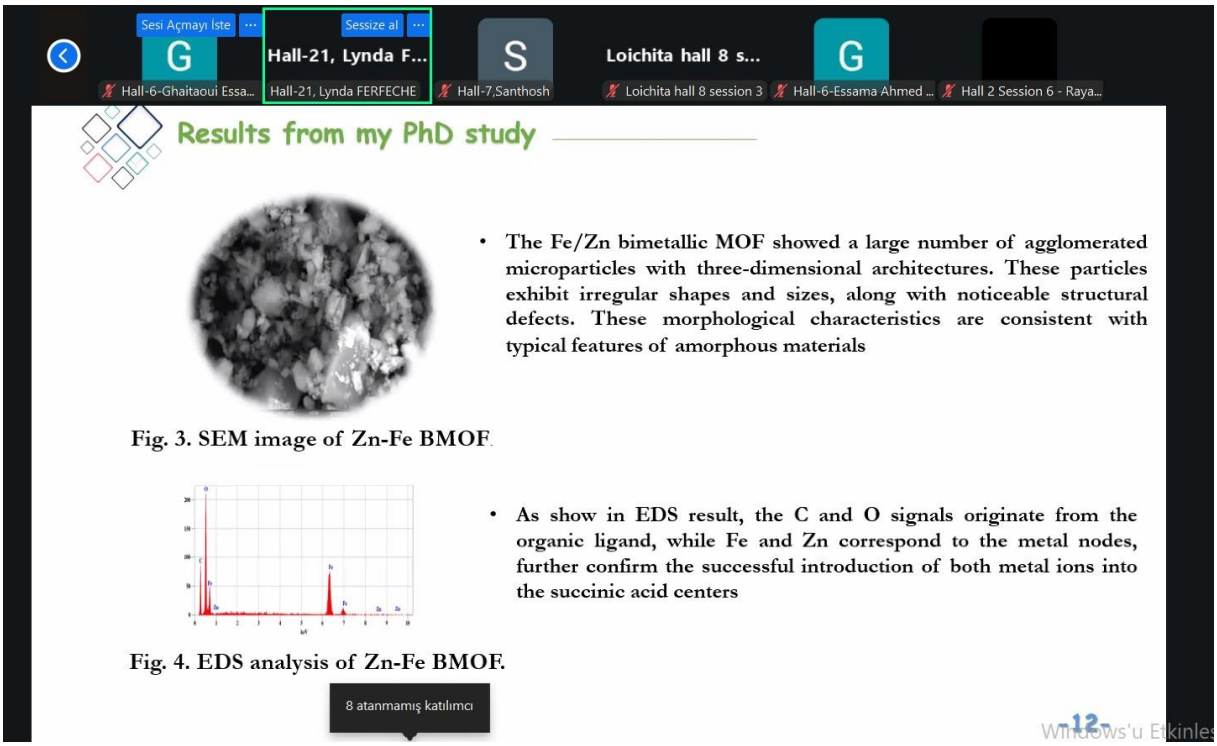


Şekil 3. Saf bileşenlerin ve ikili karışım kompleksinin FTIR spektrumları; (a): 6BA, (b): 3ABA, (c): 6BA/3ABA.

Saf 6BA, 3ABA ve 6BA/3ABA ikili karışımının FTIR spektrumları karşılaştırıldığında, karakteristik bağların piklerinin korunduğu, ancak bazı pik kaymalarının ve yeni etkileşimlerin ortaya çıktığı gözlemlenmektedir. Bu, 6BA/3ABA ikili karışımında molekül içi bağ yapılarının korunduğunu ve pik kaymalarının ve yeni pik oluşumlarının moleküller arası hidrojen bağlarının oluşumunu gösterdiğini belirtmektedir.


Hall-19 Zafer EKER
Hamdi DAĞISTANLI H...
Kadir Sinan Asla...
Kadir Sinan Aslan, Hall...
Büşra Avdan Durak, Ha...
Fatma Ağ Hall-19
H-19, BENHAR...
H-19, BENHARAF EL M...
POM ANALİZİ
(a)
(b)
(c)
(d)
(e)
(f)
20 um
Şekil 2. 6BA/3ABA ikili karışım kompleksinin sürekli ısıtılması ve soğutulması sırasında gözlemlenen POM görüntüleri; (a): kristal, (b): smektik C, (c): nematik, (d): nematik-izotropik faz geçişi, (e): nematik, (f): smektik C.
6BA/3ABA karışım kompleksinin mezofaz dokuları hem ısıtma hem de soğutma sırasında kristal, smektik C, nematik ve izotropik yapılar sergilemektedir. Sürekli ısıtma sırasında, kristal fazdan smektik C fazına geçiş sıcaklığı yaklaşık 92 °C'de, smektik C fazından nematik faza geçiş yaklaşık 103 °C'de ve nematik fazdan izotropik faza geçiş yaklaşık 157 °C'de gözlemlenmiştir. Sürekli soğutma sırasında, izotropik fazdan nematik faza geçiş yaklaşık 151 °C'de, ardından yaklaşık 96 °C'de nematik-smektik C faz geçişi ve son olarak yaklaşık 78 °C'de smektik C fazından kristal faza geçiş meydana geldi. Ayrıca, POM analizinden elde edilen sonuçlar, DSC ölçümlerinden elde edilen sonuçlarla iyi bir uyum içindedir.


H5 S2- Dr. Mark Antho...
Youssef EL GHA...
Youssef EL GHALI - Hall-1...
Yassine Ballout H-17
H5 S2 - Imie Jas... Prof. Dr. Ameer... BELAID L'KAIHAL
H5 S2 - Imie Jasmin Fl...
Prof. Dr. Ameer Fawad ...
BELAID L'KAIHAL
Singular Nonlinearities İn Non-Local Elliptic Equations
Y. EL GHALI
Laboratory LABSIPE, "ENSA"
Chouaib Doukkali University, El Jadida 24000, Morocco
December 27, 2025
Y. EL GHALI (Laboratory LABSIPE, "EN
Singular Nonlinearities İn Non-Local Ellip
December 27, 2025
1 / 10


Sesi Açmayı İste
Sessize al
Hall-21, Lynda F...
Hall-21, Lynda FERFECHE
Hall-7,Santhosh
Loichita hall 8 s...
Loichita hall 8 session 3
Hall-6-Essama Ahmed ...
Hall 2 Session 6 - Raya...
Hall-6-Ghaitaoui Essa...
Results from my PhD study
• The Fe/Zn bimetallic MOF showed a large number of agglomerated microparticles with three-dimensional architectures. These particles exhibit irregular shapes and sizes, along with noticeable structural defects. These morphological characteristics are consistent with typical features of amorphous materials
Fig. 3. SEM image of Zn-Fe BMOF
• As show in EDS result, the C and O signals originate from the organic ligand, while Fe and Zn correspond to the metal nodes, further confirm the successful introduction of both metal ions into the succinic acid centers
Fig. 4. EDS analysis of Zn-Fe BMOF.
8 atanmamış katılımcı
-12-
Windows'u Etkinles


Hall-8, Session -...
Hall-8, Session -3 -Ger...
Hall 27, Session 11- Hi...
Hall-8 session 8,...
Hall-8 session 8, PROF...
Samsung SM-A...
Samsung SM-A135F
Ss-6, Hall-1, Ho...
Ss-6, Hall-1, Ho Son DAI
Rahmouni hanane hall7
Ara odalar - Devam Ediyor
Odalar (30)
Hall 27, Session 11- Hilyatul Jannah
Hall-22 CHAIMAA ELABBARI
Hall-8 session 8, PROF AMZILE Rajaa
Hall-8, Session -3 -Gergana Gozanska
ISARC Melike KAYA
Rahmouni hanane hall7
Samsung SM-A135F
Ss-6, Hall-1, Ho Son DAI
Oda 1
Oda 2
Oda 3
Seçenekler
Bir sonraki oturumu planla
Ss-6, Hall-1, Ho.
Ss-6, Hall-1, Ho Son DAI
Windows'u Etkinles

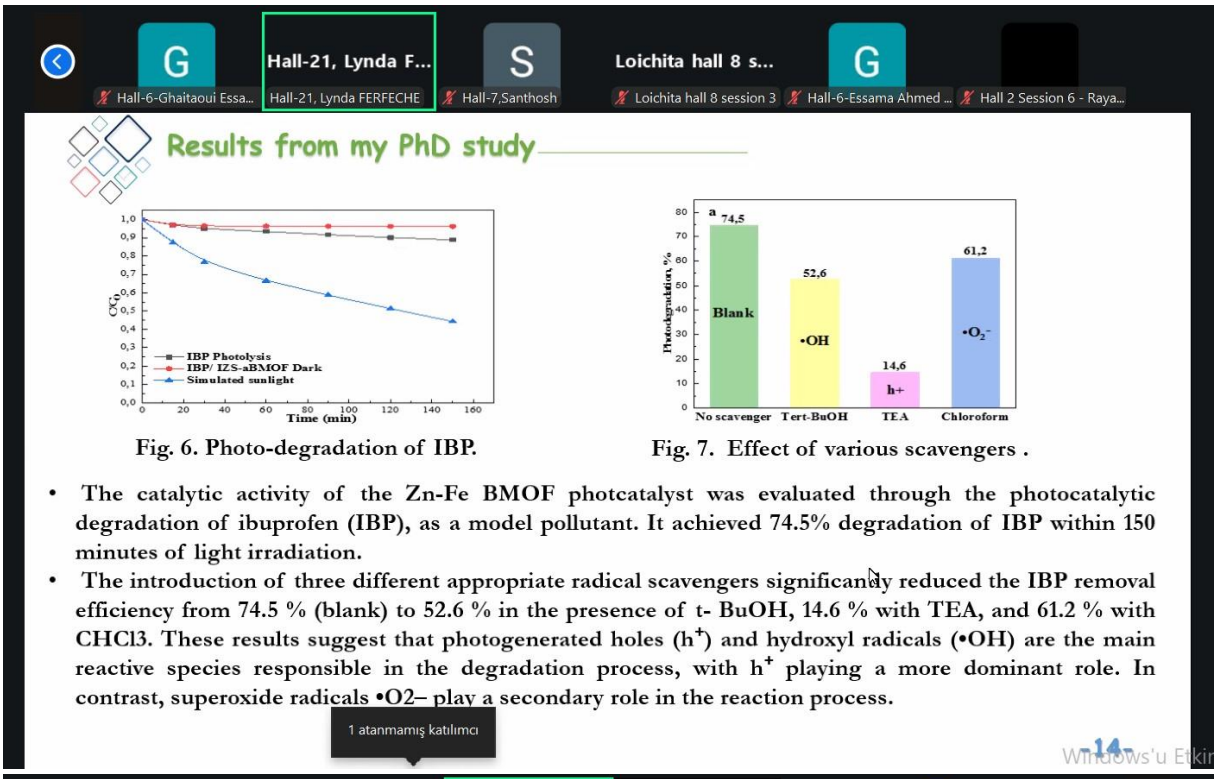
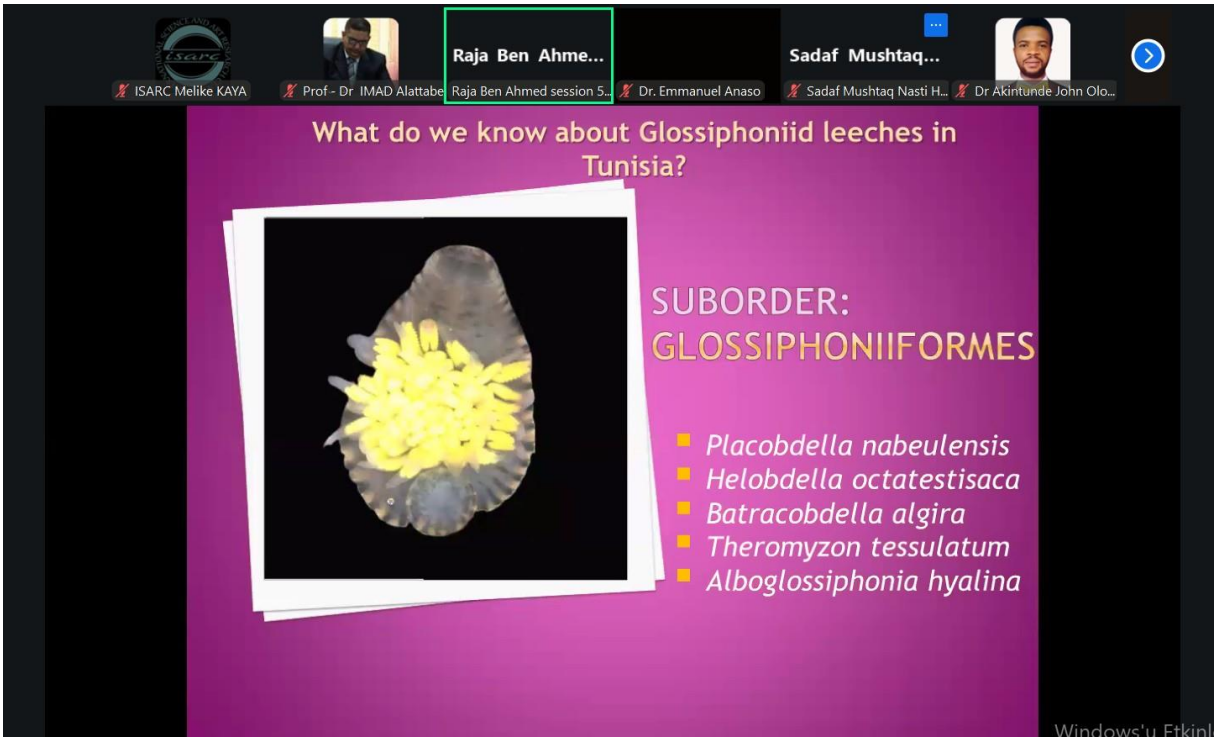


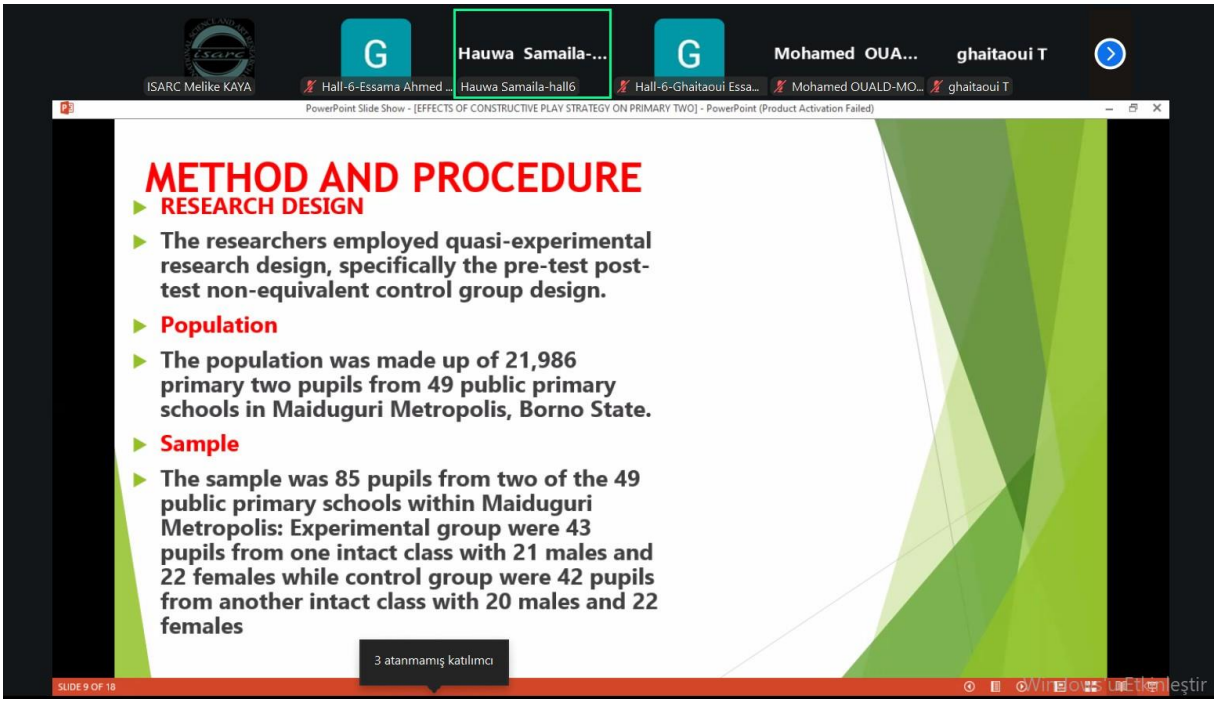
Fig. 6. Photo-degradation of IBP.

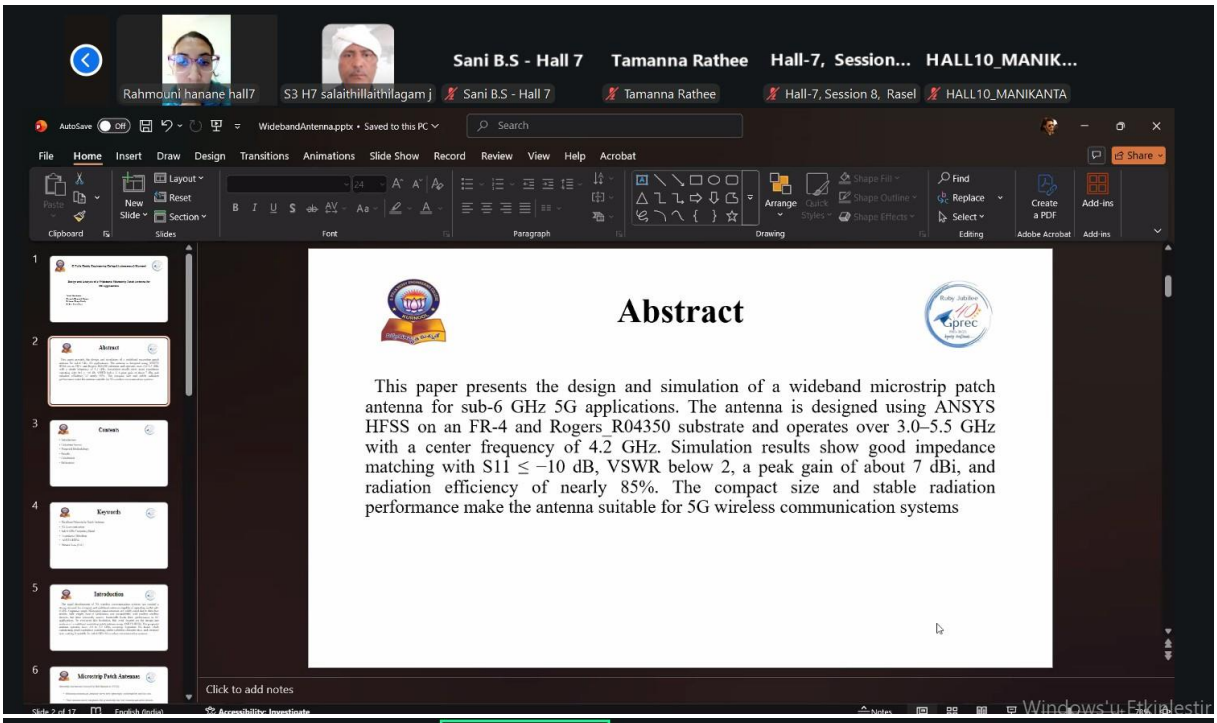
Fig. 7. Effect of various scavengers .

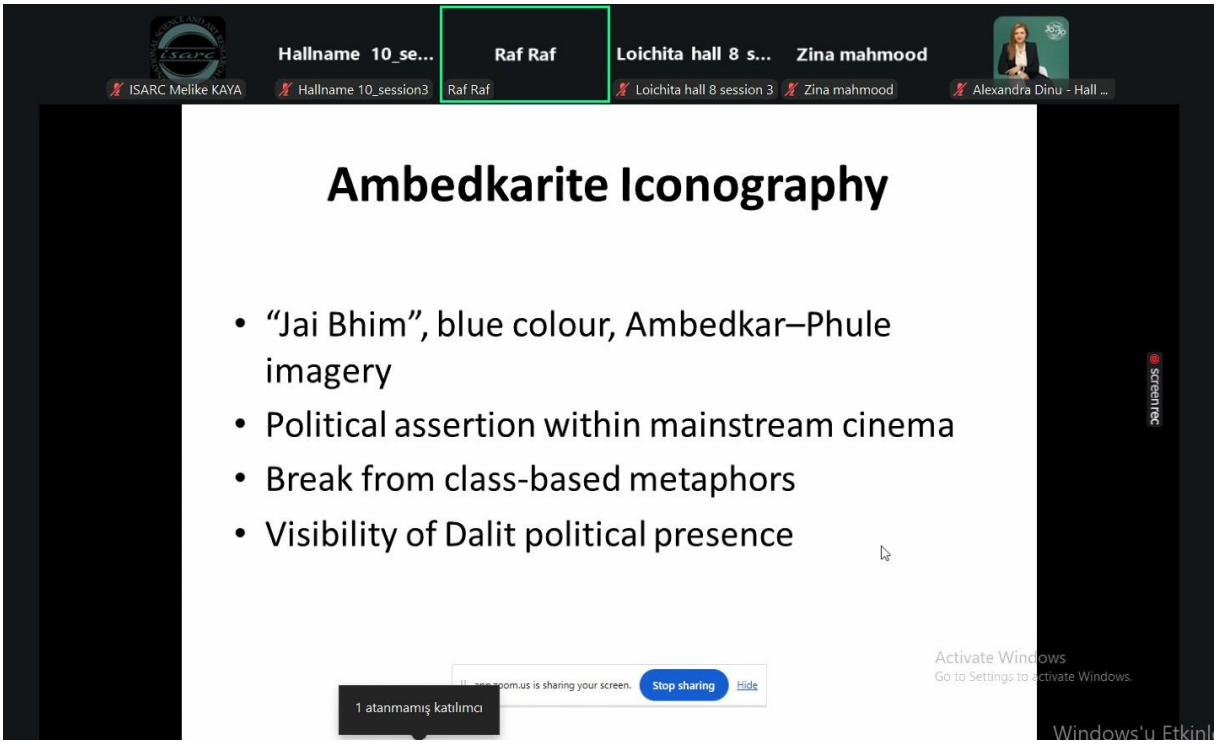
- The catalytic activity of the Zn-Fe BMOF photcatalyst was evaluated through the photocatalytic degradation of ibuprofen (IBP), as a model pollutant. It achieved 74.5% degradation of IBP within 150 minutes of light irradiation.
- The introduction of three different appropriate radical scavengers significantly reduced the IBP removal efficiency from 74.5 % (blank) to 52.6 % in the presence of t- BuOH, 14.6 % with TEA, and 61.2 % with CHCl3. These results suggest that photogenerated holes (h^+) and hydroxyl radicals (•OH) are the main reactive species responsible in the degradation process, with h^+ playing a more dominant role. In contrast, superoxide radicals •O2– play a secondary role in the reaction process.

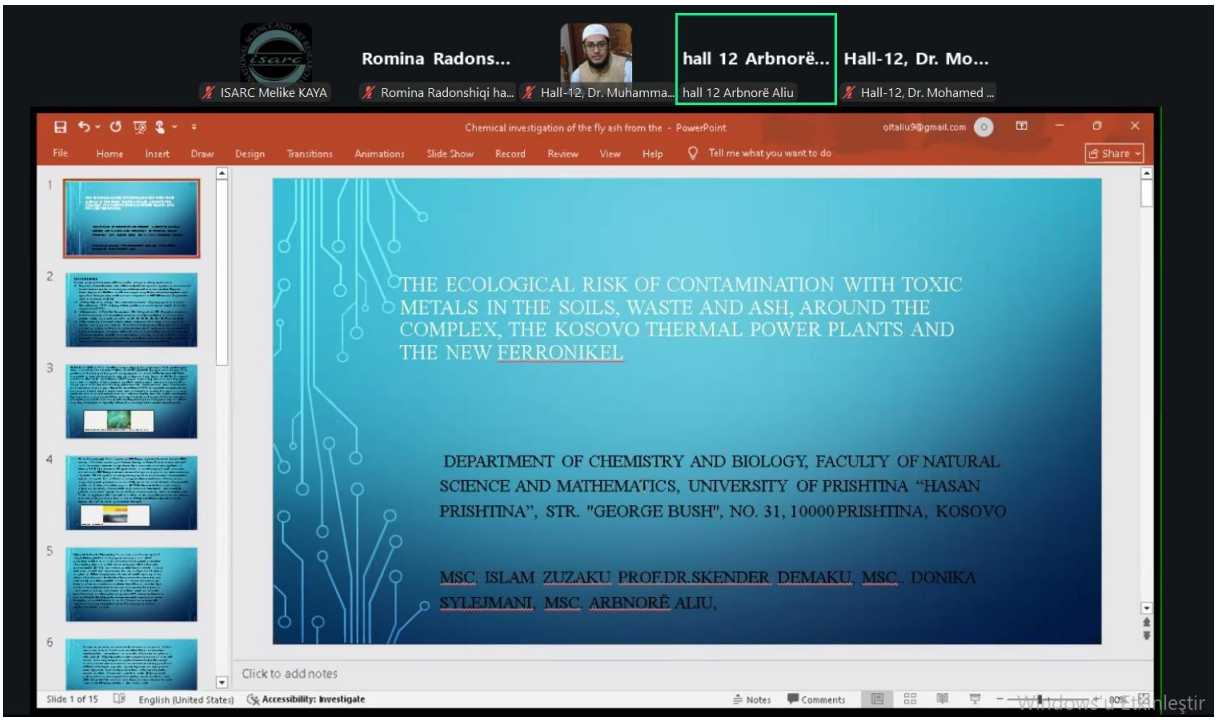


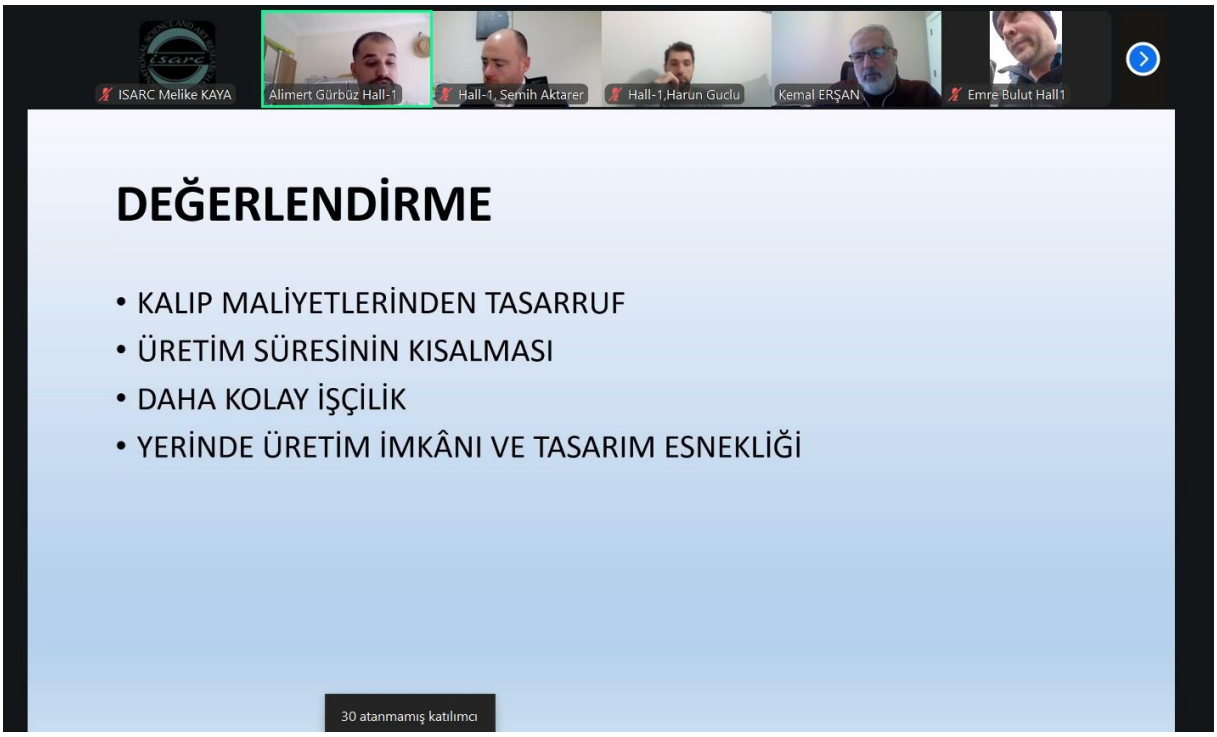

Mulikat Folasha...
Hall-6 , Maria El...
HALL-4 -Dr.Raja...
ISARC Melike KAYA
Mulikat Folashade Us...
Hall-6 , Maria El ansari
HALL-4 -Dr.Rajani Indr...
UNIVERSITÉ MOULAY ISMAÏL
FACULTÉ DES SCIENCES
5th GAZIANTEP INTERNATIONAL SCIENTIFIC RESEARCH CONGRESS
December 27-28, 2025
Ethnobotanical Diversity of Medicinal Plants in Rural Communities of Rissani, Morocco
Maria EL ANSARI[1]*, Mariame NAJEM[2], Khalid BOURAADA[3], Jamal IBIJBIJEN[1], Laila NASSIRI[1]
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[2]Laboratory of Drug Sciences, Faculty of Medicine, Pharmacy and Dentistry, Sidi Mohamed Ben Abdellah University, Fez, Morocco"
[3]Laboratory of natural Resources and Sustainable Development Economics Research, Abdelmalek Essaadi University, Polydisciplinary Faculty of Larache, Morocco.
01


ISARC Melike KAYA
Hall-6-Essama Ahmed ...
Hauwa Samaila-...
Hauwa Samaila-hall6
Hall-6-Ghaitaoui Essa...
Mohamed OUA...
Mohamed OUALD-MO...
ghaitaoui T
ghaitaoui T
PowerPoint Slide Show - [EFFECTS OF CONSTRUCTIVE PLAY STRATEGY ON PRIMARY TWO] - PowerPoint (Product Activation Failed)
METHOD AND PROCEDURE
RESEARCH DESIGN
The researchers employed quasi-experimental research design, specifically the pre-test post-test non-equivalent control group design.
Population
The population was made up of 21,986 primary two pupils from 49 public primary schools in Maiduguri Metropolis, Borno State.
Sample
The sample was 85 pupils from two of the 49 public primary schools within Maiduguri Metropolis: Experimental group were 43 pupils from one intact class with 21 males and 22 females while control group were 42 pupils from another intact class with 20 males and 22 females
3 atanmamış katılımcı
SLIDE 9 OF 18

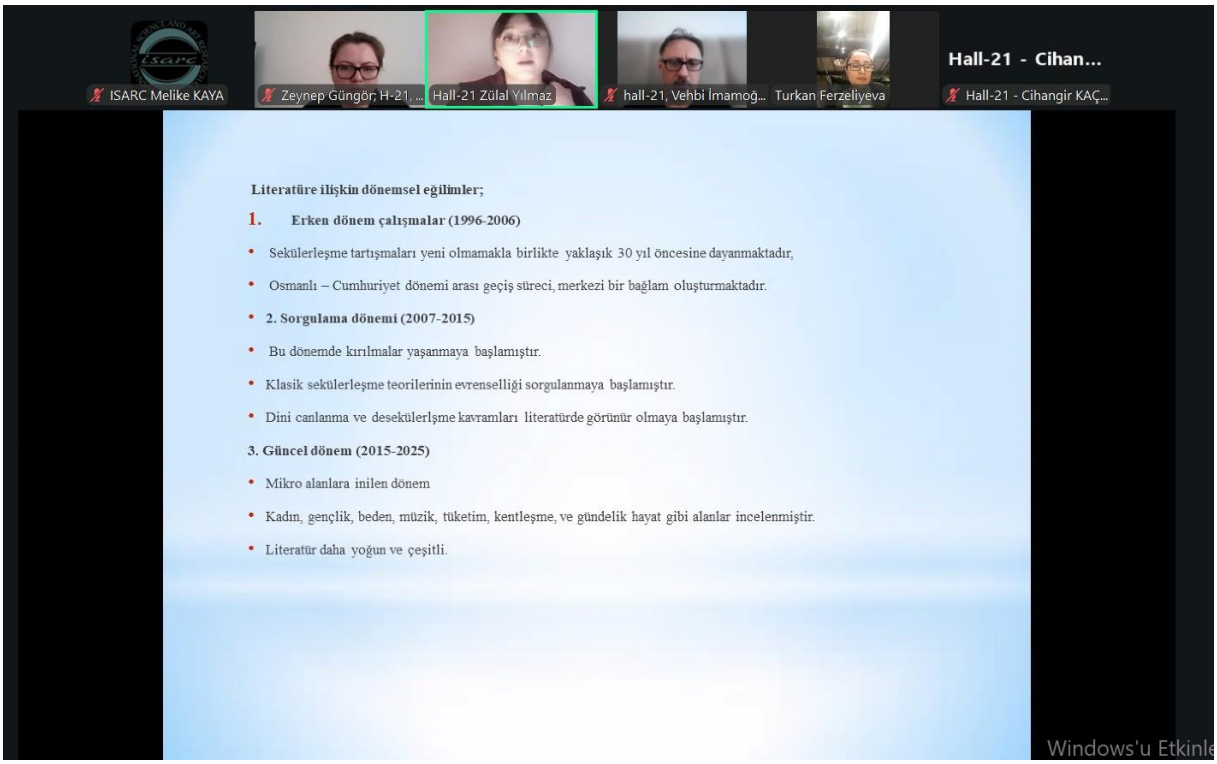

Sani B.S - Hall 7
Tamanna Rathee
Hall-7, Session...
HALL10_MANIK...
Rahmouni hanane hall7
S3 H7 salaithillaithilagam j
Sani B.S - Hall 7
Tamanna Rathee
Hall-7, Session 8, Rasel
HALL10_MANIKANTA
Abstract
This paper presents the design and simulation of a wideband microstrip patch antenna for sub-6 GHz 5G applications. The antenna is designed using ANSYS HFSS on an FR-4 and Rogers_R04350 substrate and operates over 3.0–5.5 GHz with a center frequency of 4.2 GHz. Simulation results show good impedance matching with S11 ≤ −10 dB, VSWR below 2, a peak gain of about 7 dBi, and radiation efficiency of nearly 85%. The compact size and stable radiation performance make the antenna suitable for 5G wireless communication systems
Click to add notes

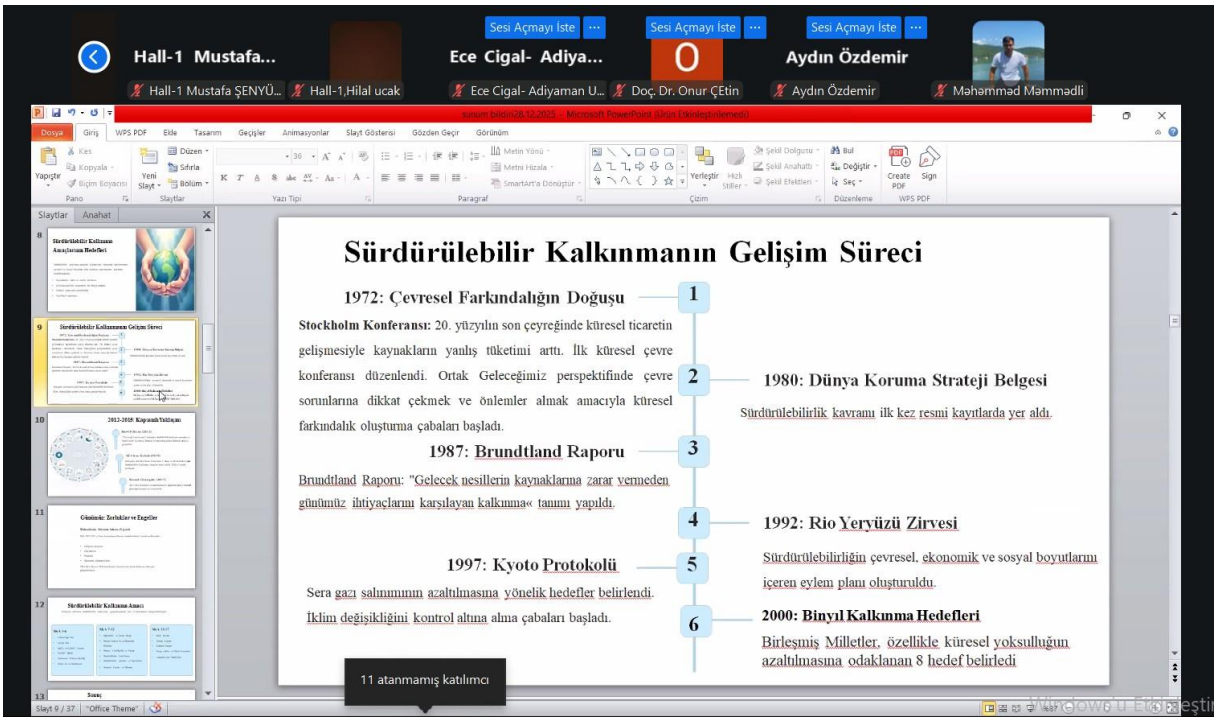

Hallname 10_se...
Raf Raf
Loichita hall 8 s...
Zina mahmood
ISARC Melike KAYA
Hallname 10_session3
Raf Raf
Loichita hall 8 session 3
Zina mahmood
Alexandra Dinu - Hall ...
Ambedkarite Iconography
• "Jai Bhim", blue colour, Ambedkar–Phule imagery
• Political assertion within mainstream cinema
• Break from class-based metaphors
• Visibility of Dalit political presence
Stop sharing
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1 atanmamış katılımcı

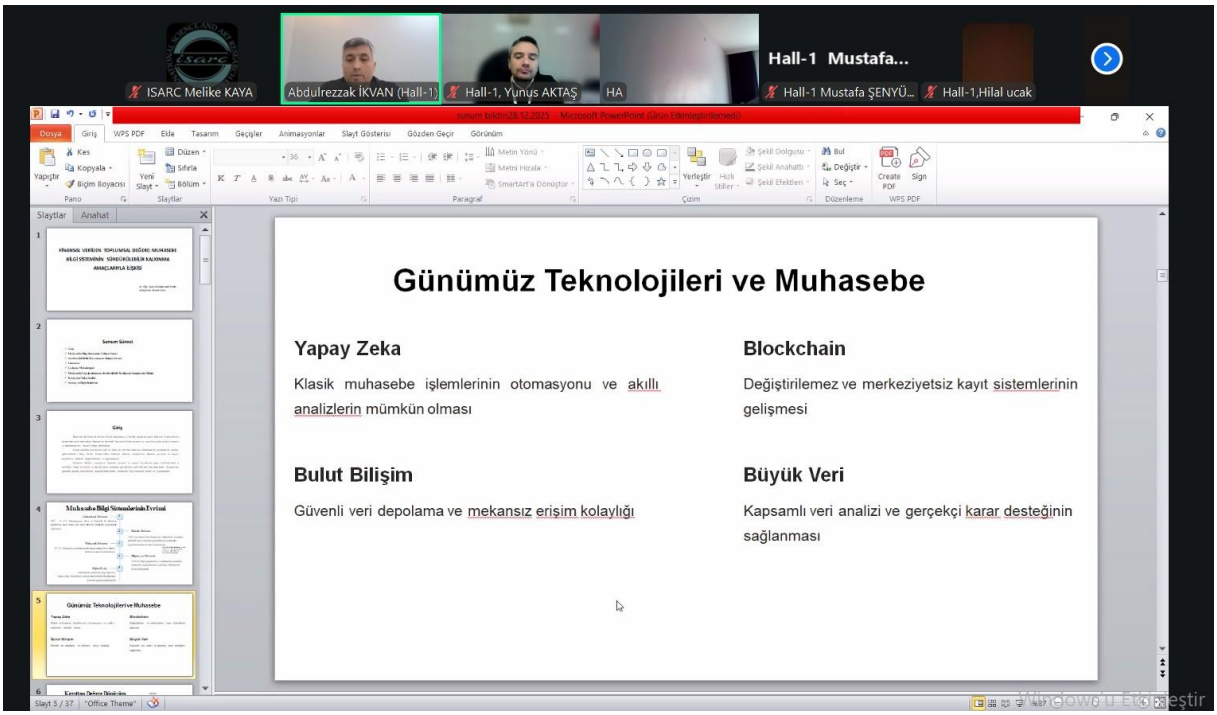

Romina Radons...
hall 12 Arbnorë...
Hall-12, Dr. Mo...
ISARC Melike KAYA
Romina Radonshiqi ha...
Hall-12, Dr. Muhamma...
hall 12 Arbnorë Aliu
Hall-12, Dr. Mohamed ...
Chemical investigation of the fly ash from the - PowerPoint
THE ECOLOGICAL RISK OF CONTAMINATION WITH TOXIC METALS IN THE SOILS, WASTE AND ASH, AROUND THE COMPLEX, THE KOSOVO THERMAL POWER PLANTS AND THE NEW FERRONIKEL
DEPARTMENT OF CHEMISTRY AND BIOLOGY, FACULTY OF NATURAL SCIENCE AND MATHEMATICS, UNIVERSITY OF PRISHTINA "HASAN PRISHTINA", STR. "GEORGE BUSH", NO. 31, 10000 PRISHTINA, KOSOVO
MSC. ISLAM ZUZAKU PROF.DR.SKENDER DEMAKU, MSC. DONIKA SYLEJMANI, MSC. ARBNORË ALIU,
Click to add notes

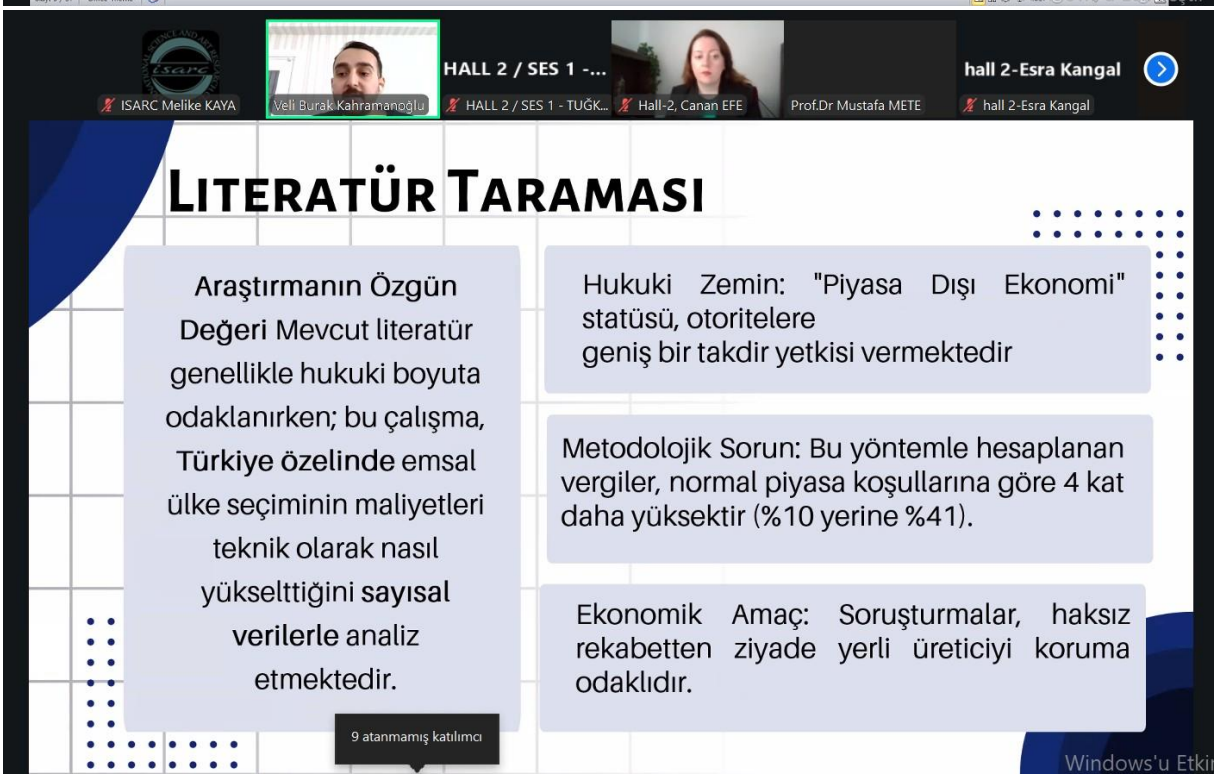

ISARC Melike KAYA
Alimert Gürbüz Hall-1
Hall-1, Semih Aktarer
Hall-1,Harun Guclu
Kemal ERŞAN
Emre Bulut Hall1
DEĞERLENDİRME
• KALIP MALİYETLERİNDEN TASARRUF
• ÜRETİM SÜRESİNİN KISALMASI
• DAHA KOLAY İŞÇİLİK
• YERİNDE ÜRETİM İMKÂNI VE TASARIM ESNEKLİĞİ
30 atanmamış katılımcı

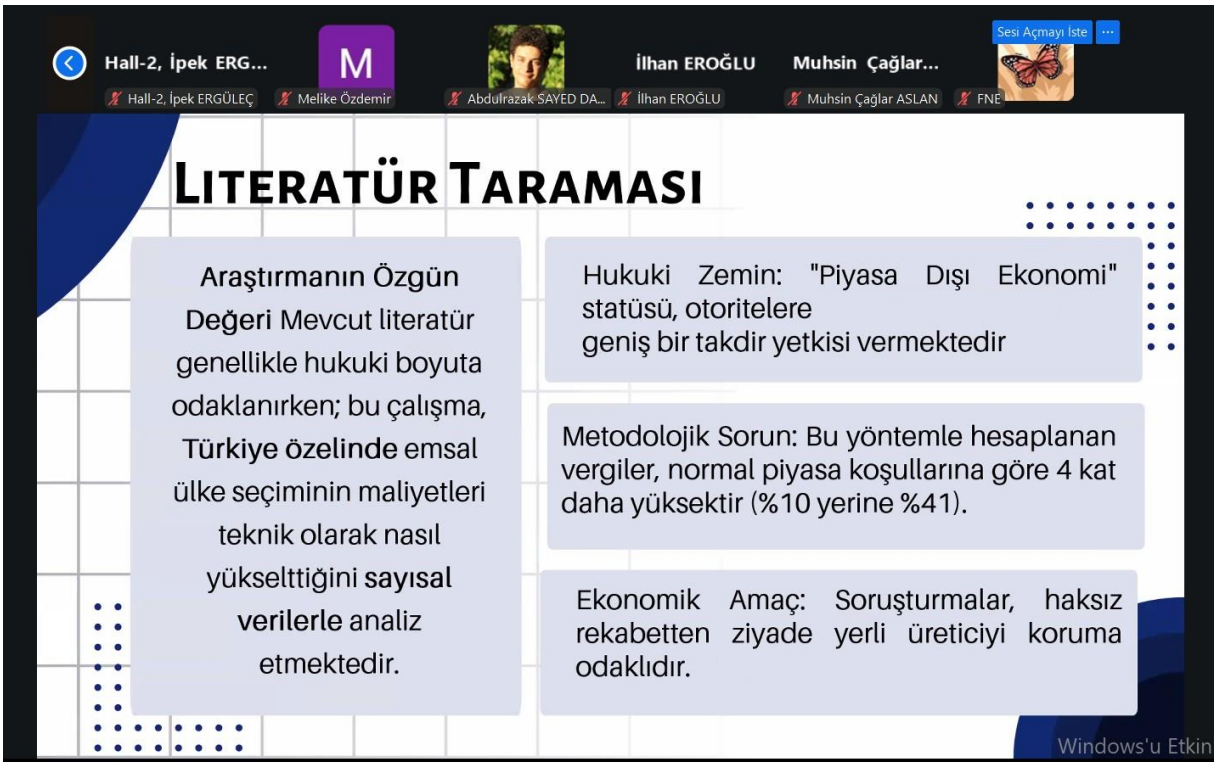

ISARC Melike KAYA
Emre Bulut Hall1
Önder CİVELEK
Hall-1, Semih Aktarer
Hall-1,Harun Guclu
Selin Efe Kayabaşı
Veri Odaklı Kapsamlı Bir Yaklaşım
1
Veri Toplama
Çok değişkenli set (Tüketim, Meteoloji, Zaman)
2
Veri Ön İşleme
Eksik veri tamamlama, Z-skor standardizasyonu, SMOTE-Tomek ile dengeleme
3
Model Eğitimi
29 farklı makine öğrenmesi modeli
4
Doğrulama
5 katlı çapraz doğrulama (5-fold cross-validation)
5
Performans Değerlendirmesi
Bağımsız test seti üzerinde metriklerin analizi
En iyi modeli belirlemek için adil, tekrarlanabilir ve kapsamlı bir metodoloji izlenerek, modellerin genelleme yeteneği ve sağlamlığı güvence altına alındı.

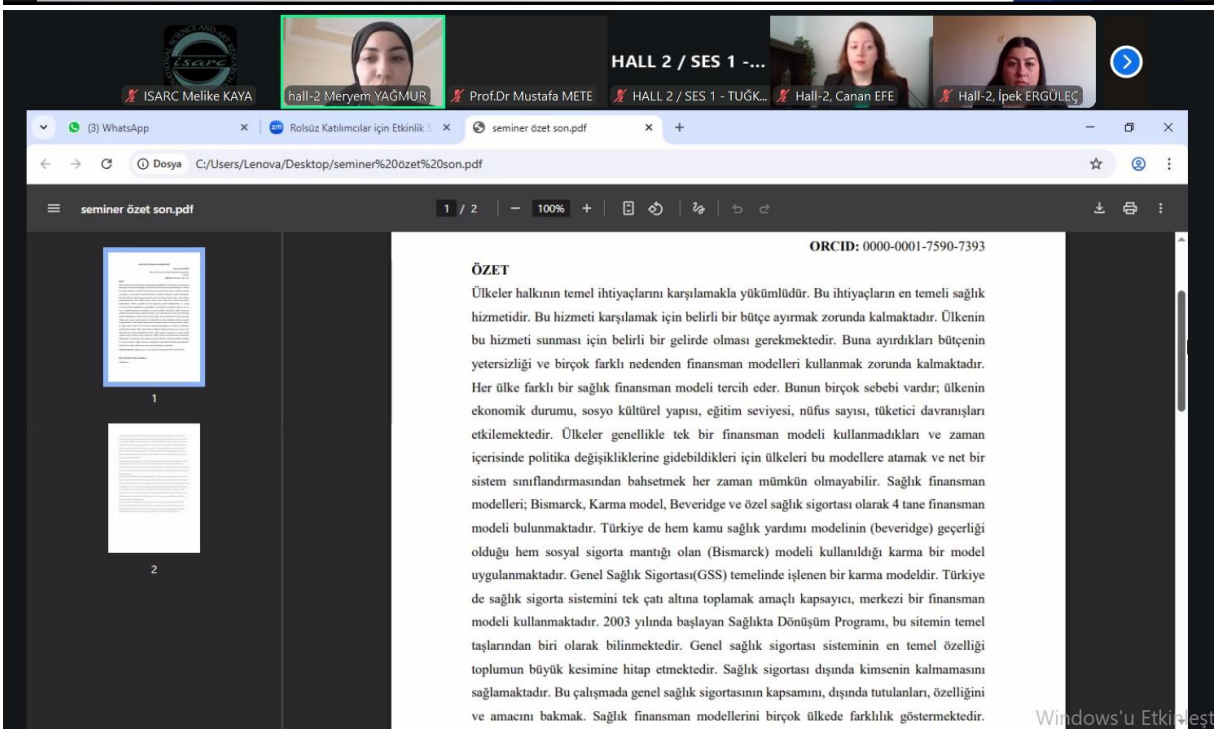

ISARC Melike KAYA
Zeynep Güngör, H-21, ...
Hall-21 Zülal Yılmaz
hall-21, Vehbi İmamoğ...
Turkan Ferzeliyeva
Hall-21 - Cihan...
Hall-21 - Cihangir KAÇ...
Literatüre ilişkin dönemsel eğilimler;
1. Erken dönem çalışmalar (1996-2006)
• Sekülerleşme tartışmaları yeni olmamakla birlikte yaklaşık 30 yıl öncesine dayanmaktadır,
• Osmanlı – Cumhuriyet dönemi arası geçiş süreci, merkezi bir bağlam oluşturmaktadır.
• 2. Sorgulama dönemi (2007-2015)
• Bu dönemde kırılmalar yaşanmaya başlamıştır.
• Klasik sekülerleşme teorilerinin evrenselliği sorgulanmaya başlamıştır.
• Dini canlanma ve desekülerlşme kavramları literatürde görünür olmaya başlamıştır.
3. Güncel dönem (2015-2025)
• Mikro alanlara inilen dönem
• Kadın, gençlik, beden, müzik, tüketim, kentleşme, ve gündelik hayat gibi alanlar incelenmiştir.
• Literatür daha yoğun ve çeşitli.
Windows'u Etkinl

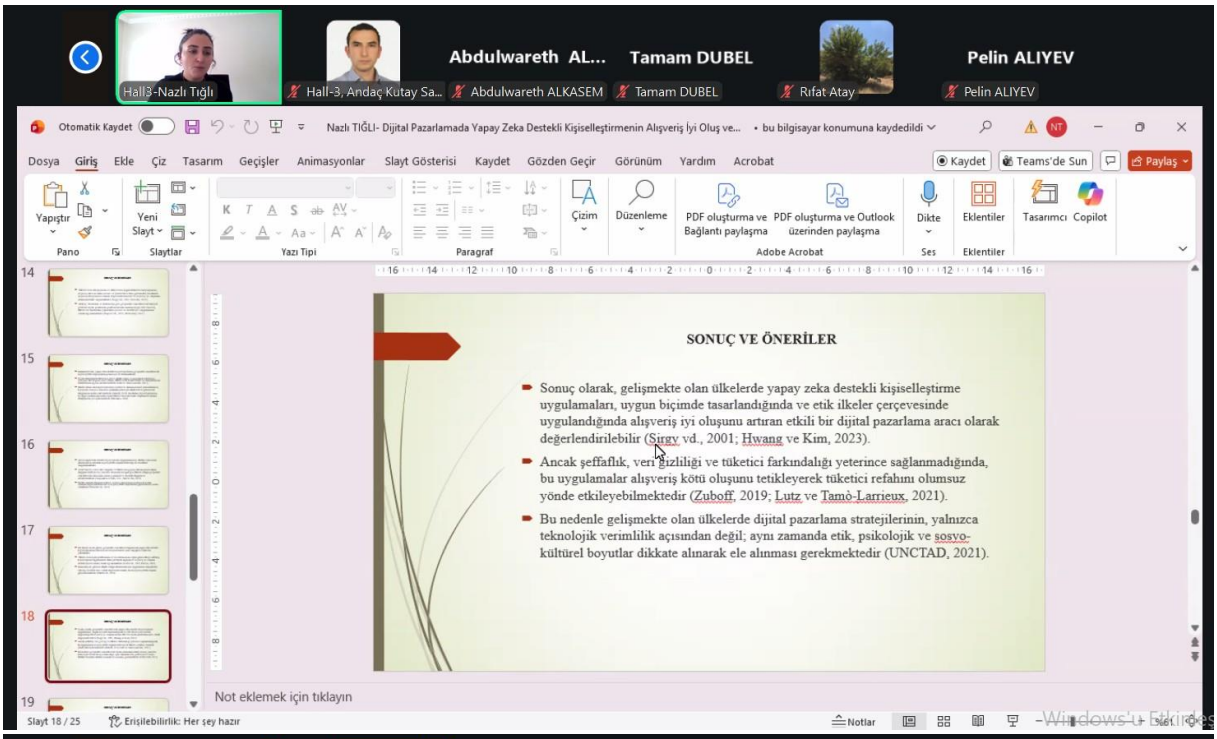

Hall-1 Mustafa...
Hall-1 Mustafa ŞENYÜ...
Hall-1,Hilal ucak
Ece Cigal- Adiya...
Ece Cigal- Adiyaman U...
Doç. Dr. Onur ÇEtin
Aydın Özdemir
Aydın Özdemir
Məhəmməd Məmmədli
Sürdürülebilir Kalkınmanın Gelişim Süreci
1972: Çevresel Farkındalığın Doğuşu
Stockholm Konferansı: 20. yüzyılın son çeyreğinde küresel ticaretin gelişmesiyle kaynakların yanlış tüketimi arttı. İlk küresel çevre konferansı düzenlendi. Ortak Geleceğimiz perspektifinde çevre sorunlarına dikkat çekmek ve önlemler almak amacıyla küresel farkındalık oluşturma çabaları başladı.
1980: Dünya Koruma Strateji Belgesi
Sürdürülebilirlik kavramı ilk kez resmi kayıtlarda yer aldı.
1987: Brundtland Raporu
Brundtland Raporu: "Gelecek nesillerin kaynaklarına zarar vermeden günümüz ihtiyaçlarını karşılayan kalkınma« tanımı yapıldı.
1992: Rio Yeryüzü Zirvesi
Sürdürülebilirliğin çevresel, ekonomik ve sosyal boyutlarını içeren eylem planı oluşturuldu.
1997: Kyoto Protokolü
Sera gazı salınımının azaltılmasına yönelik hedefler belirlendi. İklim değişikliğini kontrol altına alma çabaları başladı.
2000: Binyıl Kalkınma Hedefleri
Birleşmiş Milletler, özellikle küresel yoksulluğun azaltılmasına odaklanan 8 hedef belirledi
11 atanmamış katılımcı

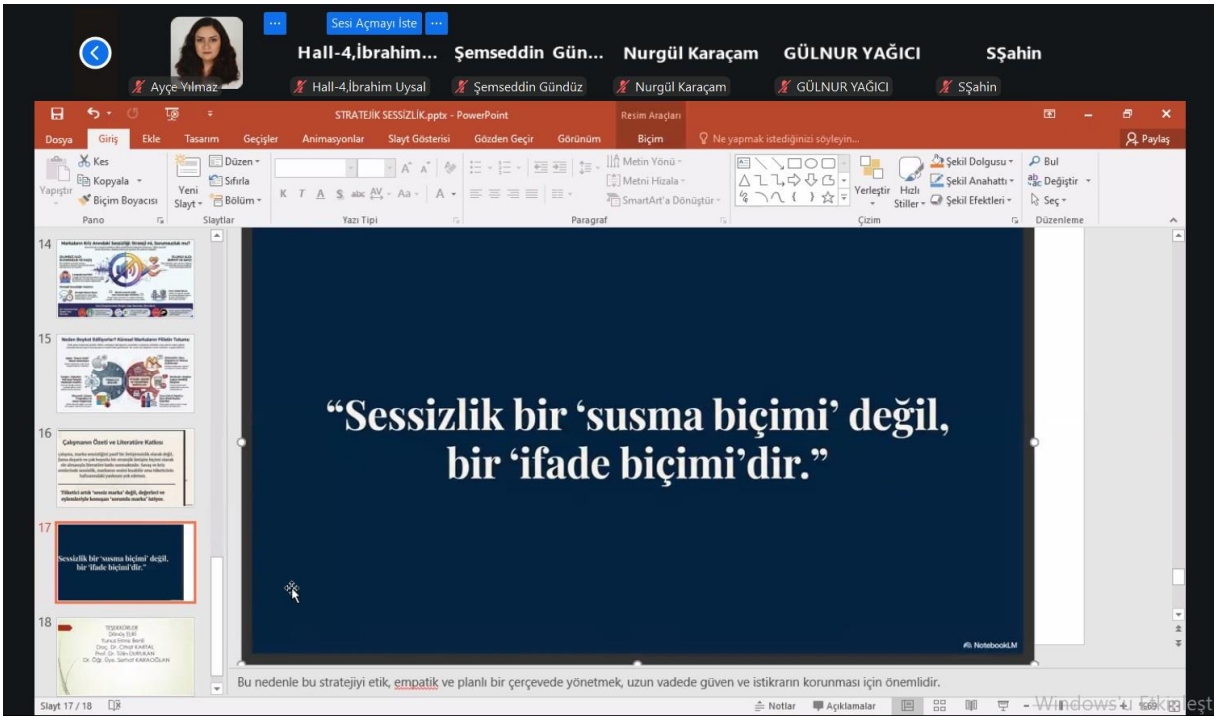

ISARC Melike KAYA
Abdulrezzak İKVAN (Hall-1)
Hall-1, Yunus AKTAŞ
HA
Hall-1 Mustafa...
Hall-1 Mustafa ŞENYÜ...
Hall-1,Hilal ucak
Günümüz Teknolojileri ve Muhasebe
Yapay Zeka
Klasik muhasebe işlemlerinin otomasyonu ve akıllı analizlerin mümkün olması
Blockchain
Değiştirilemez ve merkeziyetsiz kayıt sistemlerinin gelişmesi
Bulut Bilişim
Güvenli veri depolama ve mekansız erişim kolaylığı
Büyük Veri
Kapsamlı veri analizi ve gerçekçi karar desteğinin sağlanması

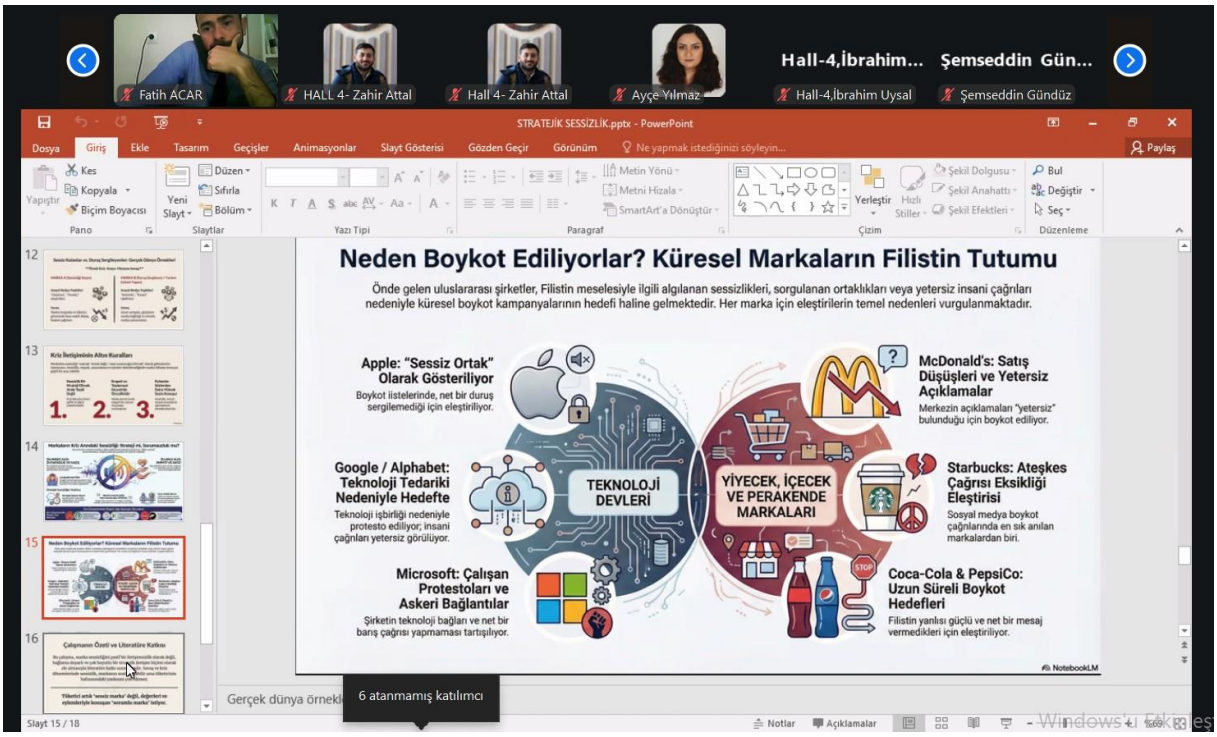

ISARC Melike KAYA
Veli Burak Kahramanoğlu
HALL 2 / SES 1 -...
HALL 2 / SES 1 - TUĞK...
Hall-2, Canan EFE
Prof.Dr Mustafa METE
hall 2-Esra Kangal
hall 2-Esra Kangal
LITERATÜR TARAMASI
Araştırmanın Özgün Değeri Mevcut literatür genellikle hukuki boyuta odaklanırken; bu çalışma, Türkiye özelinde emsal ülke seçiminin maliyetleri teknik olarak nasıl yükselttiğini sayısal verilerle analiz etmektedir.
Hukuki Zemin: "Piyasa Dışı Ekonomi" statüsü, otoritelere geniş bir takdir yetkisi vermektedir
Metodolojik Sorun: Bu yöntemle hesaplanan vergiler, normal piyasa koşullarına göre 4 kat daha yüksektir (%10 yerine %41).
Ekonomik Amaç: Soruşturmalar, haksız rekabetten ziyade yerli üreticiyi koruma odaklıdır.
9 atanmamış katılımcı

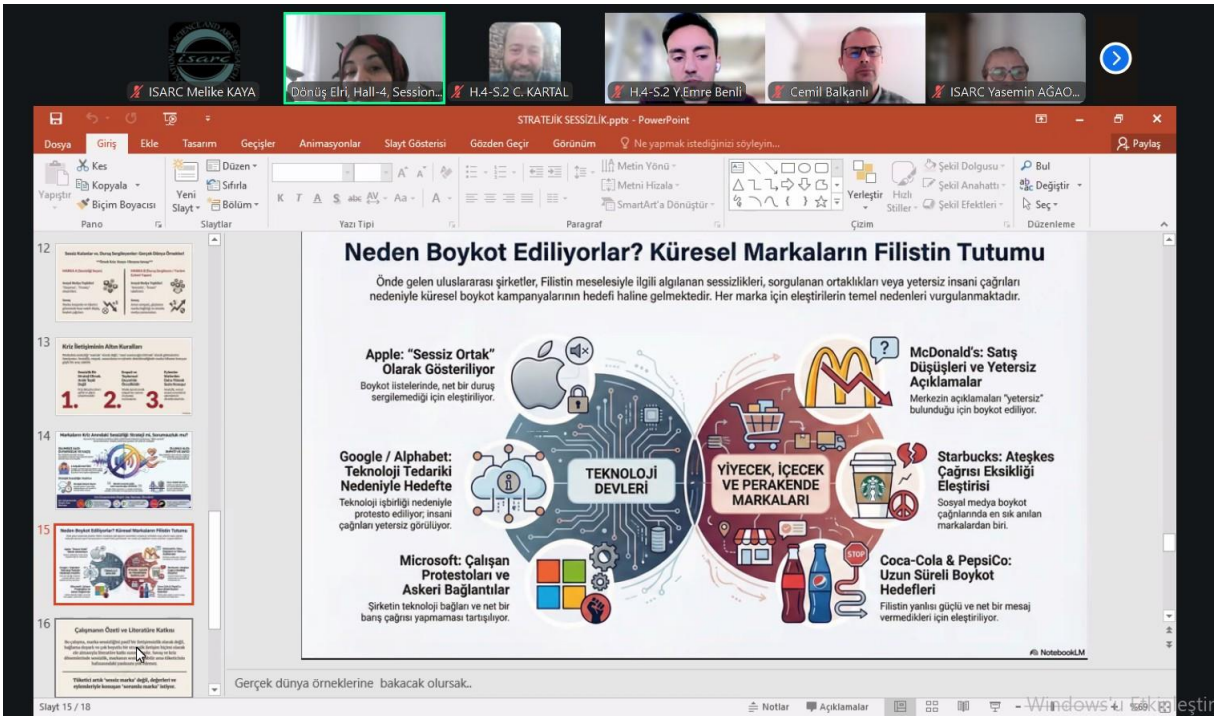

Hall-2, İpek ERG...
Hall-2, İpek ERGÜLEÇ
Melike Özdemir
Abdulrazak SAYED DA...
İlhan EROĞLU
İlhan EROĞLU
Muhsin Çağlar...
Muhsin Çağlar ASLAN
FNE
Sesi Açmayı İste
LITERATÜR TARAMASI
Araştırmanın Özgün Değeri Mevcut literatür genellikle hukuki boyuta odaklanırken; bu çalışma, Türkiye özelinde emsal ülke seçiminin maliyetleri teknik olarak nasıl yükselttiğini sayısal verilerle analiz etmektedir.
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Windows'u Etkin

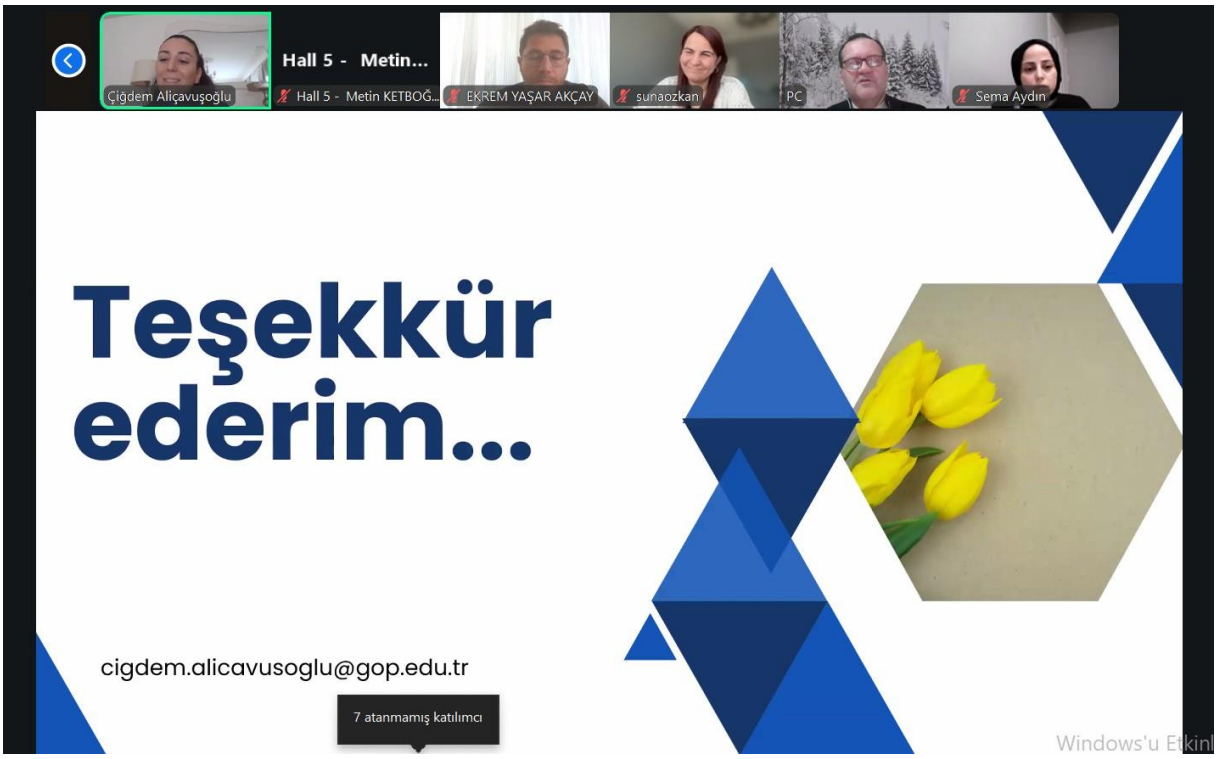

ISARC Melike KAYA
hall-2 Meryem YAĞMUR
Prof.Dr Mustafa METE
HALL 2 / SES 1 -...
HALL 2 / SES 1 - TUĞK...
Hall-2, Canan EFE
Hall-2, İpek ERGÜLEÇ
(3) WhatsApp
Rolsüz Katılımcılar için Etkinlik
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seminer özet son.pdf
1 / 2
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ORCID: 0000-0001-7590-7393
ÖZET
Ülkeler halkının temel ihtiyaçlarını karşılamakla yükümlüdür. Bu ihtiyaçların en temeli sağlık hizmetidir. Bu hizmeti karşılamak için belirli bir bütçe ayırmak zorunda kalmaktadır. Ülkenin bu hizmeti sunması için belirli bir gelirde olması gerekmektedir. Buna ayırdıkları bütçenin yetersizliği ve birçok farklı nedenden finansman modelleri kullanmak zorunda kalmaktadır. Her ülke farklı bir sağlık finansman modeli tercih eder. Bunun birçok sebebi vardır; ülkenin ekonomik durumu, sosyo kültürel yapısı, eğitim seviyesi, nüfus sayısı, tüketici davranışları etkilemektedir. Ülkeler genellikle tek bir finansman modeli kullanmadıkları ve zaman içerisinde politika değişikliklerine gidebildikleri için ülkeleri bu modellere atamak ve net bir sistem sınıflandırmasından bahsetmek her zaman mümkün olmayabilir. Sağlık finansman modelleri; Bismarck, Karma model, Beveridge ve özel sağlık sigortası olarak 4 tane finansman modeli bulunmaktadır. Türkiye de hem kamu sağlık yardımı modelinin (beveridge) geçerliği olduğu hem sosyal sigorta mantığı olan (Bismarck) modeli kullanıldığı karma bir model uygulanmaktadır. Genel Sağlık Sigortası(GSS) temelinde işlenen bir karma modeldir. Türkiye de sağlık sigorta sistemini tek çatı altına toplamak amaçlı kapsayıcı, merkezi bir finansman modeli kullanmaktadır. 2003 yılında başlayan Sağlıkta Dönüşüm Programı, bu sitemin temel taşlarından biri olarak bilinmektedir. Genel sağlık sigortası sisteminin en temel özelliği toplumun büyük kesimine hitap etmektedir. Sağlık sigortası dışında kimsenin kalmamasını sağlamaktadır. Bu çalışmada genel sağlık sigortasının kapsamını, dışında tutulanları, özelliğini ve amacını bakmak. Sağlık finansman modellerini birçok ülkede farklılık göstermektedir.
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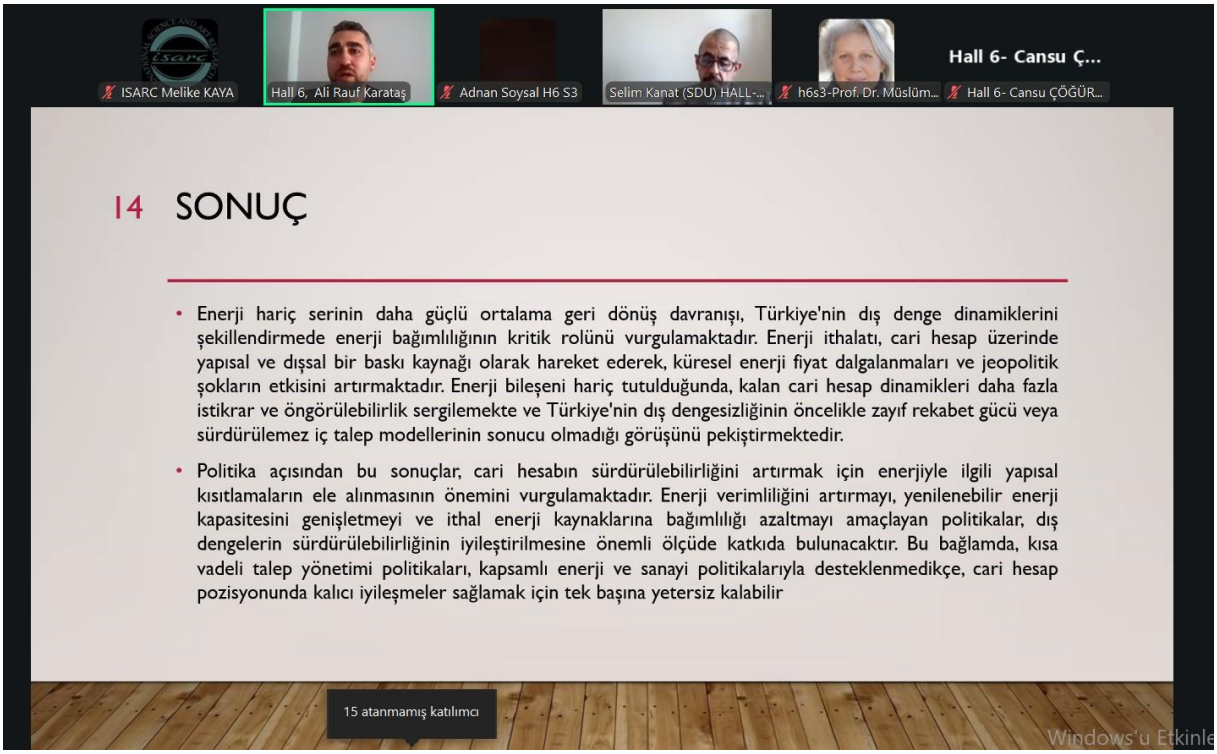

Hall-3-Nazlı Tığlı
Hall-3, Andaç Kutay Sa...
Abdulwareth AL...
Abdulwareth ALKASEM
Tamam DUBEL
Rıfat Atay
Pelin ALIYEV
Nazlı TIĞLI- Dijital Pazarlamada Yapay Zeka Destekli Kişiselleştirmenin Alışveriş İyi Oluş ve...
SONUÇ VE ÖNERİLER
Sonuç olarak, gelişmekte olan ülkelerde yapay zeka destekli kişiselleştirme uygulamaları, uygun biçimde tasarlandığında ve etik ilkeler çerçevesinde uygulandığında alışveriş iyi oluşunu artıran etkili bir dijital pazarlama aracı olarak değerlendirilebilir (Sirgy vd., 2001; Hwang ve Kim, 2023).
Ancak şeffaflık, veri gizliliği ve tüketici farkındalığı yeterince sağlanmadığında, bu uygulamalar alışveriş kötü oluşunu tetikleyerek tüketici refahını olumsuz yönde etkileyebilmektedir (Zuboff, 2019; Lutz ve Tamò-Larrieux, 2021).
Bu nedenle gelişmekte olan ülkelerde dijital pazarlama stratejilerinin, yalnızca teknolojik verimlilik açısından değil; aynı zamanda etik, psikolojik ve sosyo-kültürel boyutlar dikkate alınarak ele alınması gerekmektedir (UNCTAD, 2021).
Not eklemek için tıklayın
Slayt 18 / 25

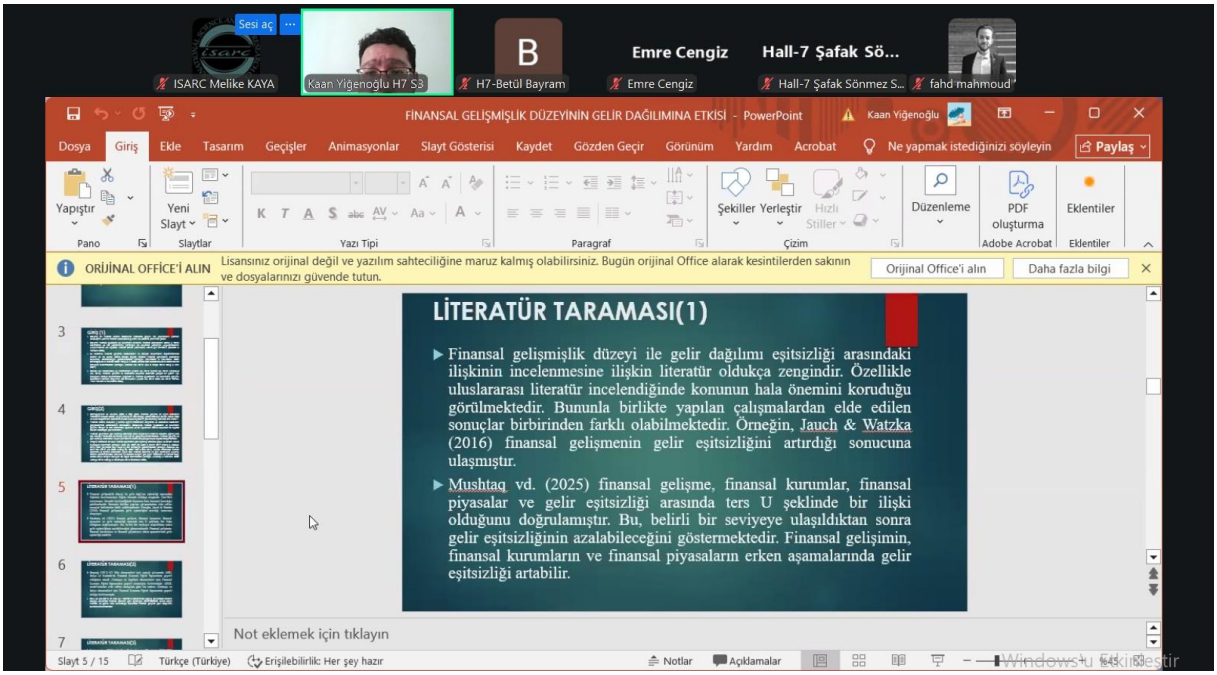

Ayçe Yılmaz
Hall-4,İbrahim...
Şemseddin Gün...
Nurgül Karaçam
GÜLNUR YAĞICI
SŞahin
Hall-4,İbrahim Uysal
Şemseddin Gündüz
Nurgül Karaçam
GÜLNUR YAĞICI
SŞahin
STRATEJİK SESSİZLİK.pptx - PowerPoint
“Sessizlik bir ‘susma biçimi’ değil, bir ‘ifade biçimi’dir.”
Bu nedenle bu stratejiyi etik, empatik ve planlı bir çerçevede yönetmek, uzun vadede güven ve istikrarın korunması için önemlidir.
Slayt 17 / 18

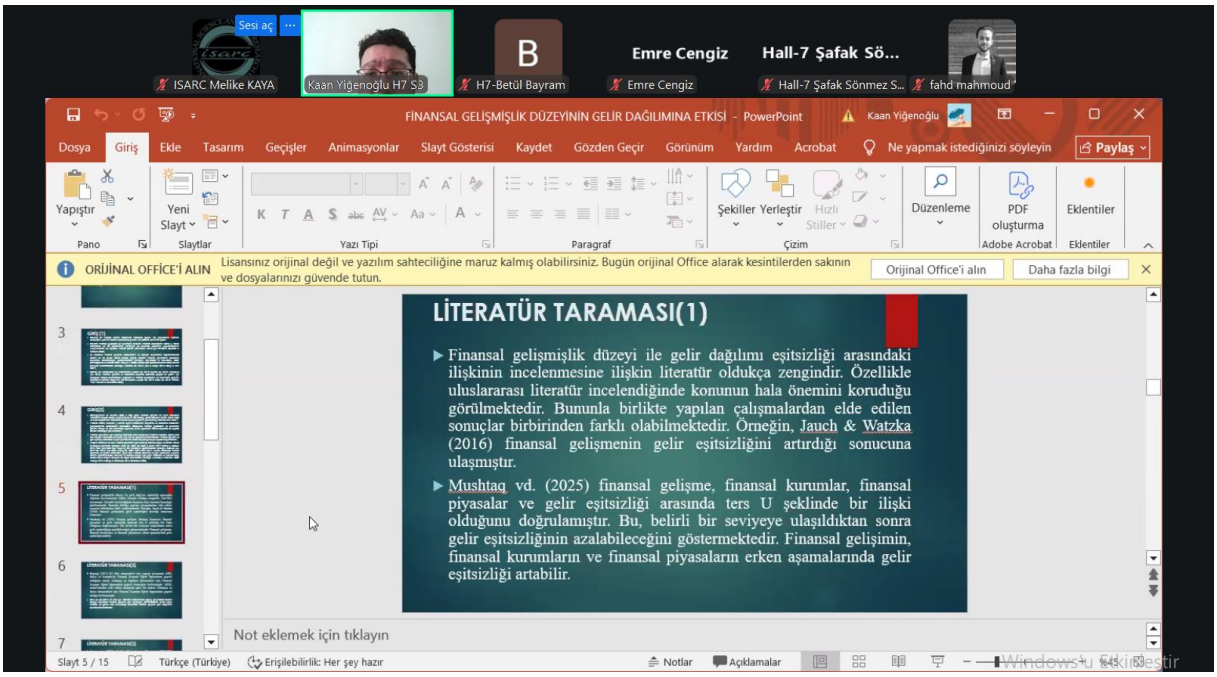

Fatih ACAR
HALL 4- Zahir Attal
Hall 4- Zahir Attal
Ayçe Yılmaz
Hall-4,İbrahim...
Şemseddin Gün...
Hall-4,İbrahim Uysal
Şemseddin Gündüz
STRATEJİK SESSİZLİK.pptx - PowerPoint
Neden Boykot Ediliyorlar? Küresel Markaların Filistin Tutumu
Önde gelen uluslararası şirketler, Filistin meselesiyle ilgili algılanan sessizlikleri, sorgulanan ortaklıkları veya yetersiz insani çağrıları nedeniyle küresel boykot kampanyalarının hedefi haline gelmektedir. Her marka için eleştirilerin temel nedenleri vurgulanmaktadır.
Apple: "Sessiz Ortak" Olarak Gösteriliyor
Boykot listelerinde, net bir duruş sergilemediği için eleştiriliyor.
Google / Alphabet: Teknoloji Tedariki Nedeniyle Hedefte
Teknoloji işbirliği nedeniyle protesto ediliyor; insani çağrıları yetersiz görülüyor.
Microsoft: Çalışan Protestoları ve Askeri Bağlantılar
Şirketin teknoloji bağları ve net bir barış çağrısı yapmaması tartışılıyor.
TEKNOLOJİ DEVLERİ
YİYECEK, İÇECEK VE PERAKENDE MARKALARI
McDonald's: Satış Düşüşleri ve Yetersiz Açıklamalar
Merkezin açıklamaları "yetersiz" bulunduğu için boykot ediliyor.
Starbucks: Ateşkes Çağrısı Eksikliği Eleştirisi
Sosyal medya boykot çağrılarında en sık anılan markalardan biri.
Coca-Cola & PepsiCo: Uzun Süreli Boykot Hedefleri
Filistin yanlısı güçlü ve net bir mesaj vermedikleri için eleştiriliyor.
NotebookLM
6 atanmamış katılımcı
Slayt 15 / 18

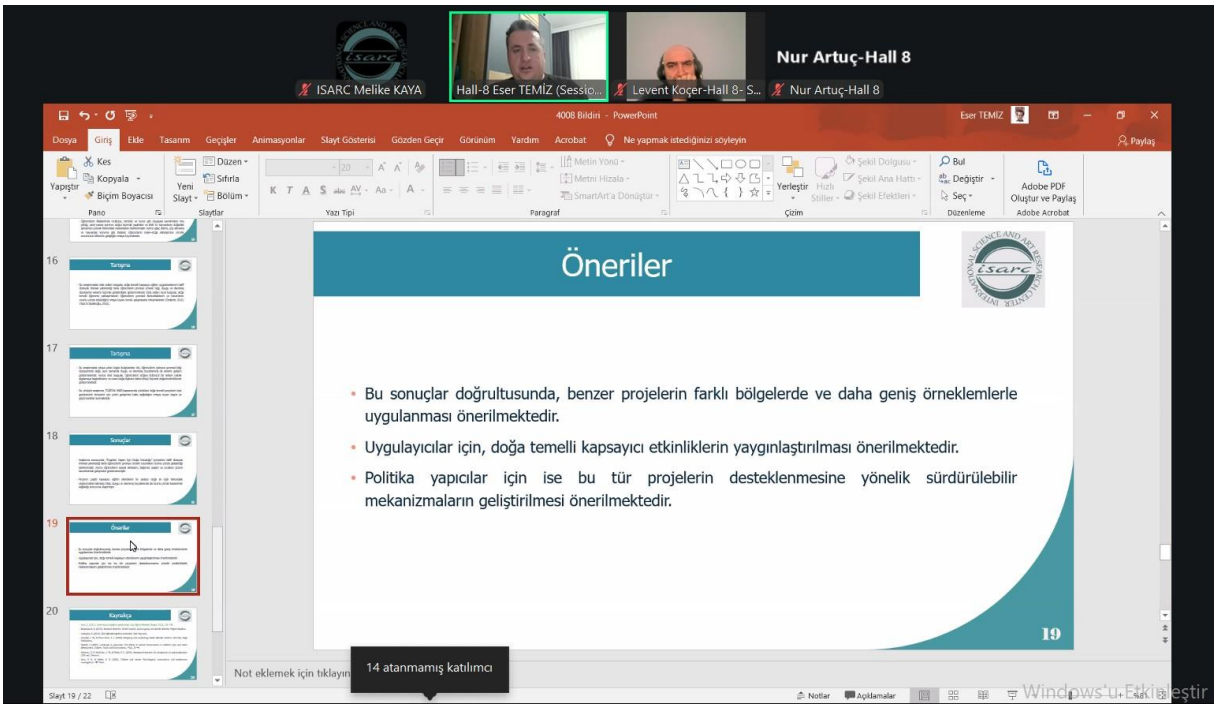

ISARC Melike KAYA
Dönüş Elri, Hall-4, Session...
H.4-S.2 C. KARTAL
H.4-S.2 Y.Emre Benli
Cemil Balkanlı
ISARC Yasemin AĞAO...
STRATEJİK SESSİZLİK.pptx - PowerPoint
Neden Boykot Ediliyorlar? Küresel Markaların Filistin Tutumu
Önde gelen uluslararası şirketler, Filistin meselesiyle ilgili algılanan sessizlikleri, sorgulanan ortaklıkları veya yetersiz insani çağrıları nedeniyle küresel boykot kampanyalarının hedefi haline gelmektedir. Her marka için eleştirilerin temel nedenleri vurgulanmaktadır.
Apple: "Sessiz Ortak" Olarak Gösteriliyor
Boykot listelerinde, net bir duruş sergilemediği için eleştiriliyor.
Google / Alphabet: Teknoloji Tedariki Nedeniyle Hedefte
Teknoloji işbirliği nedeniyle protesto ediliyor; insani çağrıları yetersiz görülüyor.
Microsoft: Çalışan Protestoları ve Askeri Bağlantılar
Şirketin teknoloji bağları ve net bir barış çağrısı yapmaması tartışılıyor.
TEKNOLOJİ DEVLERİ
YİYECEK, İÇECEK VE PERAKENDE MARKALARI
McDonald's: Satış Düşüşleri ve Yetersiz Açıklamalar
Merkezin açıklamaları "yetersiz" bulunduğu için boykot ediliyor.
Starbucks: Ateşkes Çağrısı Eksikliği Eleştirisi
Sosyal medya boykot çağrılarında en sık anılan markalardan biri.
Coca-Cola & PepsiCo: Uzun Süreli Boykot Hedefleri
Filistin yanlısı güçlü ve net bir mesaj vermedikleri için eleştiriliyor.
NotebookLM
Gerçek dünya örneklerine bakacak olursak..
Slayt 15 / 18

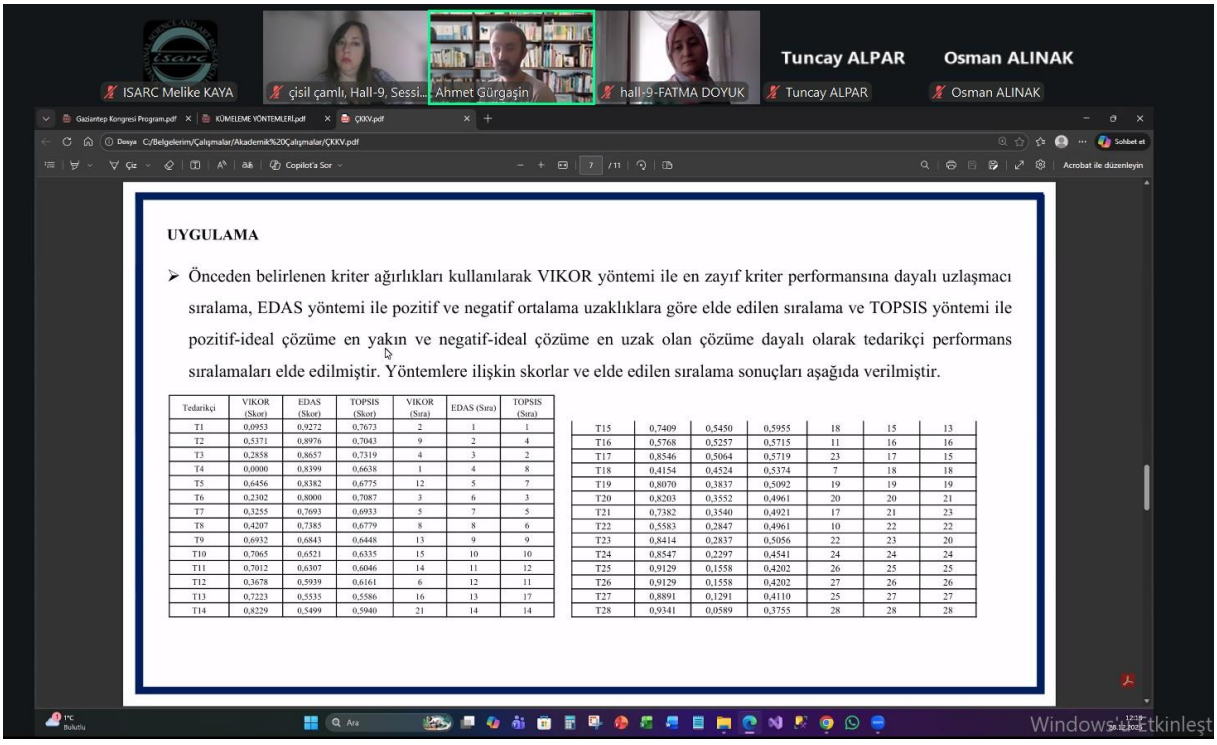

Çiğdem Aliçavuşoğlu
Hall 5 - Metin...
Hall 5 - Metin KETBOĞ...
EKREM YAŞAR AKÇAY
sunaozkan
PC
Sema Aydın
Teşekkür ederim...
cigdem.alicavusoglu@gop.edu.tr
7 atanmamış katılımcı
Windows'u Etkinl


ISARC Melike KAYA
Hall 6, Ali Rauf Karataş
Adnan Soysal H6 S3
Selim Kanat (SDU) HALL-...
h6s3-Prof. Dr. Müslüm...
Hall 6- Cansu Ç...
Hall 6- Cansu ÇÖĞÜR...
14 SONUÇ
• Enerji hariç serinin daha güçlü ortalama geri dönüş davranışı, Türkiye'nin dış denge dinamiklerini şekillendirmede enerji bağımlılığının kritik rolünü vurgulamaktadır. Enerji ithalatı, cari hesap üzerinde yapısal ve dışsal bir baskı kaynağı olarak hareket ederek, küresel enerji fiyat dalgalanmaları ve jeopolitik şokların etkisini artırmaktadır. Enerji bileşeni hariç tutulduğunda, kalan cari hesap dinamikleri daha fazla istikrar ve öngörülebilirlik sergilemekte ve Türkiye'nin dış dengesizliğinin öncelikle zayıf rekabet gücü veya sürdürülemez iç talep modellerinin sonucu olmadığı görüşünü pekiştirmektedir.
• Politika açısından bu sonuçlar, cari hesabın sürdürülebilirliğini artırmak için enerjiyle ilgili yapısal kısıtlamaların ele alınmasının önemini vurgulamaktadır. Enerji verimliliğini artırmayı, yenilenebilir enerji kapasitesini genişletmeyi ve ithal enerji kaynaklarına bağımlılığı azaltmayı amaçlayan politikalar, dış dengelerin sürdürülebilirliğinin iyileştirilmesine önemli ölçüde katkıda bulunacaktır. Bu bağlamda, kısa vadeli talep yönetimi politikaları, kapsamlı enerji ve sanayi politikalarıyla desteklenmedikçe, cari hesap pozisyonunda kalıcı iyileşmeler sağlamak için tek başına yetersiz kalabilir
15 atanmamış katılımcı
Windows'u Etkinle

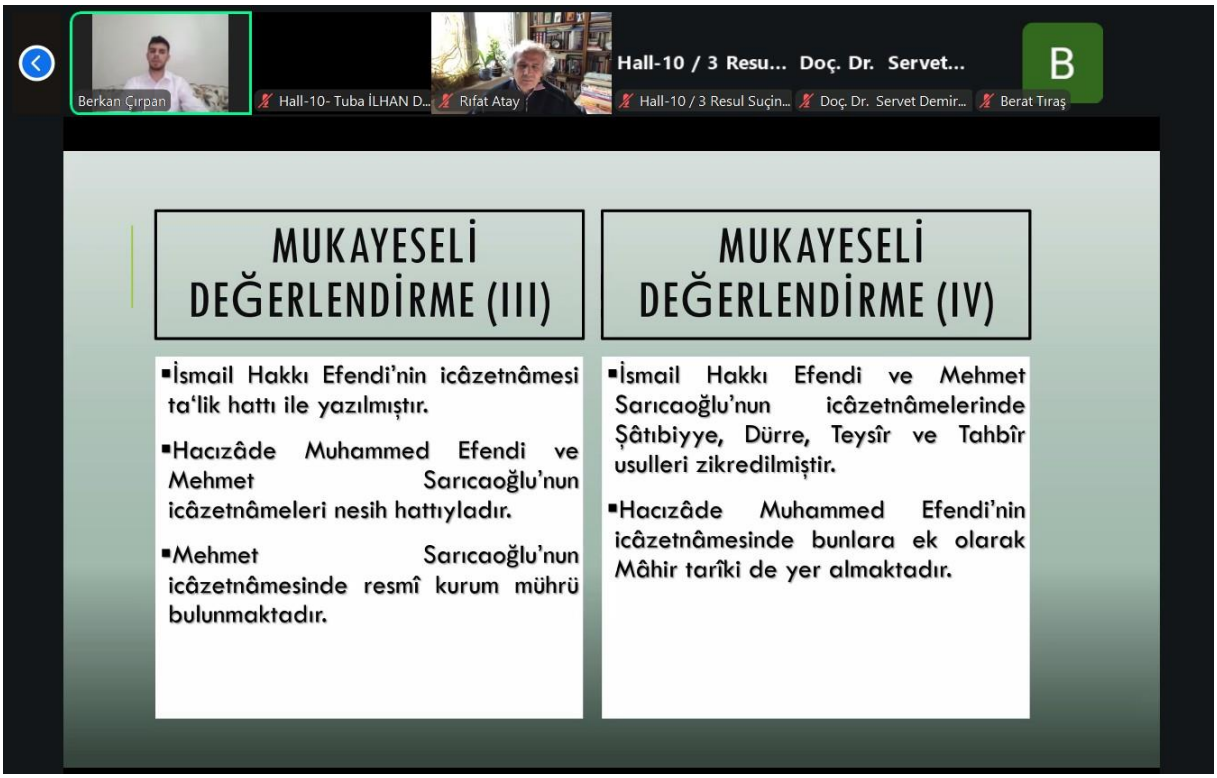

Sesi aç
ISARC Melike KAYA
Kaan Yigenoğlu H7 S3
H7-Betül Bayram
Emre Cengiz
Hall-7 Şafak Sö...
Hall-7 Şafak Sönmez S...
fahd mahmoud
FİNANSAL GELİŞMİŞLİK DÜZEYİNİN GELİR DAĞILIMINA ETKİSİ - PowerPoint
Kaan Yigenoğlu
Dosya Giriş Ekle Tasarım Geçişler Animasyonlar Slayt Gösterisi Kaydet Gözden Geçir Görünüm Yardım Acrobat
Ne yapmak istediğinizi söyleyin
Paylaş
ORİJİNAL OFFİCE'İ ALIN
Lisansınız orijinal değil ve yazılım sahteciliğine maruz kalmış olabilirsiniz. Bugün orijinal Office alarak kesintilerden sakının ve dosyalarınızı güvende tutun.
Orijinal Office'i alın
Daha fazla bilgi
LİTERATÜR TARAMASI(1)
Finansal gelişmişlik düzeyi ile gelir dağılımı eşitsizliği arasındaki ilişkinin incelenmesine ilişkin literatür oldukça zengindir. Özellikle uluslararası literatür incelendiğinde konunun hala önemini koruduğu görülmektedir. Bununla birlikte yapılan çalışmalardan elde edilen sonuçlar birbirinden farklı olabilmektedir. Örneğin, Jauch & Watzka (2016) finansal gelişmenin gelir eşitsizliğini artırdığı sonucuna ulaşmıştır.
Mushtaq vd. (2025) finansal gelişme, finansal kurumlar, finansal piyasalar ve gelir eşitsizliği arasında ters U şeklinde bir ilişki olduğunu doğrulamıştır. Bu, belirli bir seviyeye ulaşıldıktan sonra gelir eşitsizliğinin azalabileceğini göstermektedir. Finansal gelişimin, finansal kurumların ve finansal piyasaların erken aşamalarında gelir eşitsizliği artabilir.
Not eklemek için tıklayın
Slayt 5 / 15
Türkçe (Türkiye)
Erişilebilirlik: Her şey hazır
Notlar
Açıklamalar


Sesi aç
ISARC Melike KAYA
Kaan Yigenoğlu H7 S3
H7-Betül Bayram
Emre Cengiz
Hall-7 Şafak Sö...
Hall-7 Şafak Sönmez S...
fahd mahmoud
FİNANSAL GELİŞMİŞLİK DÜZEYİNİN GELİR DAĞILIMINA ETKİSİ - PowerPoint
Kaan Yigenoğlu
Dosya Giriş Ekle Tasarım Geçişler Animasyonlar Slayt Gösterisi Kaydet Gözden Geçir Görünüm Yardım Acrobat
Ne yapmak istediğinizi söyleyin
Paylaş
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Daha fazla bilgi
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Not eklemek için tıklayın
Slayt 5 / 15
Türkçe (Türkiye)
Erişilebilirlik: Her şey hazır
Notlar
Açıklamalar





Tedarikçi	VIKOR (Skor)	EDAS (Skor)	TOPSIS (Skor)	VIKOR (Sıra)	EDAS (Sıra)	TOPSIS (Sıra)
T1	0,0953	0,9272	0,7673	2	1	1
T2	0,5371	0,8976	0,7043	9	2	4
T3	0,2858	0,8657	0,7319	4	3	2
T4	0,0000	0,8399	0,6638	1	4	8
T5	0,6456	0,8382	0,6775	12	5	7
T6	0,2302	0,8000	0,7087	3	6	3
T7	0,3255	0,7693	0,6933	5	7	5
T8	0,4207	0,7385	0,6779	8	8	6
T9	0,6932	0,6843	0,6448	13	9	9
T10	0,7065	0,6521	0,6335	15	10	10
T11	0,7012	0,6307	0,6046	14	11	12
T12	0,3678	0,5939	0,6161	6	12	11
T13	0,7223	0,5535	0,5586	16	13	17
T14	0,8229	0,5499	0,5940	21	14	14
T15	0,7409	0,5450	0,5955	18	15	13
T16	0,5768	0,5257	0,5715	11	16	16
T17	0,8546	0,5064	0,5719	23	17	15
T18	0,4154	0,4524	0,5374	7	18	18
T19	0,8070	0,3837	0,5092	19	19	19
T20	0,8203	0,3552	0,4961	20	20	21
T21	0,7382	0,3540	0,4921	17	21	23
T22	0,5583	0,2847	0,4961	10	22	22
T23	0,8414	0,2837	0,5056	22	23	20
T24	0,8547	0,2297	0,4541	24	24	24
T25	0,9129	0,1558	0,4202	26	25	25
T26	0,9129	0,1558	0,4202	27	26	26
T27	0,8891	0,1291	0,4110	25	27	27
T28	0,9341	0,0589	0,3755	28	28	28


Berkan Çırpan
Hall-10- Tuba İLHAN D...
Rıfat Atay
Hall-10 / 3 Resu... Doç. Dr. Servet...
Hall-10 / 3 Resul Suçin...
Doç. Dr. Servet Demir...
Berat Tıraş
B
MUKAYESELİ DEĞERLENDİRME (III)
İsmail Hakkı Efendi'nin icâzetnâmesi ta'lik hattı ile yazılmıştır.
Hacızâde Muhammed Efendi ve Mehmet Sarıcaoğlu'nun icâzetnâmeleri nesih hattıyladır.
Mehmet Sarıcaoğlu'nun icâzetnâmesinde resmî kurum mührü bulunmaktadır.
MUKAYESELİ DEĞERLENDİRME (IV)
İsmail Hakkı Efendi ve Mehmet Sarıcaoğlu'nun icâzetnâmelerinde Şâtıbiyye, Dürre, Teysîr ve Tahbîr usulleri zikredilmiştir.
Hacızâde Muhammed Efendi'nin icâzetnâmesinde bunlara ek olarak Mâhir tarîki de yer almaktadır.


ISARC Melike KAYA
H1-Ahmet BEKEN
Berkan Çırpan
Hall-10- Tuba İLHAN D...
Rıfat Atay
Hall-10 / 3 Resu...
Hall-10 / 3 Resul Suçin...
MUKAYESELİ DEĞERLENDİRME (I)
Hacızâde Muhammed Efendi, silsileyi saymayı Ebû Amr ed-Dânî'de bırakmıştır.
İsmail Hakkı Efendi ve Mehmet Sarıcaoğlu ise sened zincirini tek tek zikretmiştir.
MUKAYESELİ DEĞERLENDİRME (II)
Mehmet Sarıcaoğlu'nun silsilesinde Hacızâde Muhammed Efendi on birinci sırada yer almaktadır.
Sarıcaoğlu'nun ve Balyalı İsmail Hakkı Efendi'nin senedleri Evliya Efendi'de birleşmektedir.

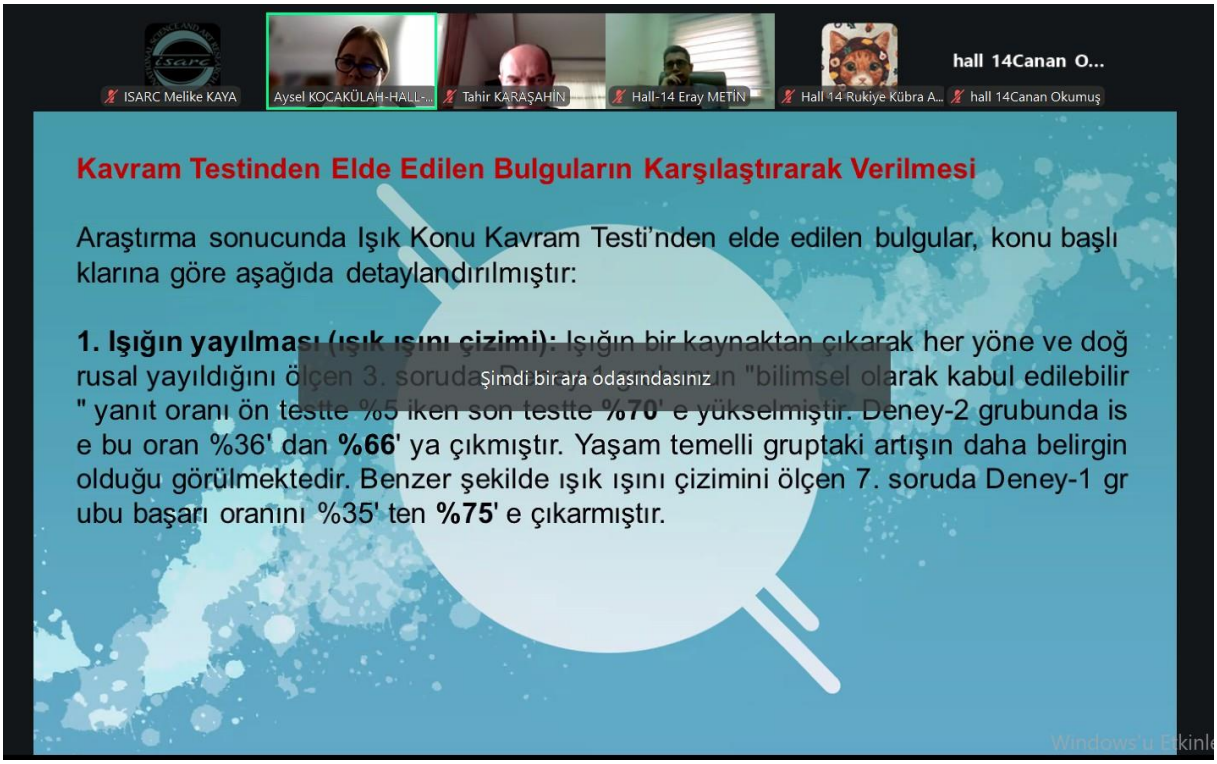

Sesi Açmayı İste
Ceyda Kaçmaz...
Hall 11 Senem T...
EDA KÖRLÜK
Hall 11 - Nuri S...
Doç. Dr. Berna DUMA...
Ceyda Kaçmaz Gümüş ...
FNE
Hall 11 Senem Tüfekçi
EDA KÖRLÜK
Hall 11 - Nuri Serdar G...
DİJİTAL TARIMIN TEMEL AMAÇLARI
▪ Tarımsal girdilerin etkin kullanımını sağlamak
8 atanmamış katılımcı
5

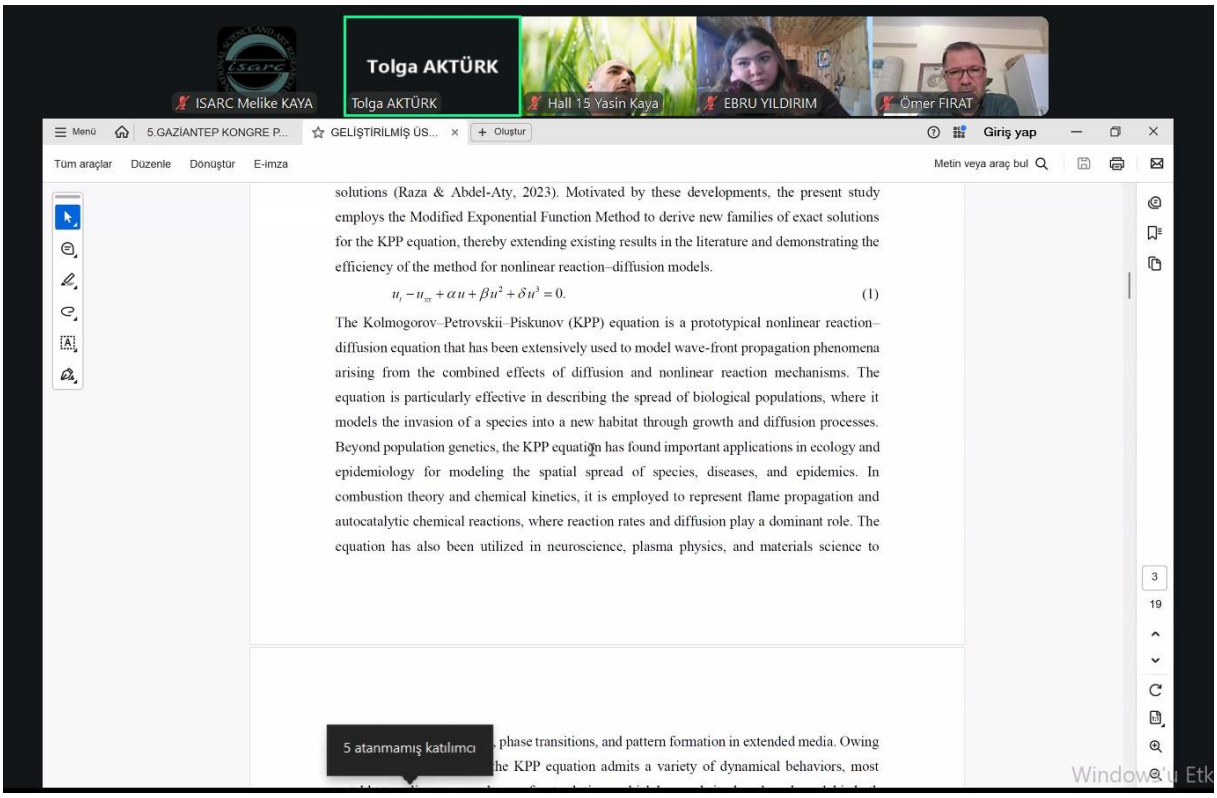

ISARC Melike KAYA
Wahidullah HILAL
Aslan Deniz Karaoglan ...
Dr Talip ŞAHİN
Doç. Dr. Berna DUMA...
Ceyda Kaçmaz...
Ceyda Kaçmaz Gümüş ...
TARIM 4.0 KAVRAMI
▪ Tarım 4.0 ve dijital teknolojilerin bütüncül kullanımı
▪ Hassas tarımın gelişmiş sistemlerle desteklenmesi
▪ Sensörler, yapay zekâ ve otomasyonun rolü
▪ Veri temelli üretim ve karar süreçleri
▪ Girdilerin doğru zaman ve miktarda kullanımı
▪ Sürdürülebilir üretim yaklaşımının güçlenmesi
8 atanmamış katılımcı
4

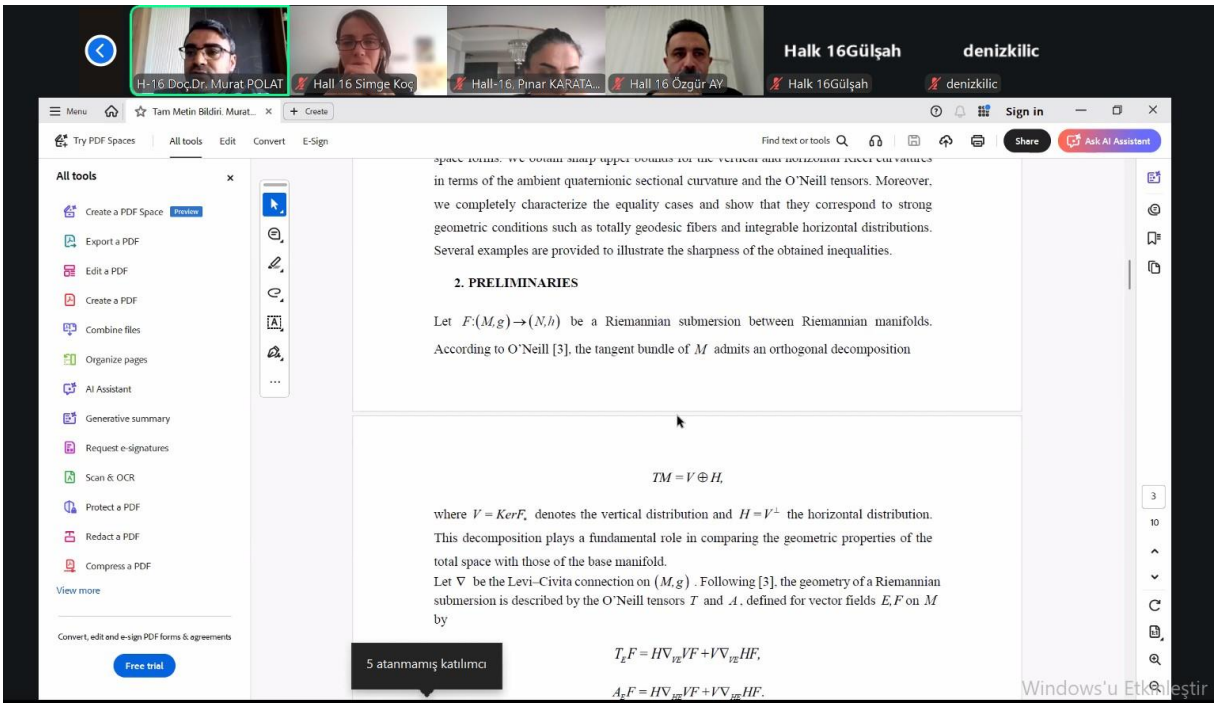

HALL 12 Nagihan Kılıç
Sude Nur ÖZCİ...
Sude Nur ÖZCİHAN H...
selim özdemir
NACİDE OZDAL
NACİDE OZDAL
Mervenur EKTİ...
Mervenur EKTİREN
Ö
HALL-12 Ömer Faruk ...
Bunun yanı sıra nanoteknoloji tabanlı feromon formülasyonlarının, biyolojik mücadele ajanlarıyla entegre kullanım potansiyeli de dikkat çekmektedir. "Çek-ve-enfekte et" ve oto-disseminasyon gibi stratejilerde feromonlar, zararlıların yönlendirilmesinde kilit rol oynayarak entomopatojen mikroorganizmaların yayılımını artırmaktadır. Bu bütüncül yaklaşımlar, entegre zararlı yönetimi (IPM) ve organik tarım sistemleri içerisinde feromonların stratejik önemini daha da güçlendirmektedir (Cook vd., 2007; Shashank vd., 2024).
8 atanmamış katılımcı
Windows'u Etkin

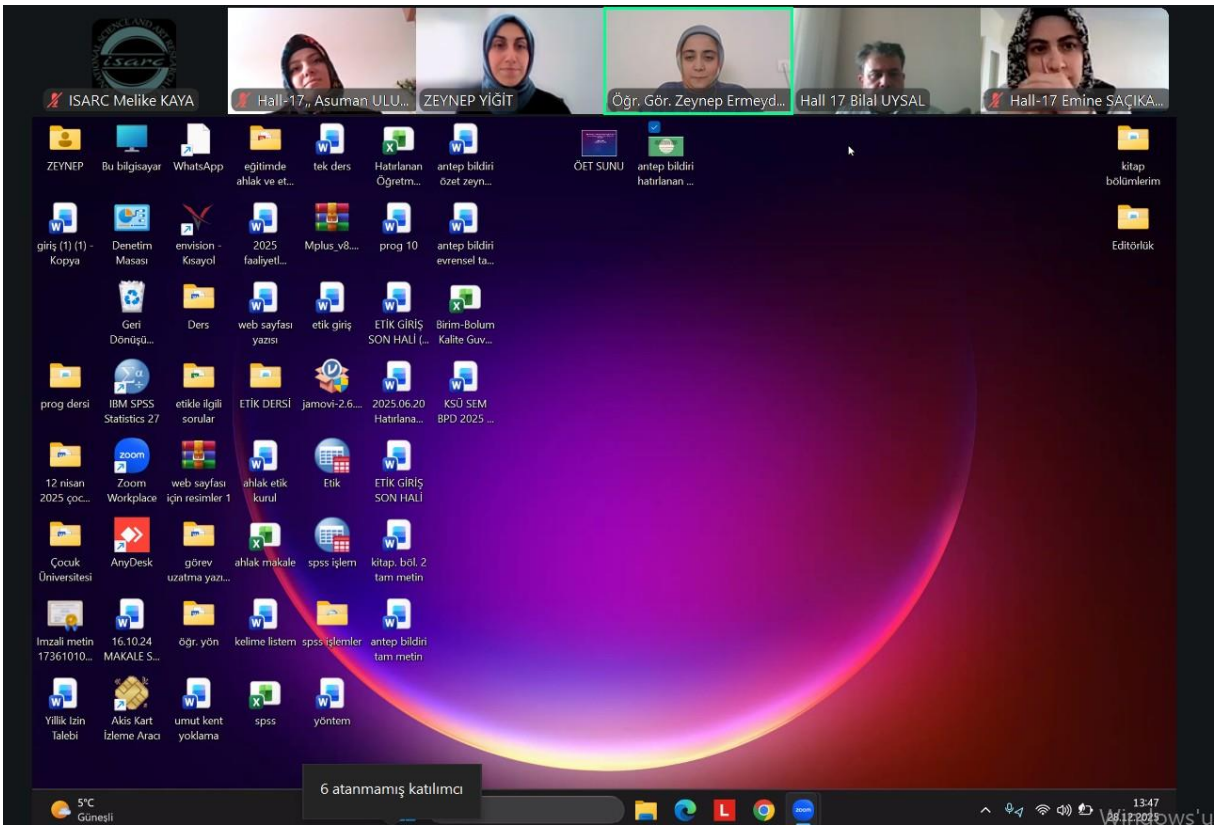

Hall-13-Bilge Ö...
Hall-13-Bilge ÖZTÜRK
Hall-13, Elif Nihan Kurt
Hall-13, Ahsen...
Hall-13, Ahsen Savaşer
Pınar
Pınar
Prof. Dr. Hasan...
Prof. Dr. Hasan BAĞCI
serdar
serdar
GİRİŞ
Bu doğrultuda, öğrenci merkezli, disiplinler arası ve beceri temelli alternatif eğitim modellerine olan ihtiyaç artmıştır. Türkiye Yüzyılı Maarif Modeli, bireyin bütüncül gelişimini esas alan ve 21. yüzyıl becerilerinin kazandırılmasını hedefleyen bir eğitim yaklaşımını benimsemektedir (MEB, 2023).
Harezmi Eğitim Modeli, yerli ve millî bir model olarak; problem çözme, iş birliği, üretim ve disiplinler arası öğrenmeyi temel almaktadır (MEB, 2023).
Windows'u Etkinle

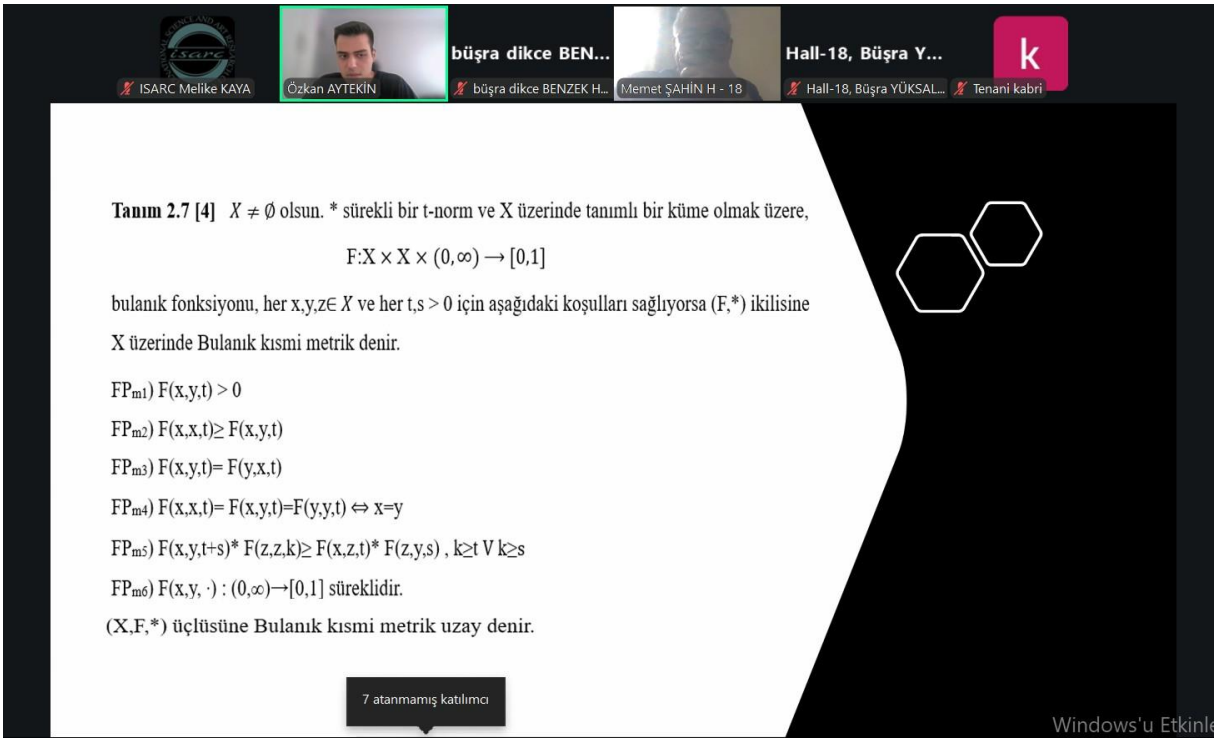

ISARC Melike KAYA
Hall 13 - SİBEL DEMİRTAŞ
Lenovo
13,Fatih Kurt
13,Fatih Kurt
Prof. Dr. Necdet KONAN
esma cici
GİRİŞ
Günümüzde bireylerden yalnızca bilgi sahibi olmaları değil; problem çözme, eleştirel düşünme, iş birliği, üretkenlik ve sorumluluk alma gibi 21. yüzyıl becerilerine sahip olmaları beklenmektedir. (Trilling & Fadel, 2009; OECD, 2018).
Bu beklentiler, eğitimi yaşam boyu devam eden bir süreç olarak ele alan anlayışla örtüşmektedir(UNESCO, 2015).
8 atanmamış katılımcı
Windows'u Etkinle


ISARC Melike KAYA
Aysel KOCAKÜLAH-HALL-...
Tahir KARAŞAHİN
Hall-14 Eray METİN
Hall 14 Rukiye Kübra A...
hall 14Canan O...
hall 14Canan Okumuş
Kavram Testinden Elde Edilen Bulguların Karşılaştırarak Verilmesi
Araştırma sonucunda Işık Konu Kavram Testi'nden elde edilen bulgular, konu başlı klarına göre aşağıda detaylandırılmıştır:
1. Işığın yayılması (ışık ışını çizimi): Işığın bir kaynaktan çıkarak her yöne ve doğ rusal yayıldığını ölçen 3. soruda Deney-1 grubunun "bilimsel olarak kabul edilebilir " yanıt oranı ön testte %5 iken son testte %70' e yükselmiştir. Deney-2 grubunda is e bu oran %36' dan %66' ya çıkmıştır. Yaşam temelli gruptaki artışın daha belirgin olduğu görülmektedir. Benzer şekilde ışık ışını çizimini ölçen 7. soruda Deney-1 gr ubu başarı oranını %35' ten %75' e çıkarmıştır.
Şimdi bir ara odasındasınız
Windows'u Etkinle


ISARC Melike KAYA
Tolga AKTÜRK
Tolga AKTÜRK
Hall 15 Yasin Kaya
EBRU YILDIRIM
Ömer FIRAT
Menü
5.GAZİANTEP KONGRE P...
GELİŞTİRİLMİŞ ÜS...
Oluştur
Giriş yap
Tüm araçlar
Düzenle
Dönüştür
E-imza
Metin veya araç bul
solutions (Raza & Abdel-Aty, 2023). Motivated by these developments, the present study employs the Modified Exponential Function Method to derive new families of exact solutions for the KPP equation, thereby extending existing results in the literature and demonstrating the efficiency of the method for nonlinear reaction–diffusion models.
$u_t - u_{xx} + \alpha u + \beta u^2 + \delta u^3 = 0.$ (1)
The Kolmogorov–Petrovskii–Piskunov (KPP) equation is a prototypical nonlinear reaction–diffusion equation that has been extensively used to model wave-front propagation phenomena arising from the combined effects of diffusion and nonlinear reaction mechanisms. The equation is particularly effective in describing the spread of biological populations, where it models the invasion of a species into a new habitat through growth and diffusion processes. Beyond population genetics, the KPP equation has found important applications in ecology and epidemiology for modeling the spatial spread of species, diseases, and epidemics. In combustion theory and chemical kinetics, it is employed to represent flame propagation and autocatalytic chemical reactions, where reaction rates and diffusion play a dominant role. The equation has also been utilized in neuroscience, plasma physics, and materials science to
5 atanmamış katılımcı
, phase transitions, and pattern formation in extended media. Owing
he KPP equation admits a variety of dynamical behaviors, most
3
19
Windows'u Etk


H-16 Doç.Dr. Murat POLAT
Hall 16 Simge Koç
Hall-16, Pınar KARATA...
Hall 16 Özgür AY
Halk 16Gülşah
denizkilic
Halk 16Gülşah
denizkilic
Menu
Tam Metin Bildiri. Murat...
Create
Sign in
Try PDF Spaces
All tools
Edit
Convert
E-Sign
Find text or tools
Share
Ask AI Assistant
All tools
Create a PDF Space
Preview
Export a PDF
Edit a PDF
Create a PDF
Combine files
Organize pages
AI Assistant
Generative summary
Request e-signatures
Scan & OCR
Protect a PDF
Redact a PDF
Compress a PDF
View more
Convert, edit and e-sign PDF forms & agreements
Free trial
in terms of the ambient quaternionic sectional curvature and the O'Neill tensors. Moreover, we completely characterize the equality cases and show that they correspond to strong geometric conditions such as totally geodesic fibers and integrable horizontal distributions. Several examples are provided to illustrate the sharpness of the obtained inequalities.
2. PRELIMINARIES
Let $F:(M,g)\to(N,h)$ be a Riemannian submersion between Riemannian manifolds. According to O'Neill [3], the tangent bundle of M admits an orthogonal decomposition
$TM = V \oplus H,$
where $V = KerF_*$ denotes the vertical distribution and $H = V^{\perp}$ the horizontal distribution. This decomposition plays a fundamental role in comparing the geometric properties of the total space with those of the base manifold.
Let ∇ be the Levi–Civita connection on (M,g). Following [3], the geometry of a Riemannian submersion is described by the O'Neill tensors T and A, defined for vector fields E,F on M by
$T_E F = H\nabla_{VE}VF + V\nabla_{VE}HF,$
$A_E F = H\nabla_{HE}VF + V\nabla_{HE}HF.$
5 atanmamış katılımcı
3
10
Windows'u Etkinleştir





Tanım 2.7 [4] $X \neq \emptyset$ olsun. * sürekli bir t-norm ve X üzerinde tanımlı bir küme olmak üzere,

$$F:X \times X \times (0,\infty) \rightarrow [0,1]$$

bulanık fonksiyonu, her $x,y,z \in X$ ve her $t,s > 0$ için aşağıdaki koşulları sağlıyorsa (F,*) ikilisine X üzerinde Bulanık kısmi metrik denir.

FP_{m1}) $F(x,y,t) > 0$

FP_{m2}) $F(x,x,t) \geq F(x,y,t)$

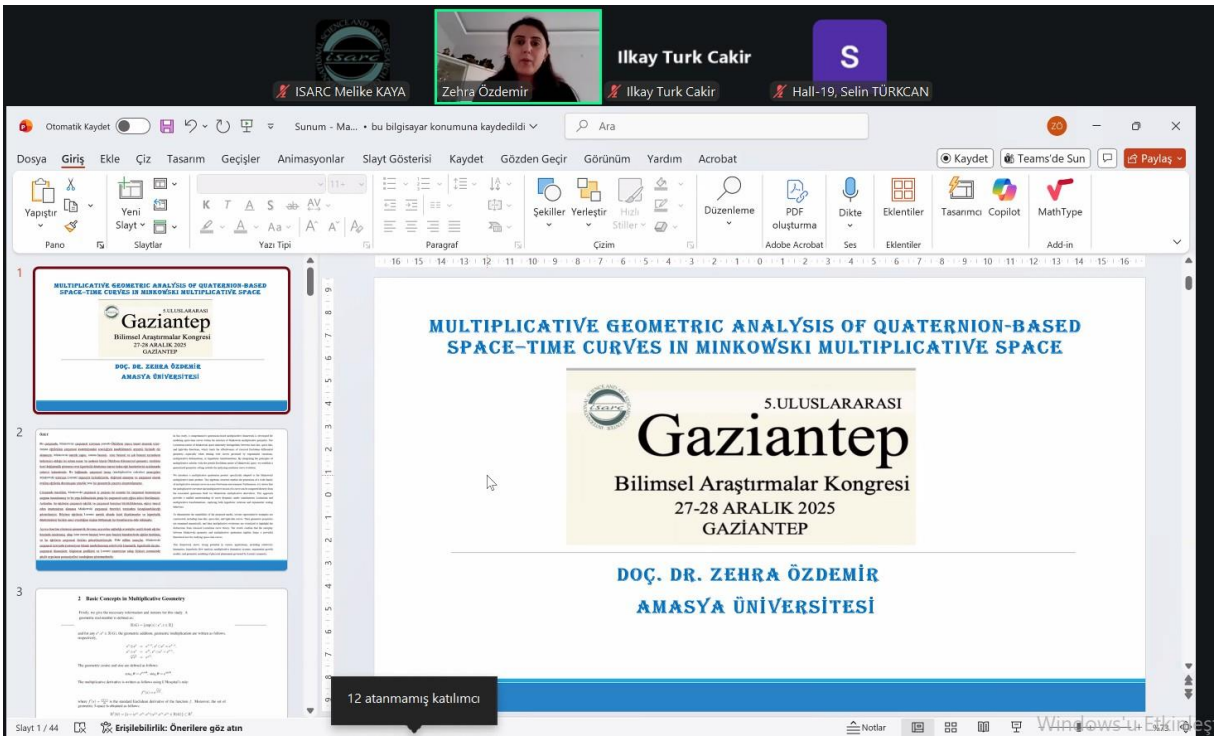
FP_{m3}) $F(x,y,t) = F(y,x,t)$

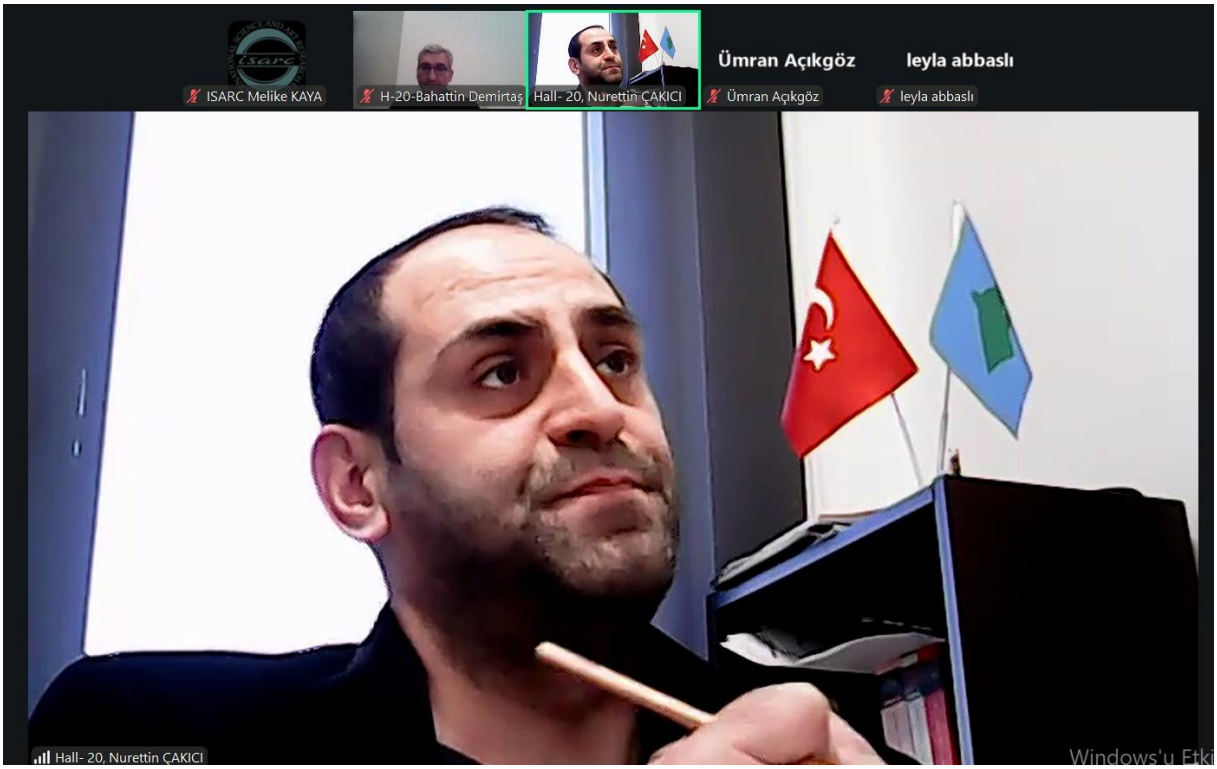
FP_{m4}) $F(x,x,t) = F(x,y,t) = F(y,y,t) \Leftrightarrow x=y$

FP_{m5}) $F(x,y,t+s) * F(z,z,k) \geq F(x,z,t) * F(z,y,s)$, $k \geq t$ V $k \geq s$

FP_{m6}) $F(x,y,\cdot) : (0,\infty) \rightarrow [0,1]$ süreklidir.

$(X,F,*)$ üçlüsüne Bulanık kısmi metrik uzay denir.


ISARC Melike KAYA
Zehra Özdemir
Ilkay Turk Cakir
Ilkay Turk Cakir
S
Hall-19, Selin TÜRKCAN
MULTIPLICATIVE GEOMETRIC ANALYSIS OF QUATERNION-BASED SPACE–TIME CURVES IN MINKOWSKI MULTIPLICATIVE SPACE
5.ULUSLARARASI
Gaziantep
Bilimsel Araştırmalar Kongresi
27-28 ARALIK 2025
GAZİANTEP
DOÇ. DR. ZEHRA ÖZDEMİR
AMASYA ÜNİVERSİTESİ
12 atanmamış katılımcı


ISARC Melike KAYA
H-20-Bahattin Demirtaş
Hall- 20, Nurettin ÇAKICI
Ümran Açıkgöz
leyla abbaslı
Ümran Açıkgöz
leyla abbaslı
Hall- 20, Nurettin ÇAKICI

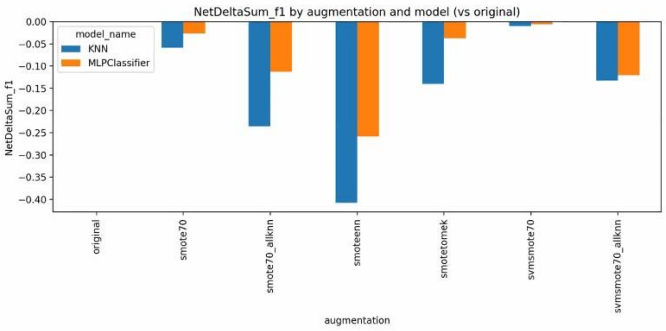
Sesi Açmayı İste

Hall 24 - Sezgin Çeker... | Anvar Abbasov Hall 24... | doğan aydin | Tuğçe Durmaz | Fatima Quluyeva | Hilal Önler

RESULTS III:
TÜM SINIFLAR ÜZERİNDE NET ETKİ

Tüm sınıflar üzerindeki net etki

- Toplam kazanımlar ve kayıplar
- Hangi varyantlar daha yıkıcı?
- Net etki tek başına karar verdirici değildir



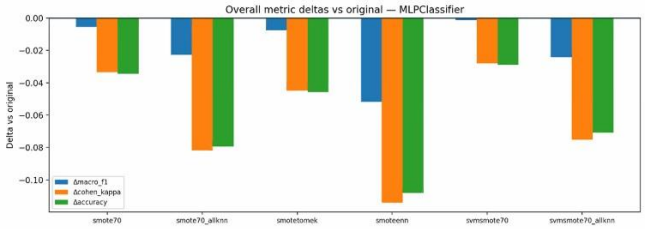
Windows'u Etkin

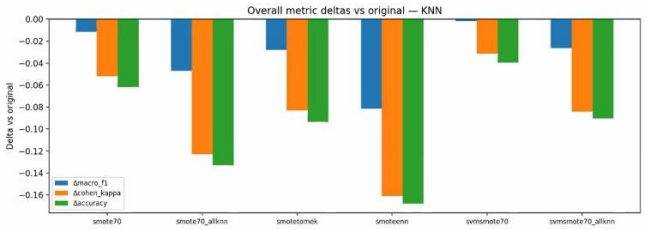
ISARC Melike KAYA | Ahmet Sertol Köksal | Hall 24 - Sezgin Çeker... | Anvar Abbasov Hall 24... | Tuğçe Durmaz | Fatima Quluyeva

RESULTS II:
GLOBAL PERFORMANS BOZULMASI

Orijinal duruma göre değişimler

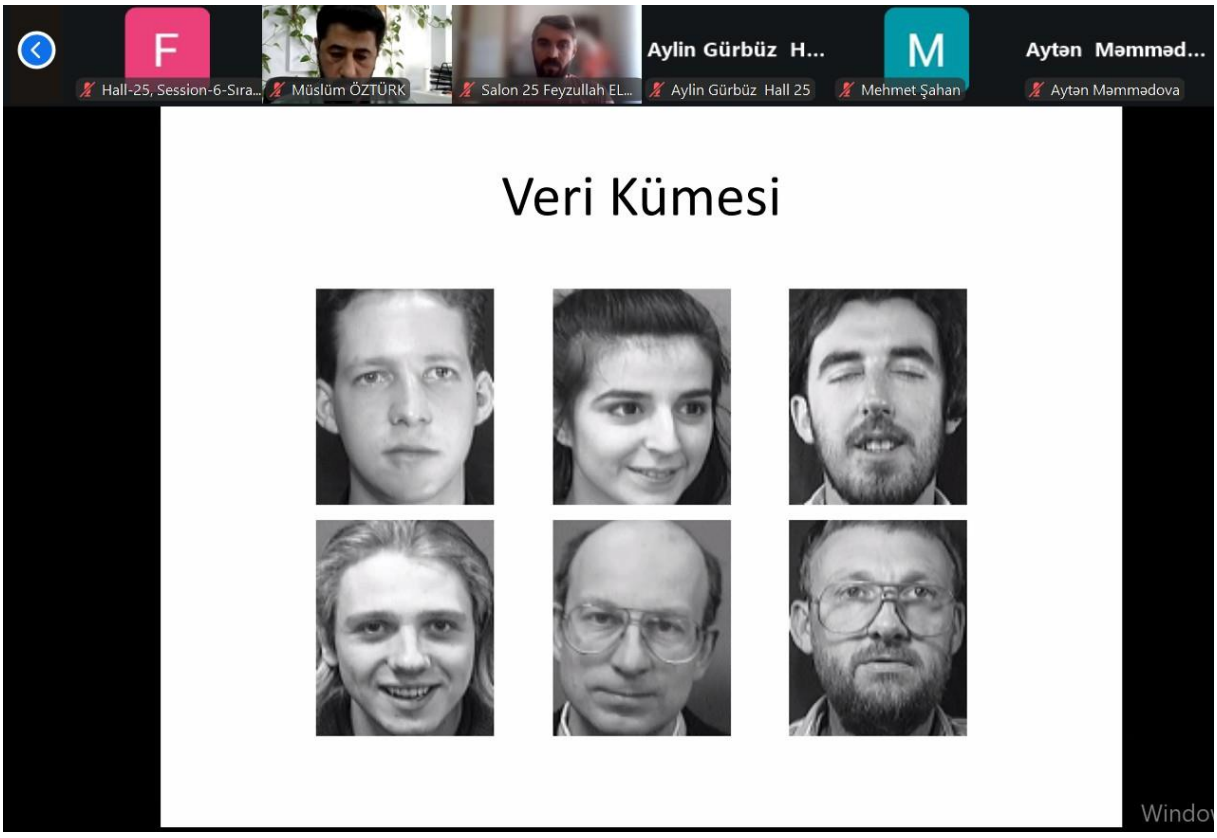
- Macro-F1'de küçük düşüşler
- Doğruluk ve kappa değerlerinde daha büyük düşüşler
- N1 iyileşmesinin kontrollü bir maliyeti var

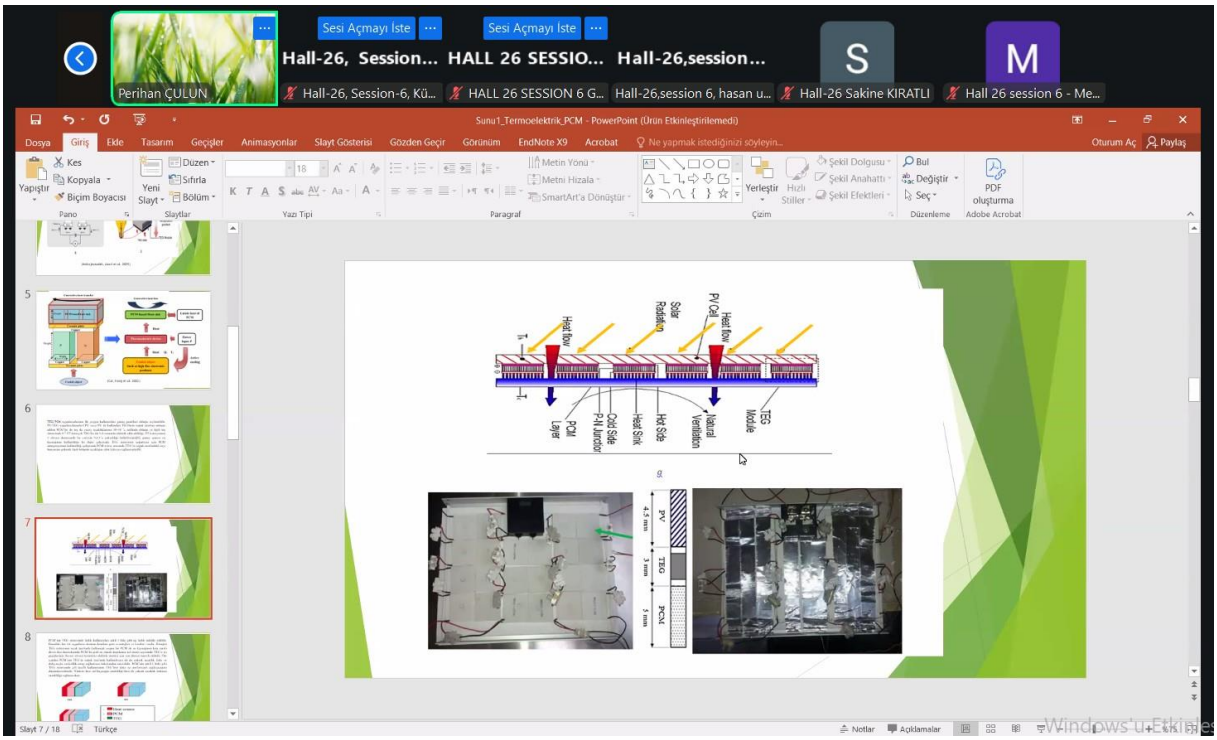


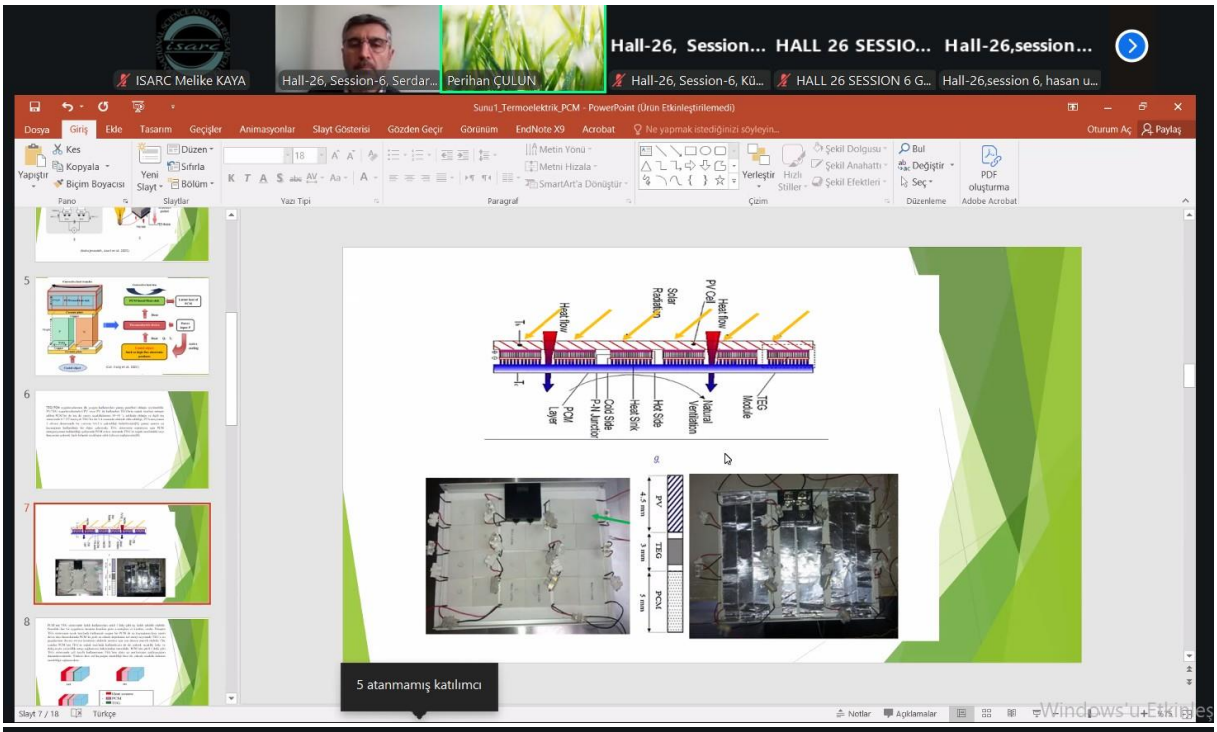


5 atanmamış katılımcı

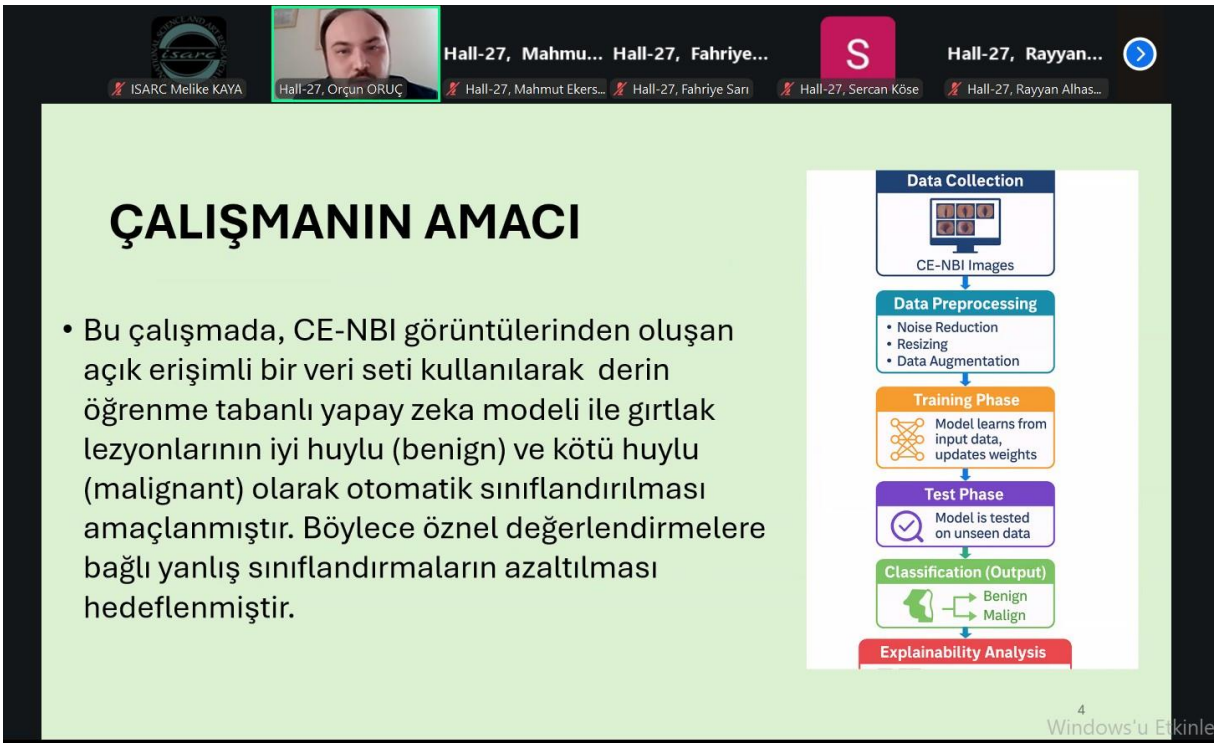
Windows'u Etkin

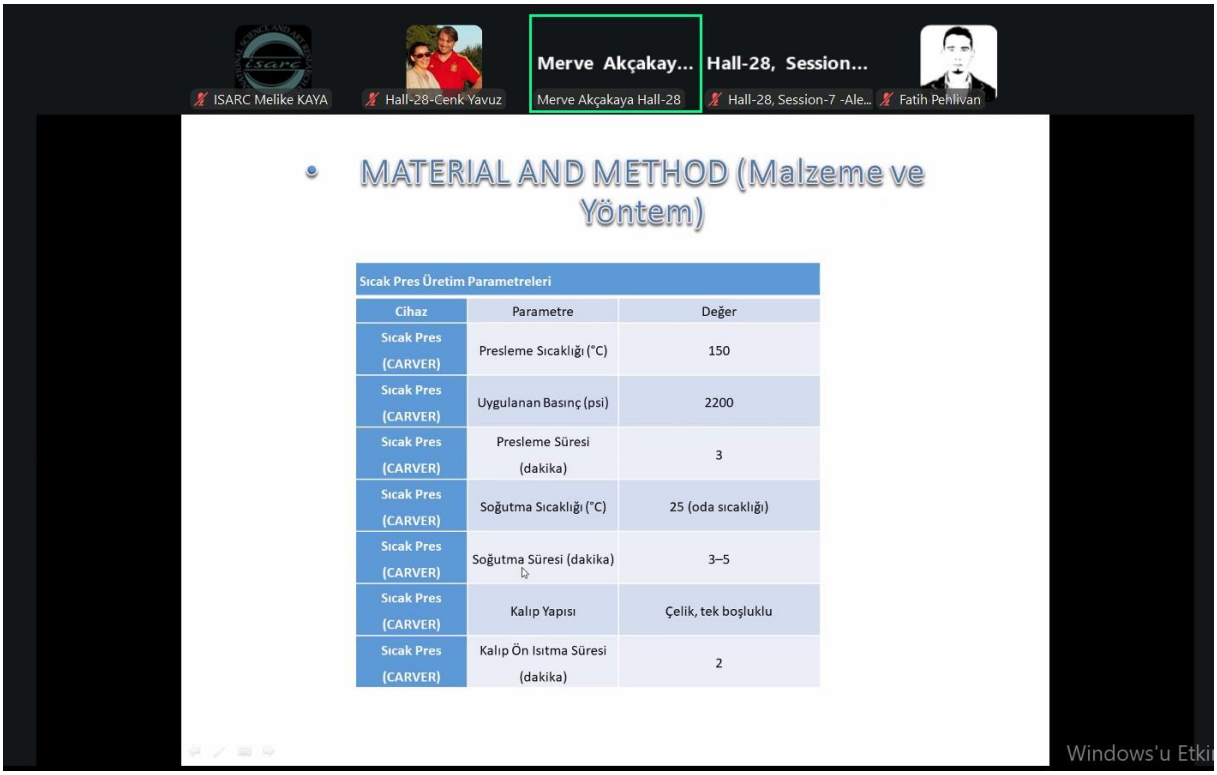

Hall-25, Session-6-Sıra...
Müslüm ÖZTÜRK
Salon 25 Feyzullah EL...
Aylin Gürbüz H...
Aylin Gürbüz Hall 25
Mehmet Şahan
Aytən Məmməd...
Aytən Məmmədova
Veri Kümesi


Perihan ÇULUN
Hall-26, Session...
HALL 26 SESSIO...
Hall-26,session...
Hall-26, Session-6, Kü...
HALL 26 SESSION 6 G...
Hall-26,session 6, hasan u...
Hall-26 Sakine KIRATLI
Hall 26 session 6 - Me...
Heat flow
Solar Radiation
PV Cell
Heat flow
PCM Layer
Cold Side P-N Junction
Heat Sink
Hot Side
Natural Ventilation
TEG Module

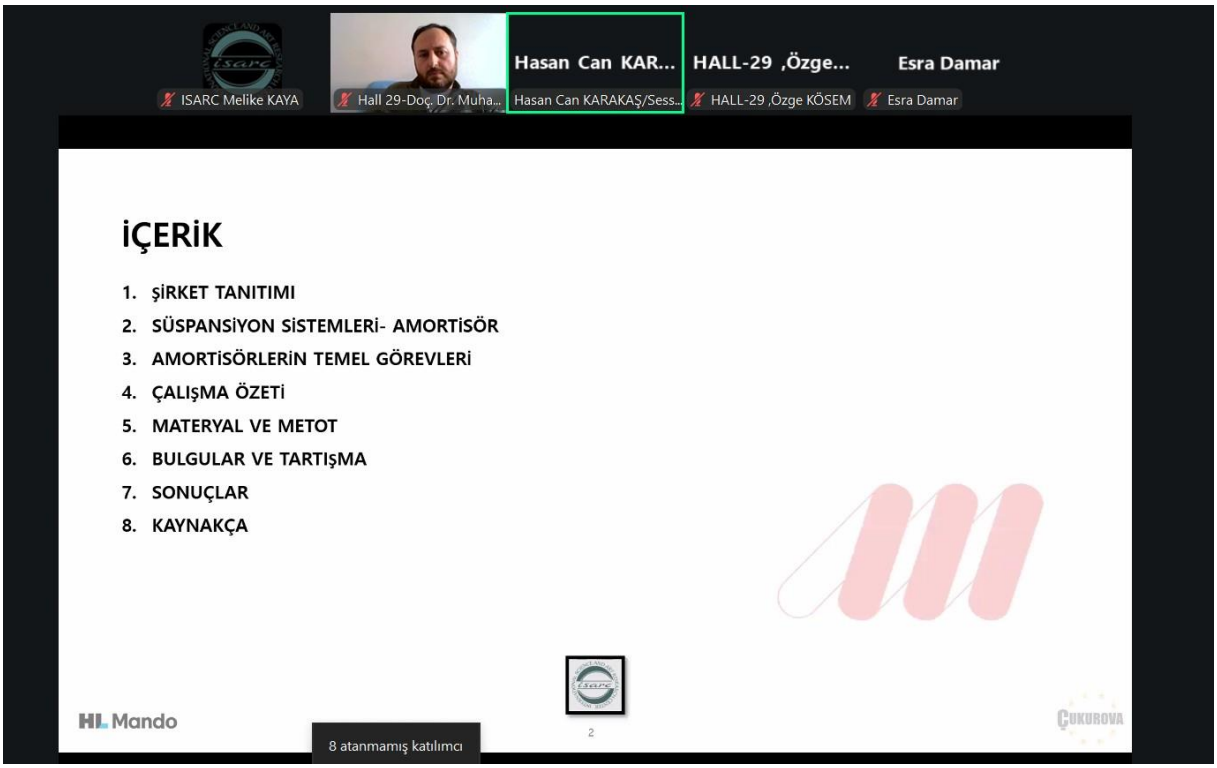

ISARC Melike KAYA
Hall-26, Session-6, Serdar...
Perihan ÇULUN
Hall-26, Session... HALL 26 SESSIO... Hall-26,session...
Hall-26, Session-6, Kü...
HALL 26 SESSION 6 G...
Hall-26,session 6, hasan u...
Sunu1_Termoelektrik_PCM - PowerPoint (Ürün Etkinleştirilemedi)
Heat flow
Solar Radiation
PV Cell
Heat flow
PCM Layer
Cold Side
PVC Laminator
Heat Sink
Hot Side
Natural Ventilation
TEG Module
PV
TEG
PCM
4.5 mm
3 mm
5 mm
5 atanmamış katılımcı

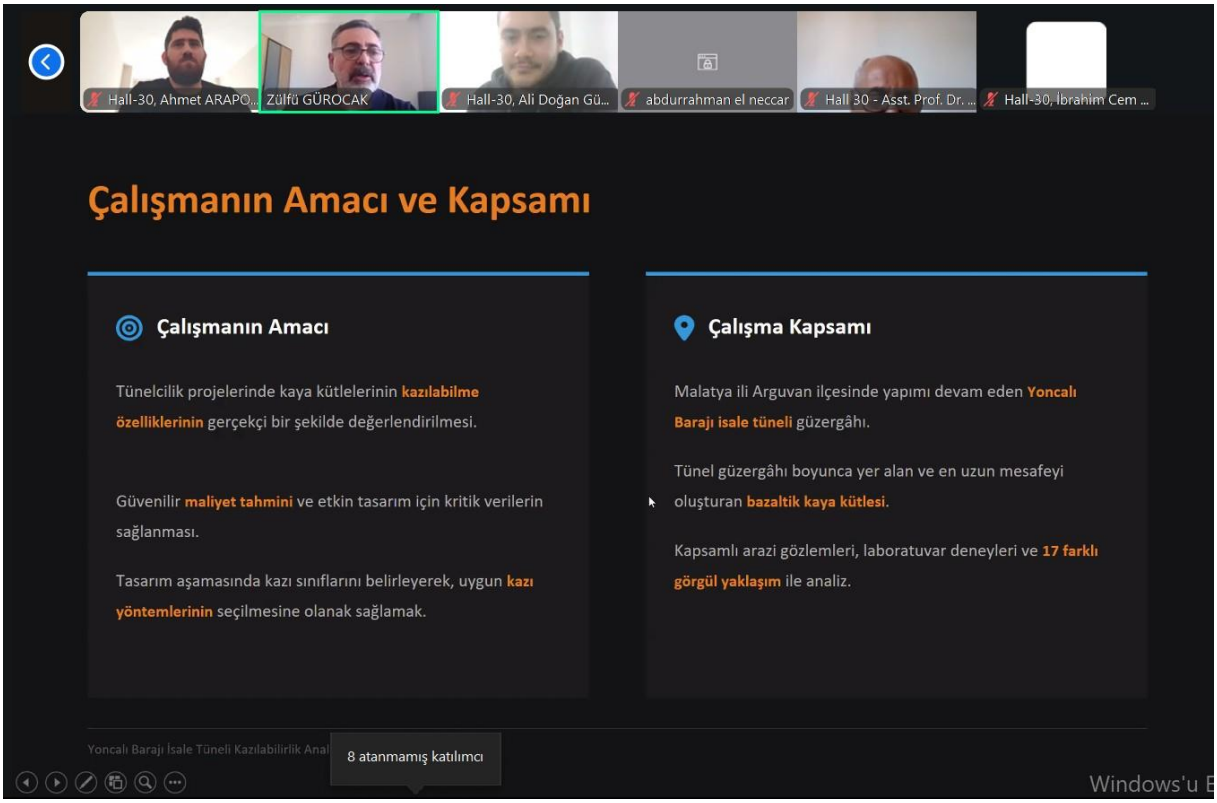

Hall-27, Rayyan...
Hall-27, Rayyan Alhas...
Uğur Karabıçak Hall27 (
Asuman SAVAŞÇIHABEŞ
Emrah ŞEKER
Elif Nur SELÇUK
Dr. Öğr. Üyesi Kubilay ...
CE-NBI Teknolojisi
NBI (Narrow Band Imaging)
• Endoskop, beyaz ışık kaynağına sahiptir.
• NBI modunda bu ışık, dar bant filtrelerden geçirilir. Filtreler iki ana dalga boyunu iletir:
• Mavi ışık (~415 nm) Yeşil ışık (~540 nm) Bu dalga boyları hemoglobin tarafından güçlü şekilde absorbe edilir.
• Mavi ışık → yüzeysel kapiller damarları
• Yeşil ışık → daha derin damarları vurgular
• Kan içeren yapılar koyu ve kontrastlı çevre dokular daha açık görünür
Böylece mikrovasküler yapı belirginleşir.
5

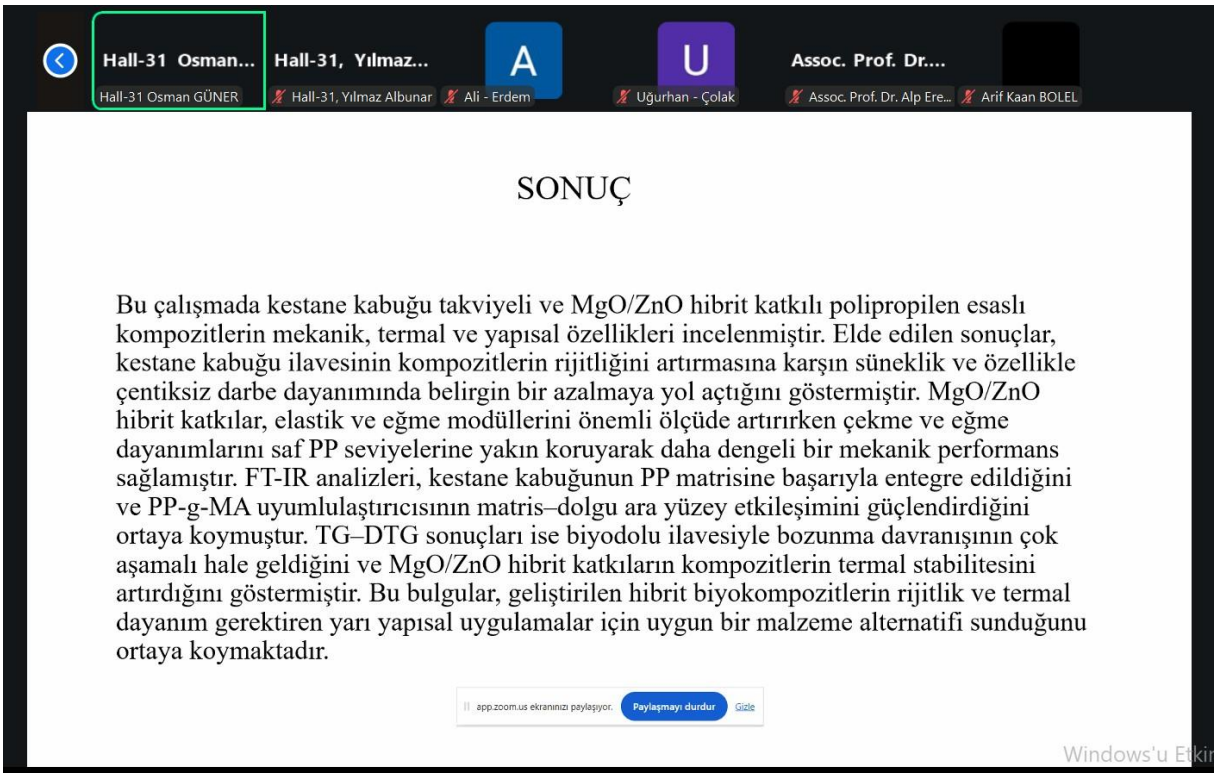


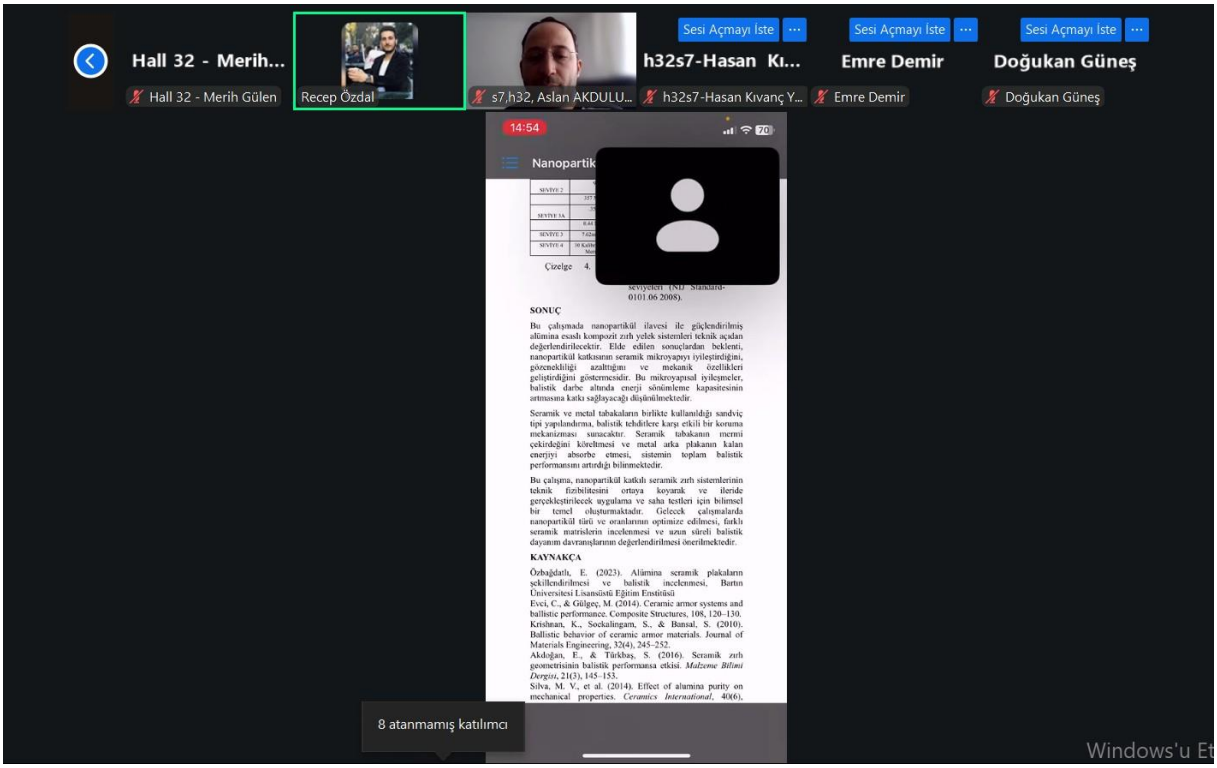


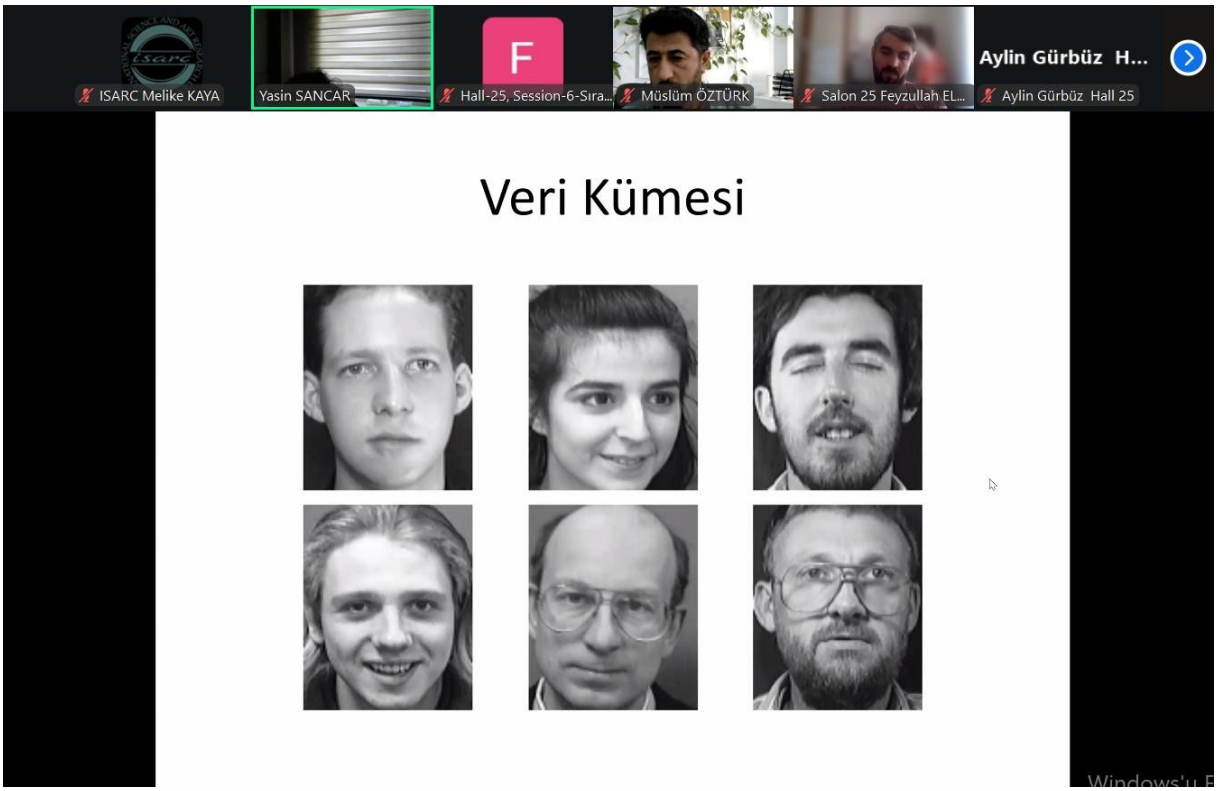
Sıcak Pres Üretim Parametreleri		
Cihaz	Parametre	Değer
Sıcak Pres (CARVER)	Presleme Sıcaklığı (°C)	150
Sıcak Pres (CARVER)	Uygulanan Basınç (psi)	2200
Sıcak Pres (CARVER)	Presleme Süresi (dakika)	3
Sıcak Pres (CARVER)	Soğutma Sıcaklığı (°C)	25 (oda sıcaklığı)
Sıcak Pres (CARVER)	Soğutma Süresi (dakika)	3–5
Sıcak Pres (CARVER)	Kalıp Yapısı	Çelik, tek boşluklu
Sıcak Pres (CARVER)	Kalıp Ön Isıtma Süresi (dakika)	2

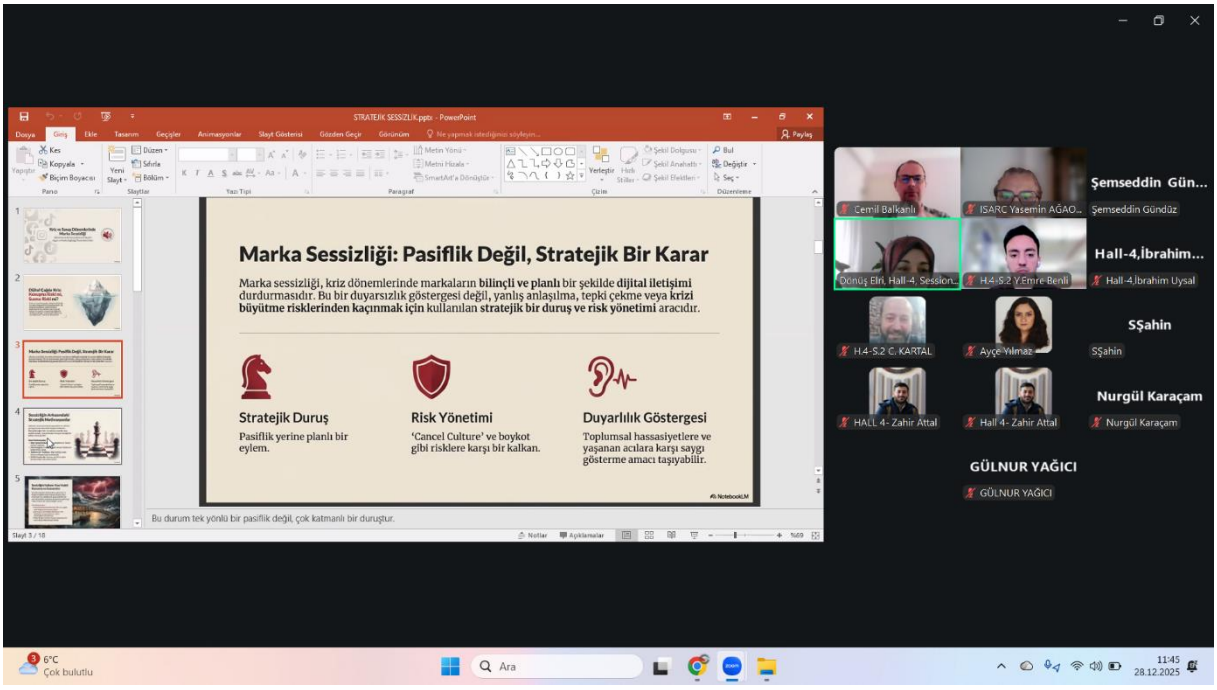

ISARC Melike KAYA
Hall 29-Doç. Dr. Muha...
Hasan Can KAR...
Hasan Can KARAKAŞ/Sess...
HALL-29 ,Özge...
HALL-29 ,Özge KÖSEM
Esra Damar
Esra Damar
İÇERİK
1. ŞİRKET TANITIMI
2. SÜSPANSİYON SİSTEMLERİ- AMORTİSÖR
3. AMORTİSÖRLERİN TEMEL GÖREVLERİ
4. ÇALIŞMA ÖZETİ
5. MATERYAL VE METOT
6. BULGULAR VE TARTIŞMA
7. SONUÇLAR
8. KAYNAKÇA
HL Mando
2
ÇUKUROVA
8 atanmamış katılımcı


Hall-30, Ahmet ARAPO...
Zülfü GÜROCAK
Hall-30, Ali Doğan Gü...
abdurrahman el neccar
Hall 30 - Asst. Prof. Dr. ...
Hall-30, İbrahim Cem ...
Çalışmanın Amacı ve Kapsamı
Çalışmanın Amacı
Tünelcilik projelerinde kaya kütlelerinin kazılabilme özelliklerinin gerçekçi bir şekilde değerlendirilmesi.
Güvenilir maliyet tahmini ve etkin tasarım için kritik verilerin sağlanması.
Tasarım aşamasında kazı sınıflarını belirleyerek, uygun kazı yöntemlerinin seçilmesine olanak sağlamak.
Çalışma Kapsamı
Malatya ili Arguvan ilçesinde yapımı devam eden Yoncalı Barajı isale tüneli güzergâhı.
Tünel güzergâhı boyunca yer alan ve en uzun mesafeyi oluşturan bazaltik kaya kütlesi.
Kapsamlı arazi gözlemleri, laboratuvar deneyleri ve 17 farklı görgül yaklaşım ile analiz.
Yoncalı Barajı İsale Tüneli Kazılabilirlik Anal
8 atanmamış katılımcı
Windows'u E

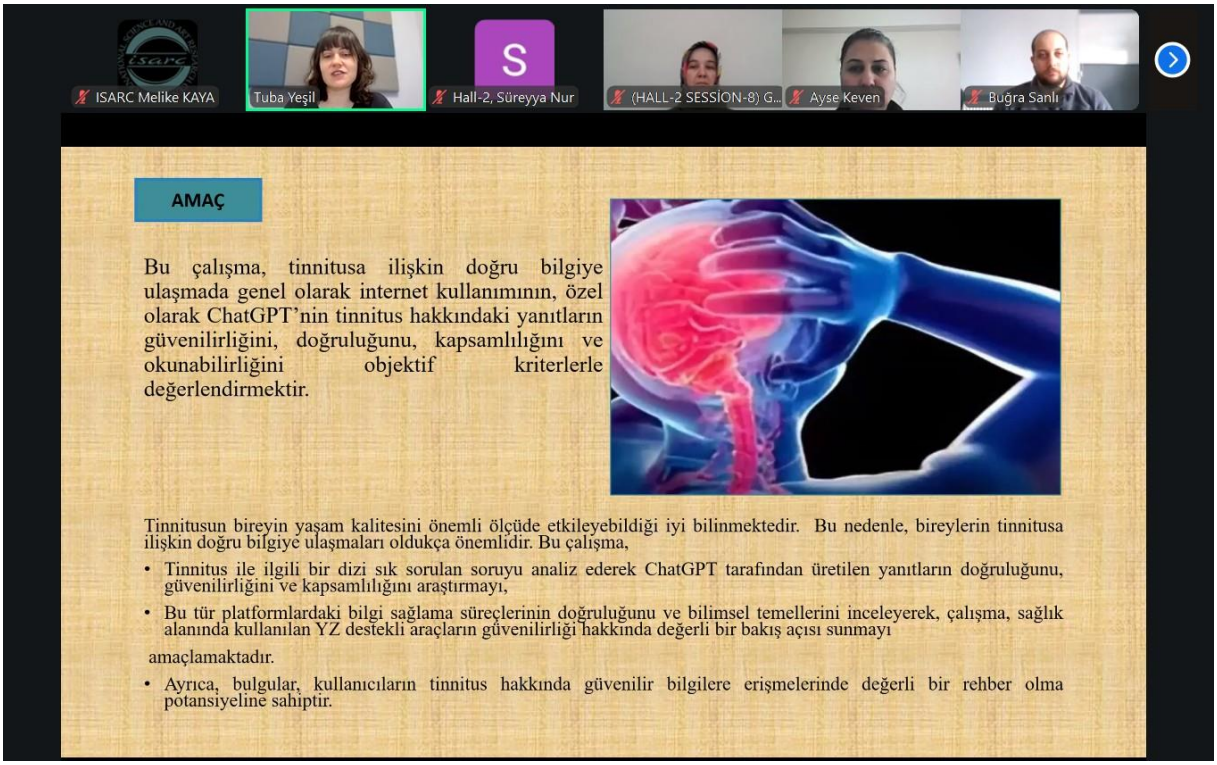

Hall-31 Osman...
Hall-31 Osman GÜNER
Hall-31, Yılmaz...
Hall-31, Yılmaz Albunar
Ali - Erdem
Uğurhan - Çolak
Assoc. Prof. Dr....
Assoc. Prof. Dr. Alp Ere...
Arif Kaan BOLEL
SONUÇ
Bu çalışmada kestane kabuğu takviyeli ve MgO/ZnO hibrit katkılı polipropilen esaslı kompozitlerin mekanik, termal ve yapısal özellikleri incelenmiştir. Elde edilen sonuçlar, kestane kabuğu ilavesinin kompozitlerin rijitliğini artırmasına karşın süneklik ve özellikle çentiksiz darbe dayanımında belirgin bir azalmaya yol açtığını göstermiştir. MgO/ZnO hibrit katkılar, elastik ve eğme modüllerini önemli ölçüde artırırken çekme ve eğme dayanımlarını saf PP seviyelerine yakın koruyarak daha dengeli bir mekanik performans sağlamıştır. FT-IR analizleri, kestane kabuğunun PP matrisine başarıyla entegre edildiğini ve PP-g-MA uyumlulaştırıcısının matris–dolgu ara yüzey etkileşimini güçlendirdiğini ortaya koymuştur. TG–DTG sonuçları ise biyodolu ilavesiyle bozunma davranışının çok aşamalı hale geldiğini ve MgO/ZnO hibrit katkıların kompozitlerin termal stabilitesini artırdığını göstermiştir. Bu bulgular, geliştirilen hibrit biyokompozitlerin rijitlik ve termal dayanım gerektiren yarı yapısal uygulamalar için uygun bir malzeme alternatifi sunduğunu ortaya koymaktadır.
app.zoom.us ekranınızı paylaşıyor.
Paylaşmayı durdur
Gizle
Windows'u Etkin

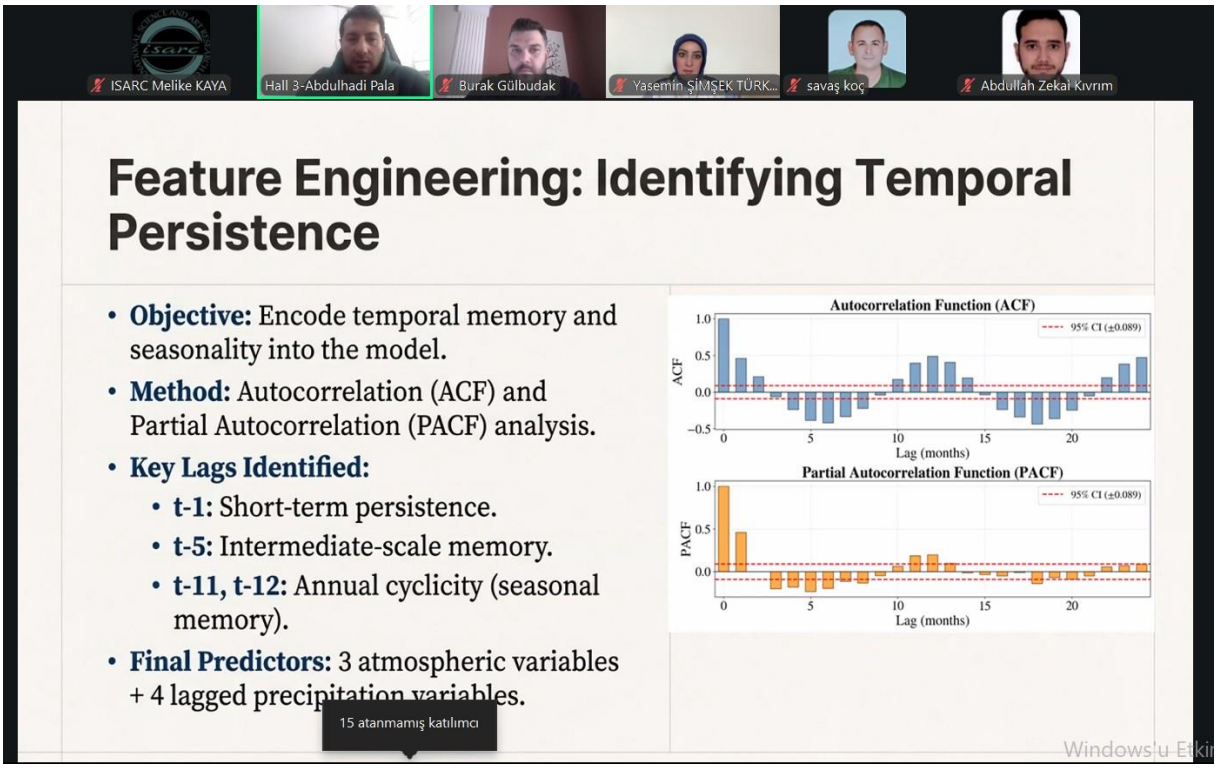

Hall 32 - Merih...
Hall 32 - Merih Gülen
Recep Özdal
s7,h32, Aslan AKDULU...
h32s7-Hasan Kı...
h32s7-Hasan Kıvanç Y...
Emre Demir
Doğukan Güneş
Sesi Açmayı İste
14:54
Çizelge 4.
SONUÇ
Bu çalışmada nanopartikül ilavesi ile güçlendirilmiş alümina esaslı kompozit zırh yelek sistemleri teknik açıdan değerlendirilecektir. Elde edilen sonuçlardan beklenti, nanopartikül katkısının seramik mikroyapıyı iyileştirdiğini, gözenekliliği azalttığını ve mekanik özellikleri geliştirdiğini göstermesidir. Bu mikroyapısal iyileşmeler, balistik darbe altında enerji sönümleme kapasitesinin artmasına katkı sağlayacağı düşünülmektedir.
Seramik ve metal tabakaların birlikte kullanıldığı sandviç tipi yapılandırma, balistik tehditlere karşı etkili bir koruma mekanizması sunacaktır. Seramik tabakanın mermi çekirdeğini körleltmesi ve metal arka plakanın kalan enerjiyi absorbe etmesi, sistemin toplam balistik performansını artırdığı bilinmektedir.
Bu çalışma, nanopartikül katkılı seramik zırh sistemlerinin teknik fizibilitesini ortaya koyarak ve ileride gerçekleştirilecek uygulama ve saha testleri için bilimsel bir temel oluşturmaktadır. Gelecek çalışmalarda nanopartikül türü ve oranlarının optimize edilmesi, farklı seramik matrislerin incelenmesi ve uzun süreli balistik dayanım davranışlarının değerlendirilmesi önerilmektedir.
KAYNAKÇA
Özbağdatlı, E. (2023). Alümina seramik plakaların şekillendirilmesi ve balistik incelenmesi. Bartın Üniversitesi Lisansüstü Eğitim Enstitüsü
Evci, C., & Gülgec, M. (2014). Ceramic armor systems and ballistic performance. Composite Structures, 108, 120–130.
Krishnan, K., Sockalingam, S., & Bansal, S. (2010). Ballistic behavior of ceramic armor materials. Journal of Materials Engineering, 32(4), 245–252.
Akdoğan, E., & Türkbaş, S. (2016). Seramik zırh geometrisinin balistik performansa etkisi. Malzeme Bilimi Dergisi, 21(3), 145–153.
Silva, M. V., et al. (2014). Effect of alumina purity on mechanical properties. Ceramics International, 40(6),
8 atanmamış katılımcı
Windows'u Et


ISARC Melike KAYA
Yasin SANCAR
Hall-25, Session-6-Sıra...
Müslüm ÖZTÜRK
Salon 25 Feyzullah EL...
Aylin Gürbüz H...
Aylin Gürbüz Hall 25
Veri Kümesi

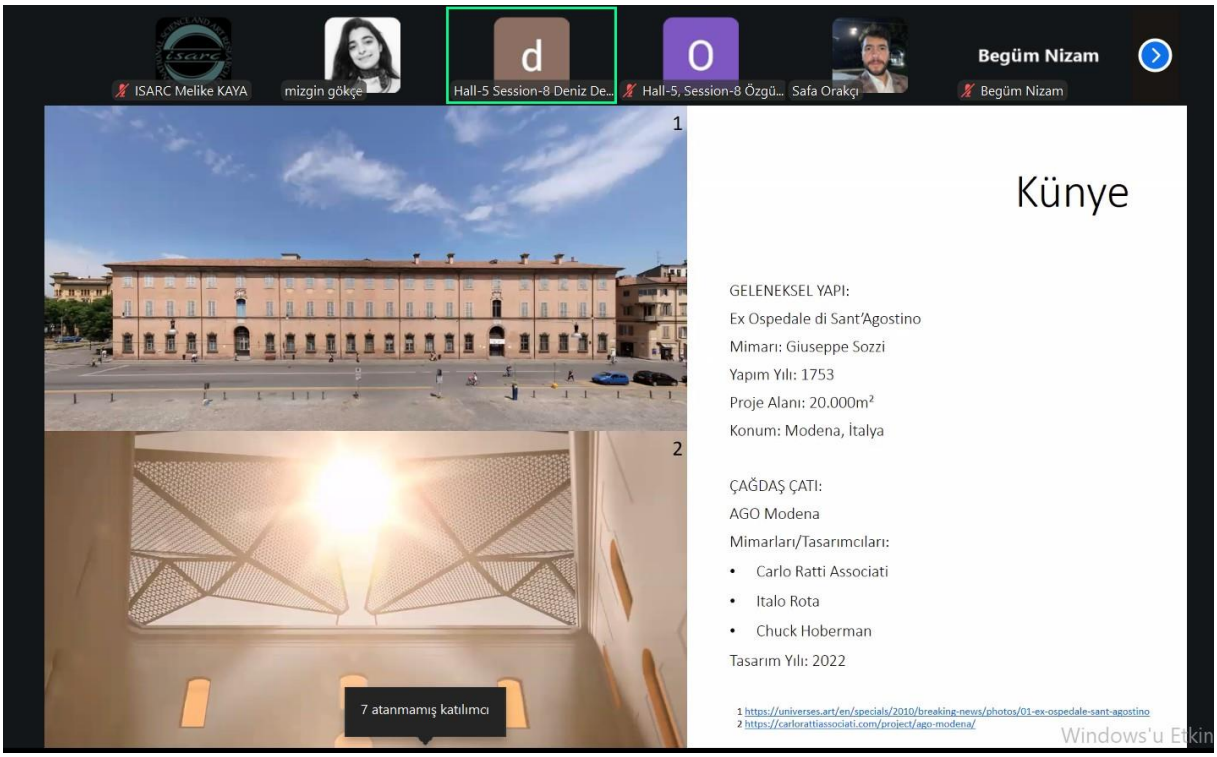

STRATEJİK SESSİZLİK.pptx - PowerPoint
Marka Sessizliği: Pasiflik Değil, Stratejik Bir Karar
Marka sessizliği, kriz dönemlerinde markaların bilinçli ve planlı bir şekilde dijital iletişimi durdurmasıdır. Bu bir duyarsızlık göstergesi değil, yanlış anlaşılma, tepki çekme veya krizi büyütme risklerinden kaçınmak için kullanılan stratejik bir duruş ve risk yönetimi aracıdır.
Stratejik Duruş
Pasiflik yerine planlı bir eylem.
Risk Yönetimi
'Cancel Culture' ve boykot gibi risklere karşı bir kalkan.
Duyarlılık Göstergesi
Toplumsal hassasiyetlere ve yaşanan acılara karşı saygı gösterme amacı taşıyabilir.
Bu durum tek yönlü bir pasiflik değil, çok katmanlı bir duruştur.
Cemil Balkanlı
ISARC Yasemin AĞAO...
Şemseddin Gün...
Şemseddin Gündüz
Dönüş Elri, Hall-4, Session...
H.4-S.2 Y.Emre Benli
Hall-4,İbrahim...
Hall-4,İbrahim Uysal
H.4-S.2 C. KARTAL
Ayçe Yılmaz
SŞahin
SŞahin
HALL 4- Zahir Attal
Hall 4- Zahir Attal
Nurgül Karaçam
Nurgül Karaçam
GÜLNUR YAĞICI
GÜLNUR YAĞICI
6°C
Çok bulutlu
Ara
11:45
28.12.2025

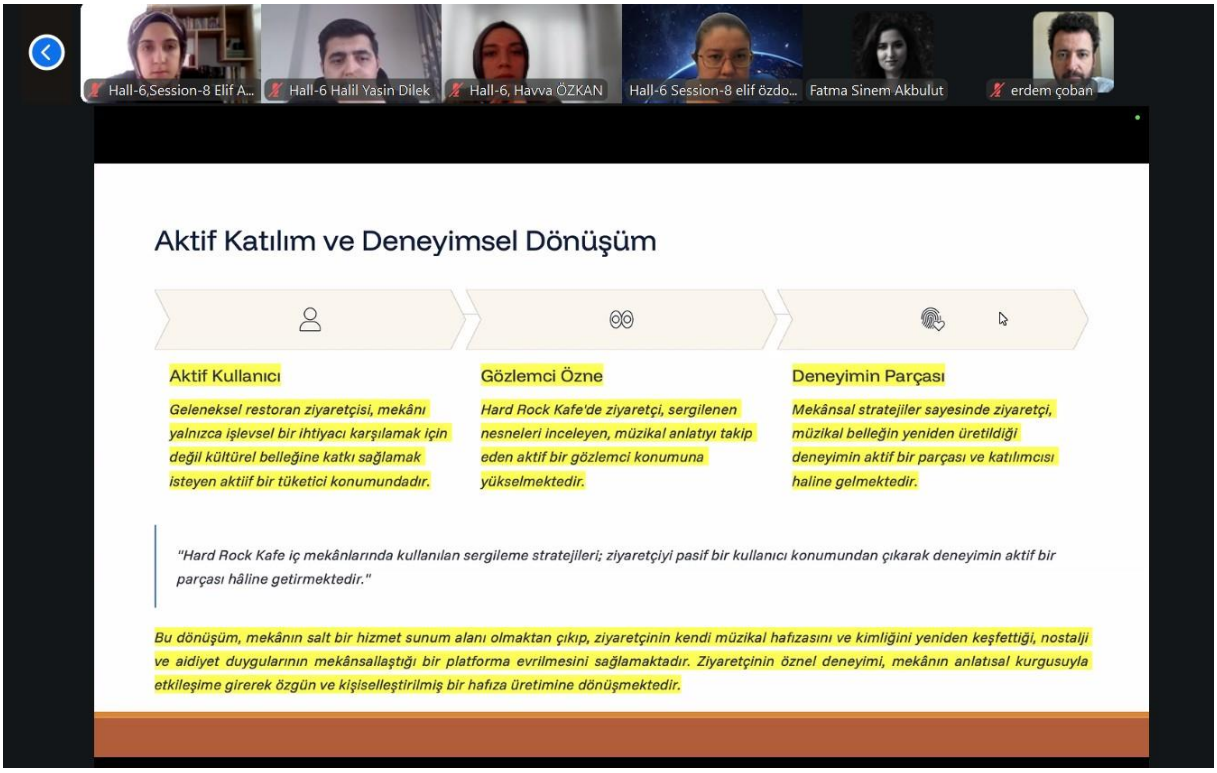

(HALL-2 SESSİON-8) G...
Ayse Keven
Buğra Sanlı
Hall-2, Session-8, NAR...
Sibel Torunoğlu Hall-2 ...
Yasin PARLATIR
Yasin PARLATIR
YÖNTEM
1. Ne Yaptık?
2. Nasıl Yaptık?
3. Neyi Ölçtük?
ChatGPT tarafından oluşturulan tinnitus ile ilgili sık sorulan 50 sorudan 10 tanesini analiz ettik.
5 tarafsız uzman, yanıtları dört puanlık bir kalite ölçeği kullanarak değerlendirdi.
Değerlendiriciler Arası Güvenilirlik: Uzmanların ne kadar tutarlı olduğunu ölçmek için Sınıf İçi Korelasyon Katsayısı (ICC) kullanıldı.
Okunabilirlik: Metinlerin anlaşılırlığını ölçmek için Ateşman okunabilirlik yöntemi kullanıldı.

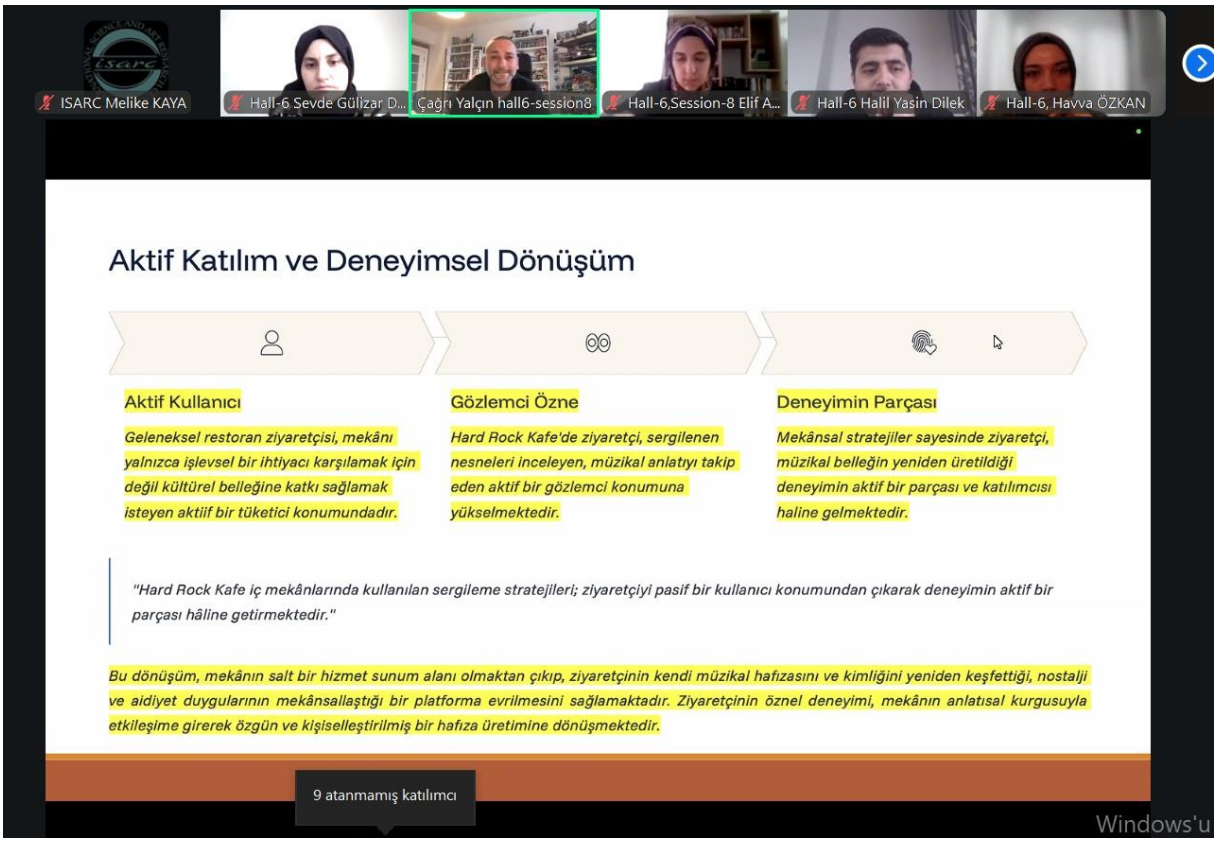

ISARC Melike KAYA
Tuba Yeşil
Hall-2, Süreyya Nur
(HALL-2 SESSİON-8) G...
Ayse Keven
Buğra Sanlı
AMAÇ
Bu çalışma, tinnitusa ilişkin doğru bilgiye ulaşmada genel olarak internet kullanımının, özel olarak ChatGPT'nin tinnitus hakkındaki yanıtların güvenilirliğini, doğruluğunu, kapsamlılığını ve okunabilirliğini objektif kriterlerle değerlendirmektir.
Tinnitusun bireyin yaşam kalitesini önemli ölçüde etkileyebildiği iyi bilinmektedir. Bu nedenle, bireylerin tinnitusa ilişkin doğru bilgiye ulaşmaları oldukça önemlidir. Bu çalışma,
• Tinnitus ile ilgili bir dizi sık sorulan soruyu analiz ederek ChatGPT tarafından üretilen yanıtların doğruluğunu, güvenilirliğini ve kapsamlılığını araştırmayı,
• Bu tür platformlardaki bilgi sağlama süreçlerinin doğruluğunu ve bilimsel temellerini inceleyerek, çalışma, sağlık alanında kullanılan YZ destekli araçların güvenilirliği hakkında değerli bir bakış açısı sunmayı
amaçlamaktadır.
• Ayrıca, bulgular, kullanıcıların tinnitus hakkında güvenilir bilgilere erişmelerinde değerli bir rehber olma potansiyeline sahiptir.

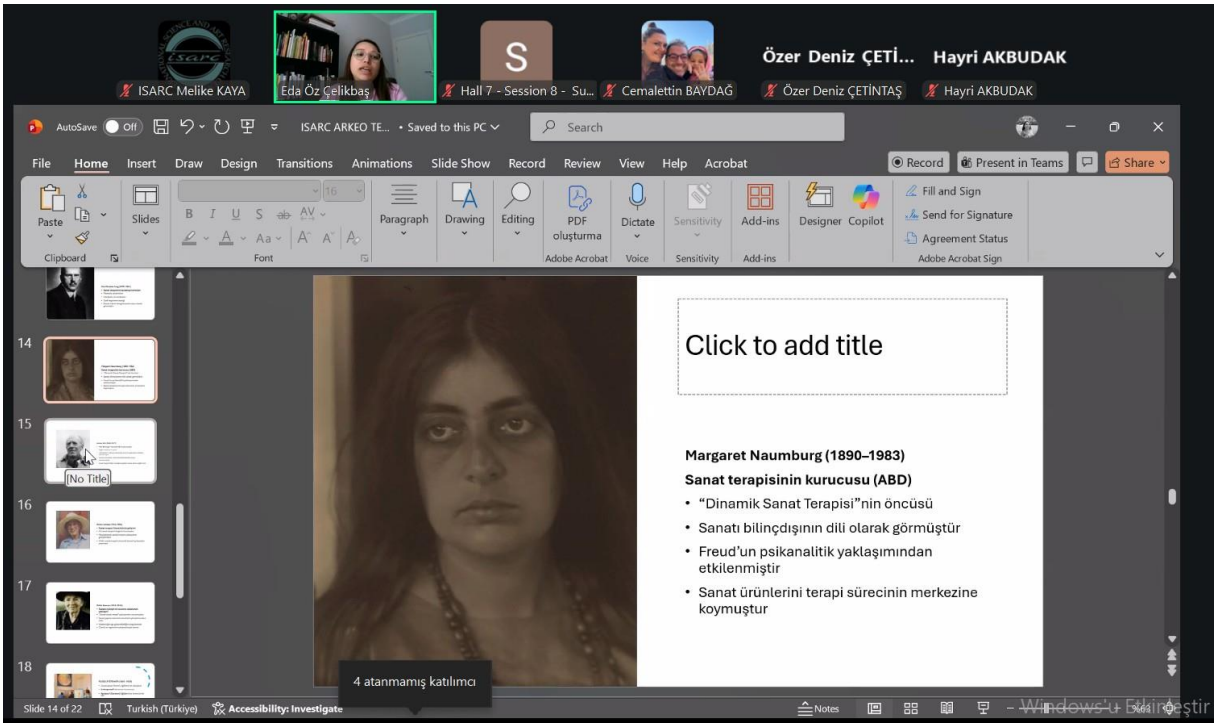

ISARC Melike KAYA
Hall 3-Abdulhadi Pala
Burak Gülbudak
Yasemin ŞİMŞEK TÜRK...
savaş koç
Abdullah Zekai Kıvrım
Feature Engineering: Identifying Temporal Persistence
Objective: Encode temporal memory and seasonality into the model.
Method: Autocorrelation (ACF) and Partial Autocorrelation (PACF) analysis.
Key Lags Identified:
t-1: Short-term persistence.
t-5: Intermediate-scale memory.
t-11, t-12: Annual cyclicity (seasonal memory).
Final Predictors: 3 atmospheric variables + 4 lagged precipitation variables.
Autocorrelation Function (ACF)
95% CI (±0.089)
ACF
Lag (months)
Partial Autocorrelation Function (PACF)
95% CI (±0.089)
PACF
Lag (months)
15 atanmamış katılımcı
Windows'u Etkin

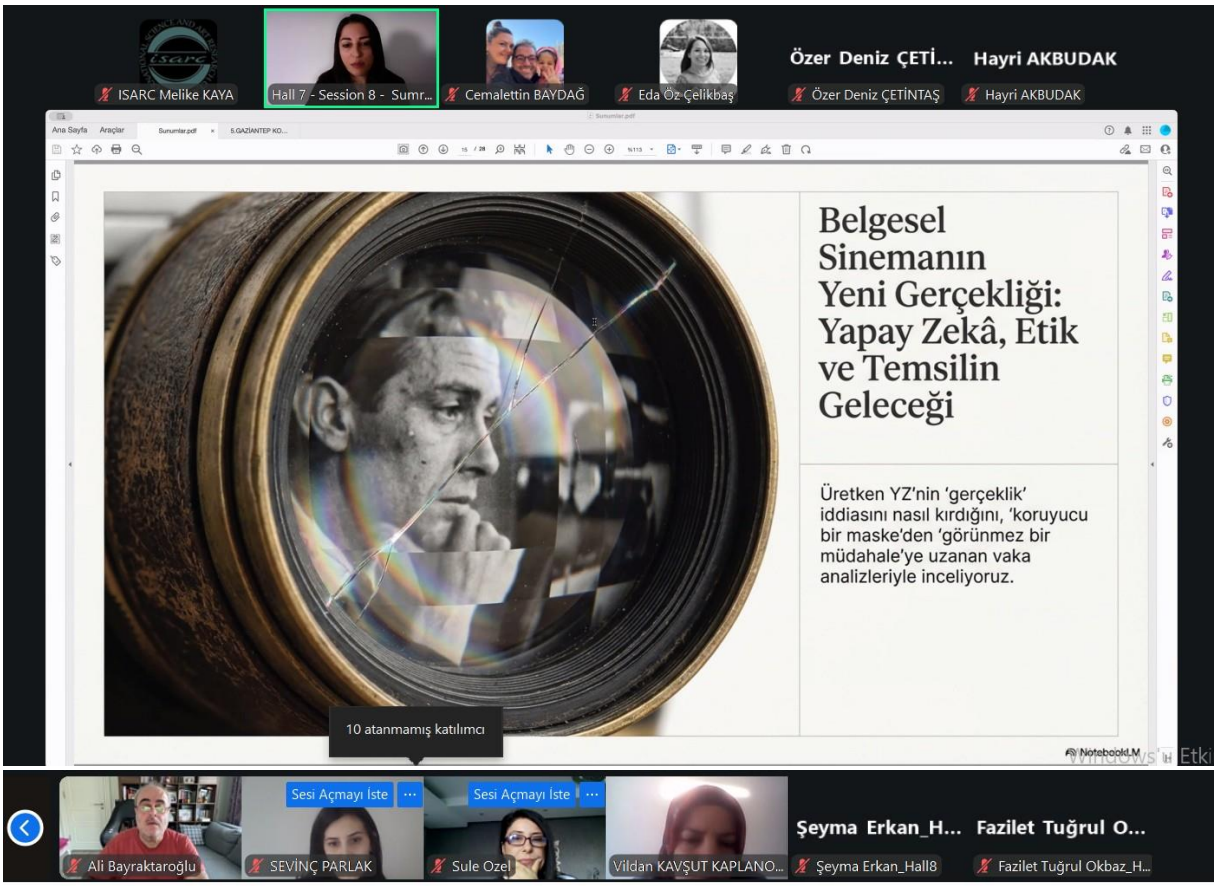

Dr. Mihriban Özgün-H...
Hall-4, Session-8- Doç. Dr....
Hall 4 Mehmet KAPLAN
Hall- 4 Session- 8 Muh...
Neslihan Çelik, Hall-4, ...
Hall-4, Sessinon-8, Öğ...
Yeni Bir Paradigma Doğuyor: Yeşil Sukuk
İslami Finans İlkeleri
(Etik, Adil Paylaşım, Faiz Yasağı)
Yeşil Sukuk
Sürdürülebilirlik Hedefleri
(Çevre Koruma, Yenilenebilir Enerji)
Amaç: Güneş enerjisi parkları, biyogaz tesisleri ve rüzgar santralleri gibi çevre dostu projeleri finanse eden, Şeriata uygun stratejik bir yatırım aracı.
8 atanmamış katılımcı
Windows'u


ISARC Melike KAYA
mizgin gökçe
Hall-5 Session-8 Deniz De...
Hall-5, Session-8 Özgü...
Safa Orakçı
Begüm Nizam
Begüm Nizam
1
2
7 atanmamış katılımcı
Künye
GELENEKSEL YAPI:
Ex Ospedale di Sant'Agostino
Mimarı: Giuseppe Sozzi
Yapım Yılı: 1753
Proje Alanı: 20.000m²
Konum: Modena, İtalya
ÇAĞDAŞ ÇATI:
AGO Modena
Mimarları/Tasarımcıları:
Carlo Ratti Associati
Italo Rota
Chuck Hoberman
Tasarım Yılı: 2022
1 https://universes.art/en/specials/2010/breaking-news/photos/01-ex-ospedale-sant-agostino
2 https://carlorattiassociati.com/project/ago-modena/
Windows'u Etkin


Hall-6,Session-8 Elif A...
Hall-6 Halil Yasin Dilek
Hall-6, Havva ÖZKAN
Hall-6 Session-8 elif özdo...
Fatma Sinem Akbulut
erdem çoban
Aktif Katılım ve Deneyimsel Dönüşüm
Aktif Kullanıcı
Geleneksel restoran ziyaretçisi, mekânı yalnızca işlevsel bir ihtiyacı karşılamak için değil kültürel belleğine katkı sağlamak isteyen aktiif bir tüketici konumundadır.
Gözlemci Özne
Hard Rock Kafe'de ziyaretçi, sergilenen nesneleri inceleyen, müzikal anlatıyı takip eden aktif bir gözlemci konumuna yükselmektedir.
Deneyimin Parçası
Mekânsal stratejiler sayesinde ziyaretçi, müzikal belleğin yeniden üretildiği deneyimin aktif bir parçası ve katılımcısı haline gelmektedir.
"Hard Rock Kafe iç mekânlarında kullanılan sergileme stratejileri; ziyaretçiyi pasif bir kullanıcı konumundan çıkarak deneyimin aktif bir parçası hâline getirmektedir."
Bu dönüşüm, mekânın salt bir hizmet sunum alanı olmaktan çıkıp, ziyaretçinin kendi müzikal hafızasını ve kimliğini yeniden keşfettiği, nostalji ve aidiyet duygularının mekânsallaştığı bir platforma evrilmesini sağlamaktadır. Ziyaretçinin öznel deneyimi, mekânın anlatısal kurgusuyla etkileşime girerek özgün ve kişiselleştirilmiş bir hafıza üretimine dönüşmektedir.

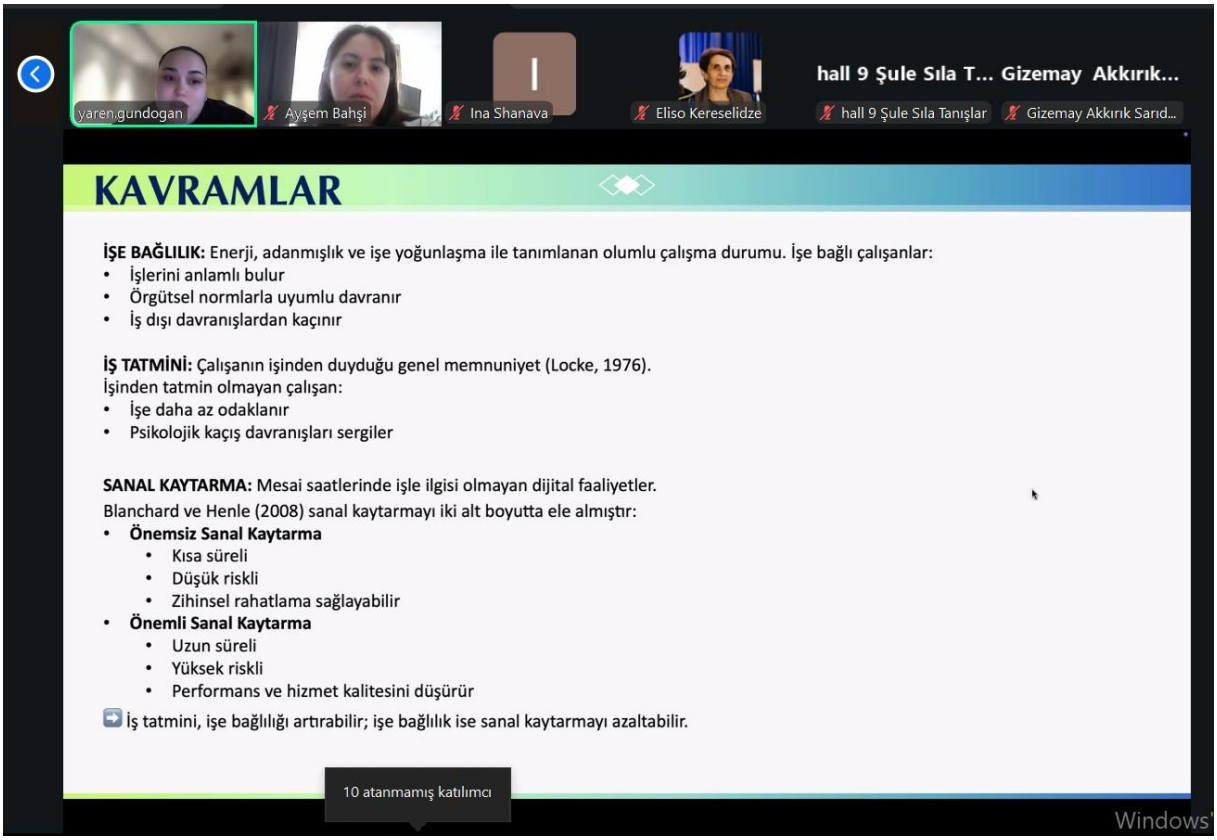

ISARC Melike KAYA
Hall-6 Sevde Gülizar D...
Çağrı Yalçın hall6-session8
Hall-6,Session-8 Elif A...
Hall-6 Halil Yasin Dilek
Hall-6, Havva ÖZKAN
Aktif Katılım ve Deneyimsel Dönüşüm
Aktif Kullanıcı
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9 atanmamış katılımcı
Windows'u

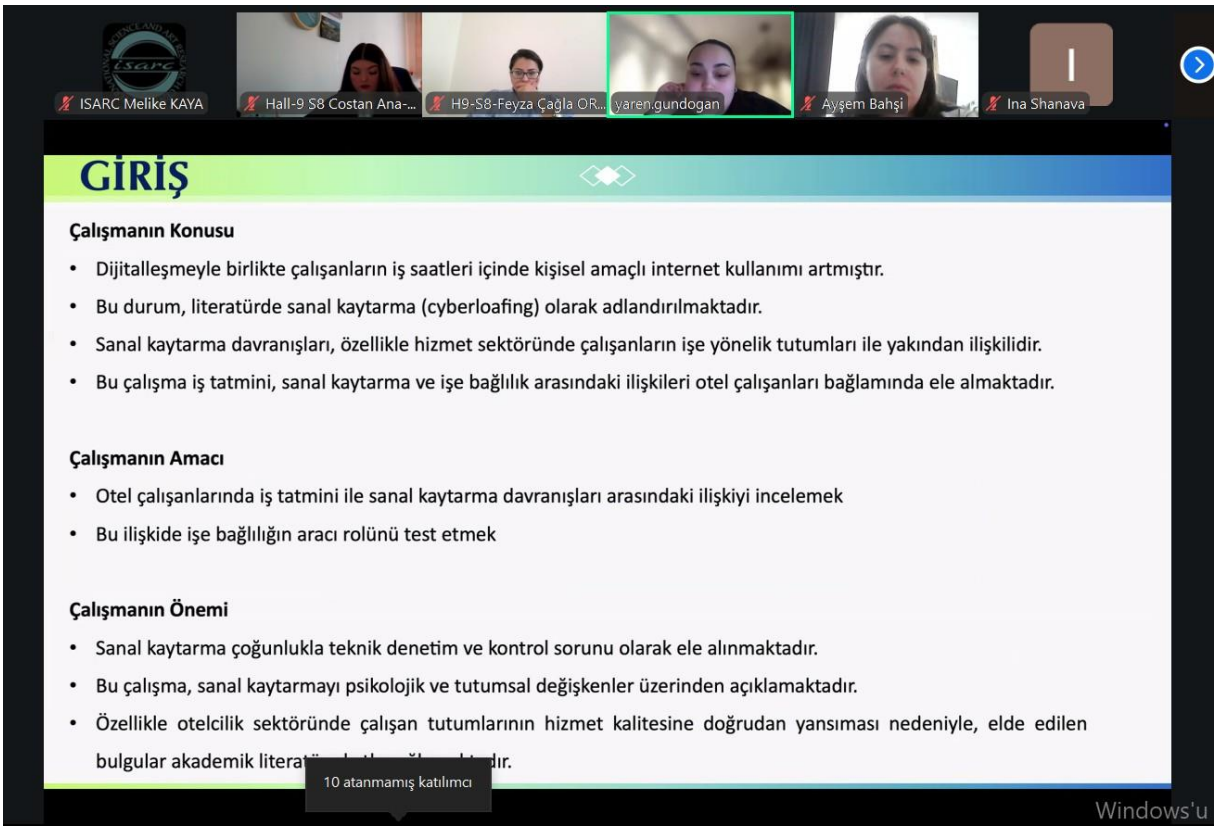

ISARC Melike KAYA
Eda Öz Çelikbaş
Hall 7 - Session 8 - Su...
Cemalettin BAYDAĞ
Özer Deniz ÇETİ...
Hayri AKBUDAK
Özer Deniz ÇETİNTAŞ
Hayri AKBUDAK
Click to add title
Margaret Naumburg (1890–1983)
Sanat terapisinin kurucusu (ABD)
• "Dinamik Sanat Terapisi"nin öncüsü
• Sanatı bilinçdışının dili olarak görmüştür
• Freud'un psikanalitik yaklaşımından etkilenmiştir
• Sanat ürünlerini terapi sürecinin merkezine koymuştur
4 atanmamış katılımcı
Windows'u Etkinleştir


ISARC Melike KAYA
Hall 7 - Session 8 - Sumr...
Cemalettin BAYDAĞ
Eda Öz Çelikbaş
Özer Deniz ÇETİ...
Hayri AKBUDAK
Özer Deniz ÇETİNTAŞ
Hayri AKBUDAK
Belgesel Sinemanın Yeni Gerçekliği: Yapay Zekâ, Etik ve Temsilin Geleceği
Üretken YZ'nin 'gerçeklik' iddiasını nasıl kırdığını, 'koruyucu bir maske'den 'görünmez bir müdahale'ye uzanan vaka analizleriyle inceliyoruz.
10 atanmamış katılımcı
Sesi Açmayı İste
Sesi Açmayı İste
Ali Bayraktaroğlu
SEVİNÇ PARLAK
Sule Ozel
Vildan KAVŞUT KAPLANO...
Şeyma Erkan_H...
Fazilet Tuğrul O...
Şeyma Erkan_Hall8
Fazilet Tuğrul Okbaz_H...

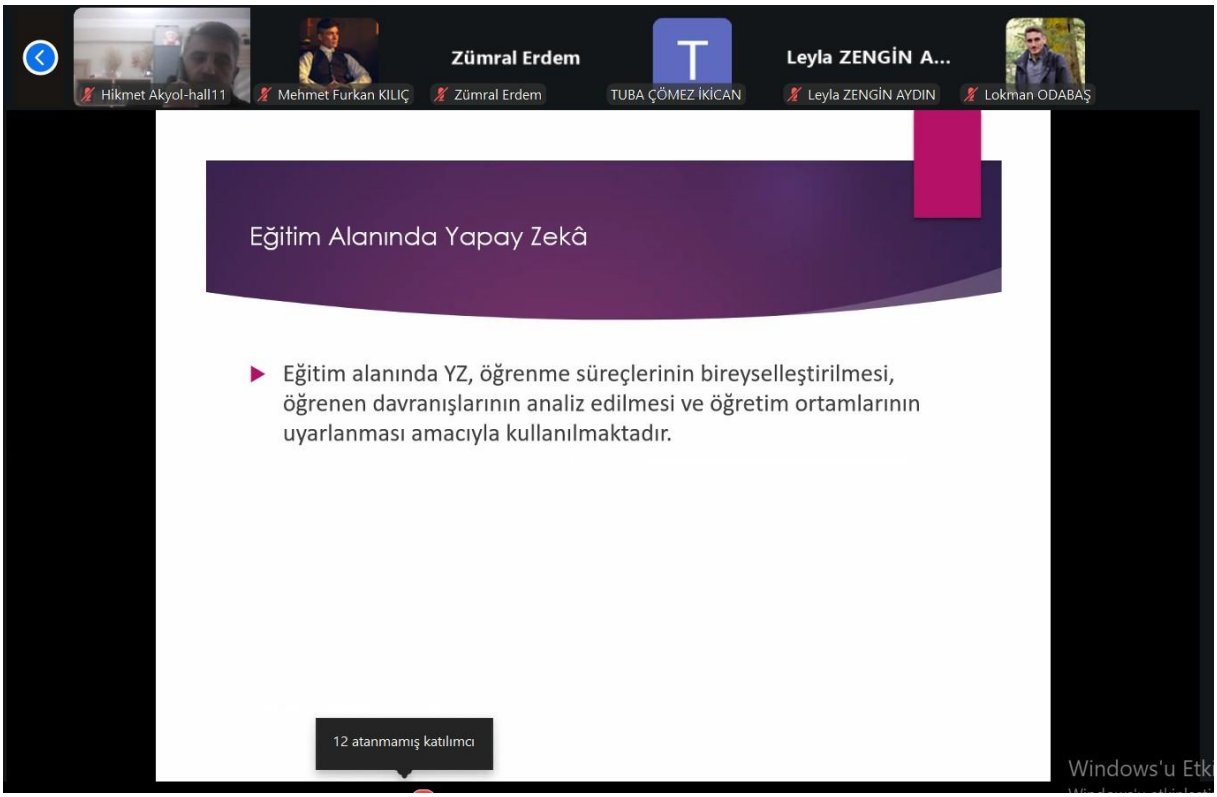

MARDİN İLİ MİDYAT İLÇESİ
GÜMÜŞ VE ALTIN TAKI ÖRNEKLERİ


ISARC Melike KAYA
elifinci
Sabina Aliyeva Namaz...
hall8-Leyla Uluçam
Ali Bayraktaroğlu
SEVİNÇ PARLAK
AHLAK BİLGİ ÜRETİM
MARDİN İLİ MİDYAT İLÇESİ GÜMÜŞ VE ALTIN TAKI ÖRNEKLERİ

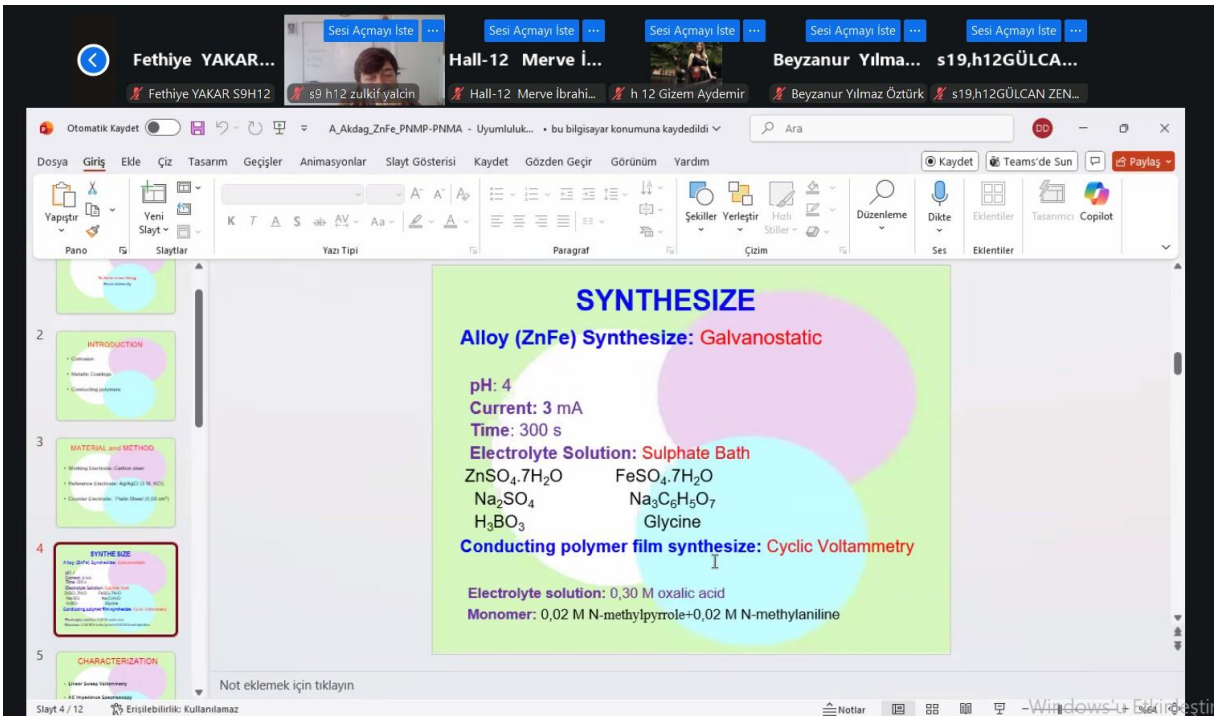

yaren.gundogan
Ayşem Bahşi
Ina Shanava
Eliso Kereselidze
hall 9 Şule Sıla T... Gizemay Akkırık...
hall 9 Şule Sıla Tanışlar
Gizemay Akkırık Sarıd...
KAVRAMLAR
İŞE BAĞLILIK: Enerji, adanmışlık ve işe yoğunlaşma ile tanımlanan olumlu çalışma durumu. İşe bağlı çalışanlar:
• İşlerini anlamlı bulur
• Örgütsel normlarla uyumlu davranır
• İş dışı davranışlardan kaçınır
İŞ TATMİNİ: Çalışanın işinden duyduğu genel memnuniyet (Locke, 1976).
İşinden tatmin olmayan çalışan:
• İşe daha az odaklanır
• Psikolojik kaçış davranışları sergiler
SANAL KAYTARMA: Mesai saatlerinde işle ilgisi olmayan dijital faaliyetler.
Blanchard ve Henle (2008) sanal kaytarmayı iki alt boyutta ele almıştır:
• Önemsiz Sanal Kaytarma
• Kısa süreli
• Düşük riskli
• Zihinsel rahatlama sağlayabilir
• Önemli Sanal Kaytarma
• Uzun süreli
• Yüksek riskli
• Performans ve hizmet kalitesini düşürür
İş tatmini, işe bağlılığı artırabilir; işe bağlılık ise sanal kaytarmayı azaltabilir.
10 atanmamış katılımcı

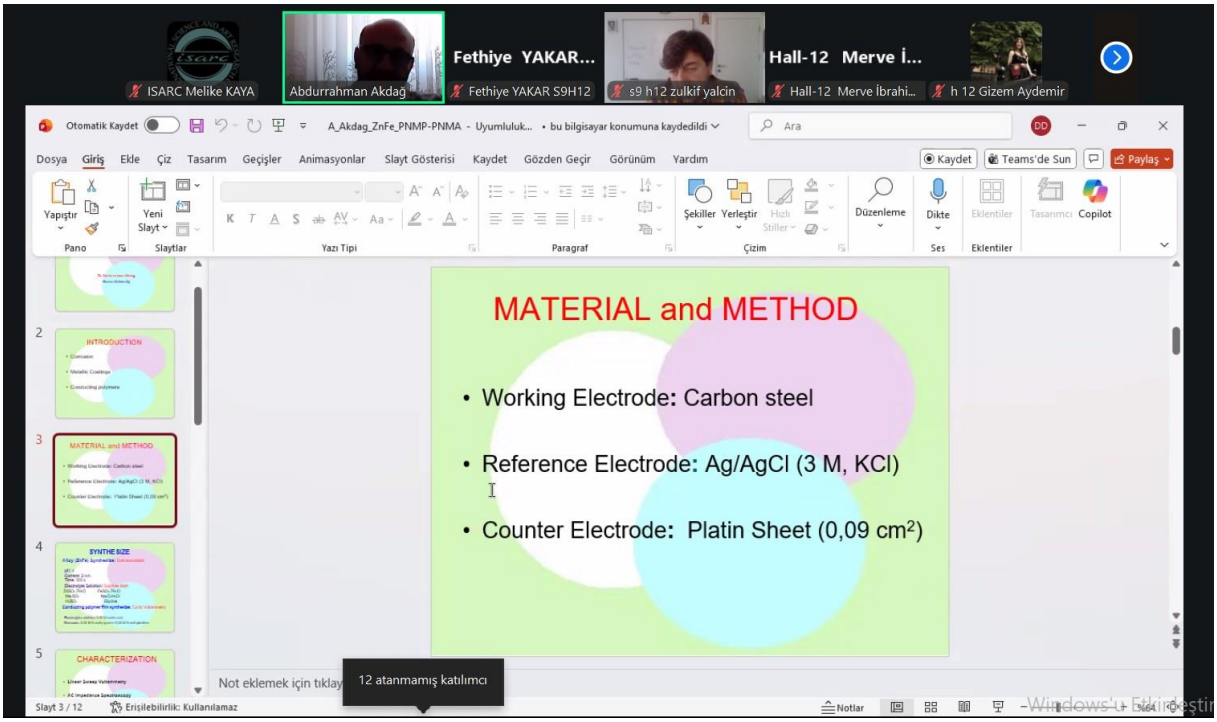

ISARC Melike KAYA
Hall-9 S8 Costan Ana-...
H9-S8-Feyza Çağla OR...
yaren.gundogan
Ayşem Bahşi
Ina Shanava
GİRİŞ
Çalışmanın Konusu
• Dijitalleşmeyle birlikte çalışanların iş saatleri içinde kişisel amaçlı internet kullanımı artmıştır.
• Bu durum, literatürde sanal kaytarma (cyberloafing) olarak adlandırılmaktadır.
• Sanal kaytarma davranışları, özellikle hizmet sektöründe çalışanların işe yönelik tutumları ile yakından ilişkilidir.
• Bu çalışma iş tatmini, sanal kaytarma ve işe bağlılık arasındaki ilişkileri otel çalışanları bağlamında ele almaktadır.
Çalışmanın Amacı
• Otel çalışanlarında iş tatmini ile sanal kaytarma davranışları arasındaki ilişkiyi incelemek
• Bu ilişkide işe bağlılığın aracı rolünü test etmek
Çalışmanın Önemi
• Sanal kaytarma çoğunlukla teknik denetim ve kontrol sorunu olarak ele alınmaktadır.
• Bu çalışma, sanal kaytarmayı psikolojik ve tutumsal değişkenler üzerinden açıklamaktadır.
• Özellikle otelcilik sektöründe çalışan tutumlarının hizmet kalitesine doğrudan yansıması nedeniyle, elde edilen bulgular akademik
10 atanmamış katılımcı
Windows'u

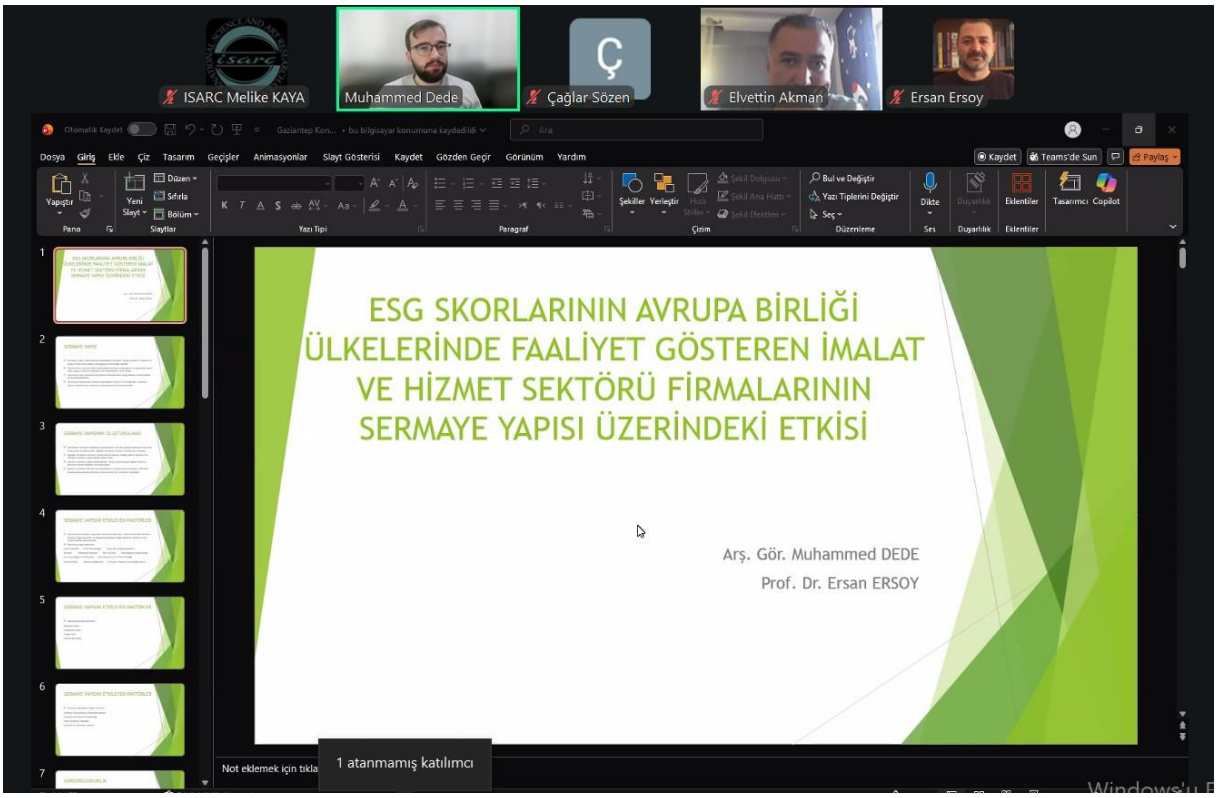

ISARC Melike KAYA
Zeynep ŞENER - Hall 10
Hasan Hüseyin MUTLU
Hall 10-Seyda Savran ...
dilek yalçın
Hasan Hüseyin MUTLU


Hikmet Akyol-hall11
Mehmet Furkan KILIÇ
Zümral Erdem
Zümral Erdem
TUBA ÇÖMEZ İKİCAN
Leyla ZENGİN A...
Leyla ZENGİN AYDIN
Lokman ODABAŞ
Eğitim Alanında Yapay Zekâ
Eğitim alanında YZ, öğrenme süreçlerinin bireyselleştirilmesi, öğrenen davranışlarının analiz edilmesi ve öğretim ortamlarının uyarlanması amacıyla kullanılmaktadır.
12 atanmamış katılımcı
Windows'u Etk

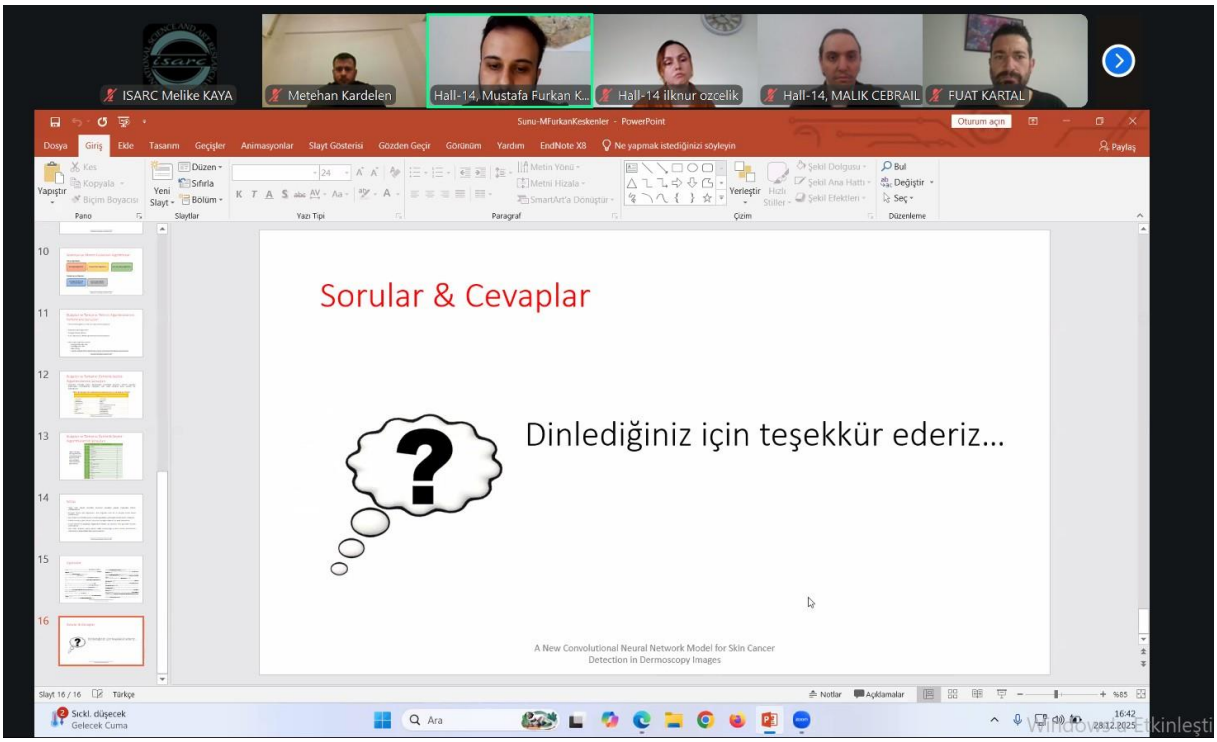

ISARC Melike KAYA
Hall 11-Kübra Aymelek H...
Hikmet Akyol-hall11
Mehmet Furkan KILIÇ
Zümral Erdem
Zümral Erdem
TUBA ÇÖMEZ İKİCAN
Yapay Zekâ
Yapay Zekâ sistemleri büyük veri kümeleri üzerinde eğitilerek öngörü üretme, sınıflandırma yapma ve uyarlanabilir geri bildirim sağlama kapasitesine sahiptir.
Bu özellikleri sayesinde YZ, yalnızca teknik bir araç değil, aynı zamanda sosyal sistemlerle etkileşim kurabilen bilişsel bir teknoloji olarak değerlendirilmektedir.
Windows'u Etkin

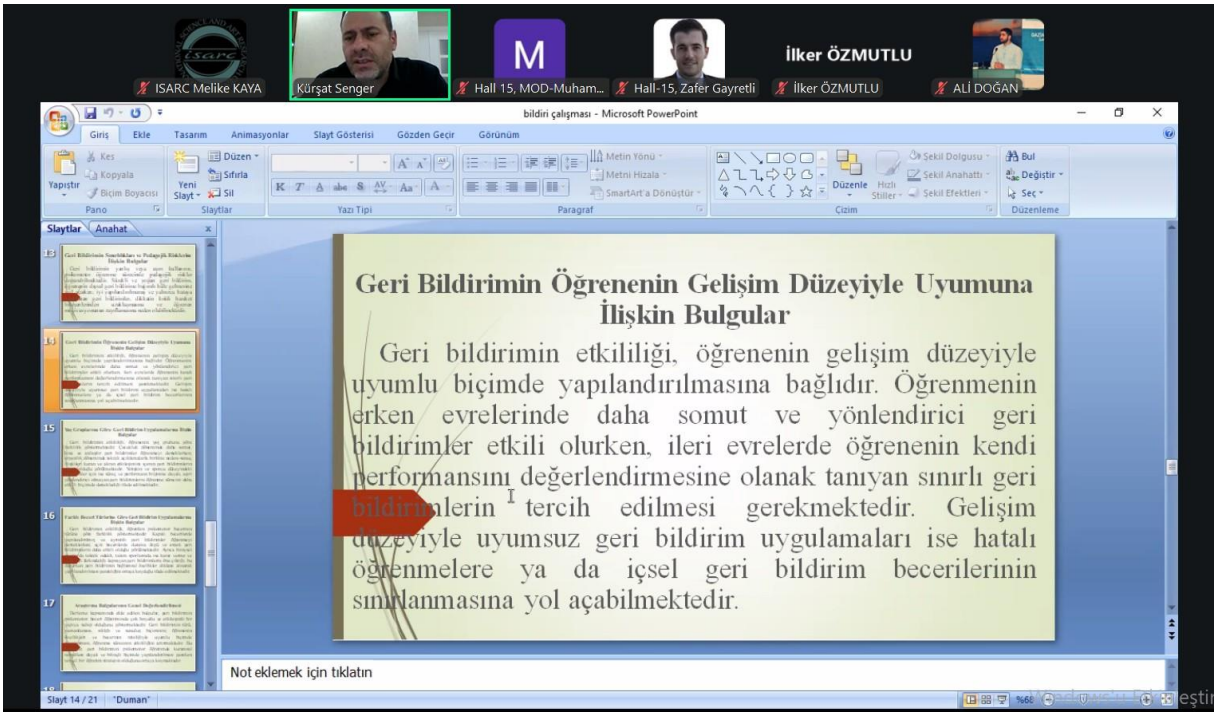

Fethiye YAKAR...
Hall-12 Merve İ...
Beyzanur Yılma...
s19,h12GÜLCA...
SYNTHESIZE
Alloy (ZnFe) Synthesize: Galvanostatic
pH: 4
Current: 3 mA
Time: 300 s
Electrolyte Solution: Sulphate Bath
$ZnSO_4.7H_2O$ $FeSO_4.7H_2O$
Na_2SO_4 $Na_3C_6H_5O_7$
H_3BO_3 Glycine
Conducting polymer film synthesize: Cyclic Voltammetry
Electrolyte solution: 0,30 M oxalic acid
Monomer: 0,02 M N-methylpyrrole+0,02 M N-methylaniline

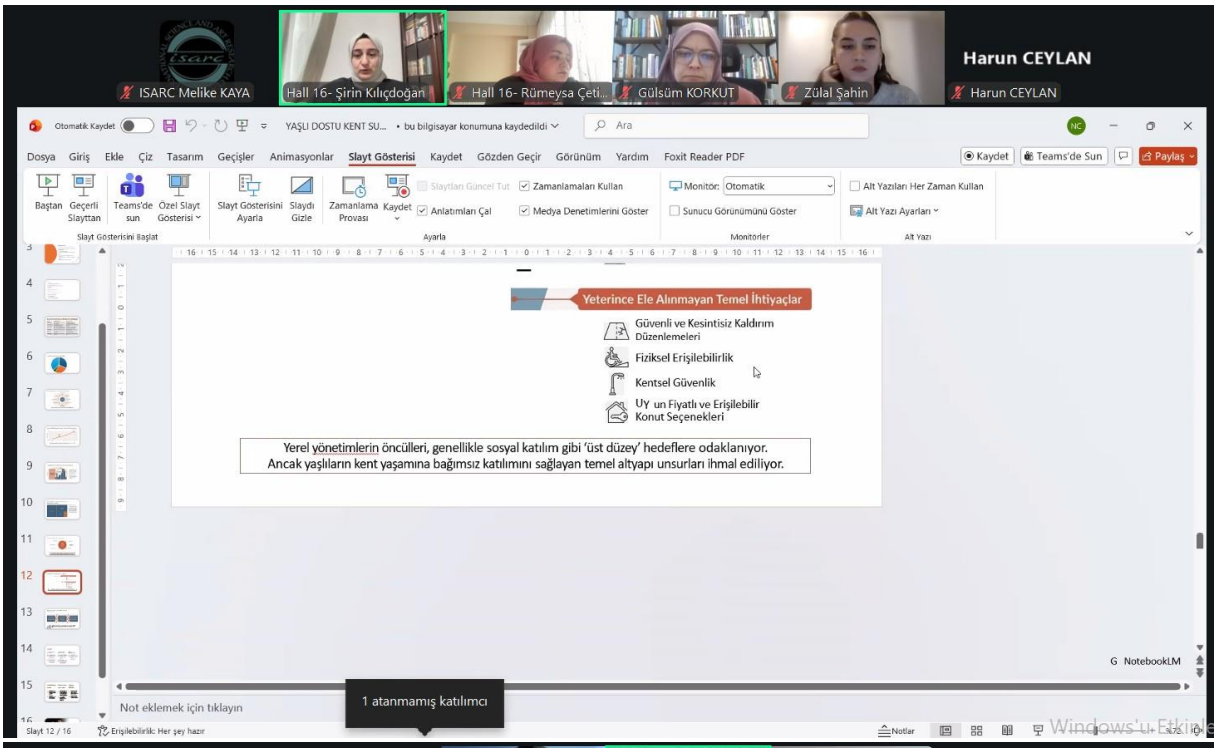

ISARC Melike KAYA
Abdurrahman Akdağ
Fethiye YAKAR...
Hall-12 Merve İ...
MATERIAL and METHOD
• Working Electrode: Carbon steel
• Reference Electrode: Ag/AgCl (3 M, KCl)
• Counter Electrode: Platin Sheet (0,09 cm²)
12 atanmamış katılımcı

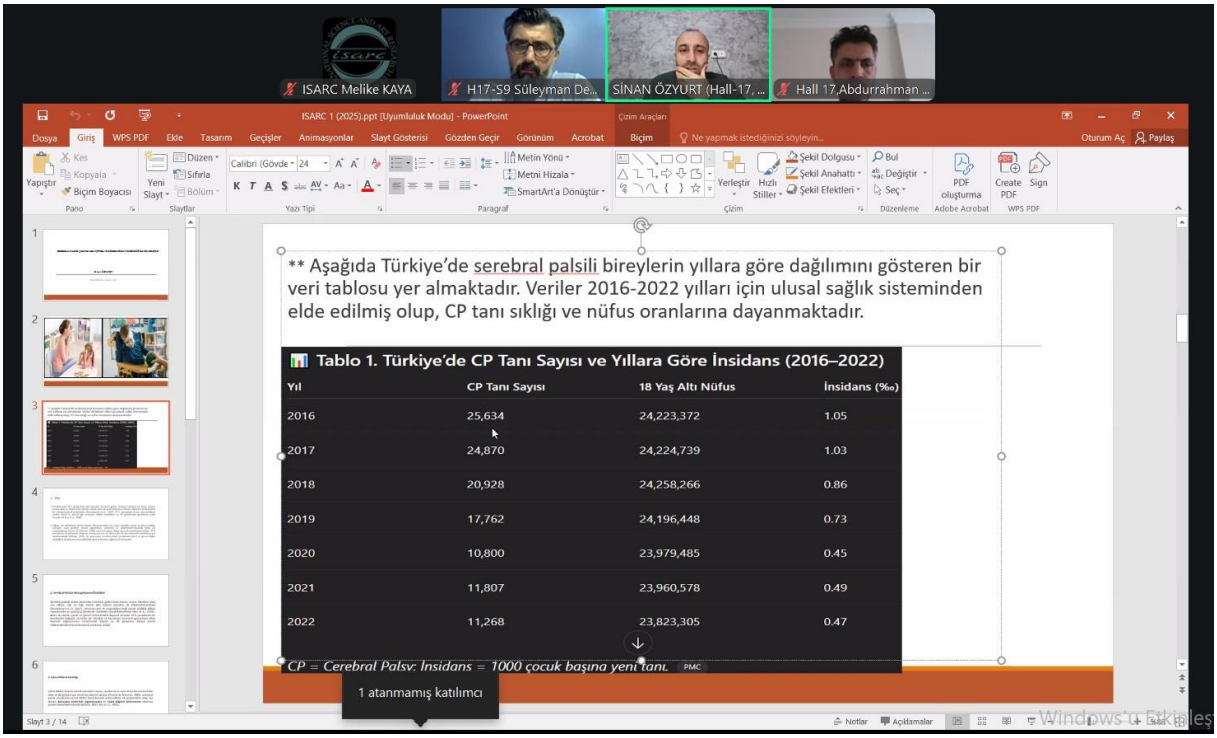

ISARC Melike KAYA
Muhammed Dede
Çağlar Sözen
Elvettin Akman
Ersan Ersoy
ESG SKORLARININ AVRUPA BİRLİĞİ ÜLKELERİNDE FAALİYET GÖSTEREN İMALAT VE HİZMET SEKTÖRÜ FİRMALARININ SERMAYE YAPISI ÜZERİNDEKİ ETKİSİ
Arş. Gör. Muhammed DEDE
Prof. Dr. Ersan ERSOY
1 atanmamış katılımcı

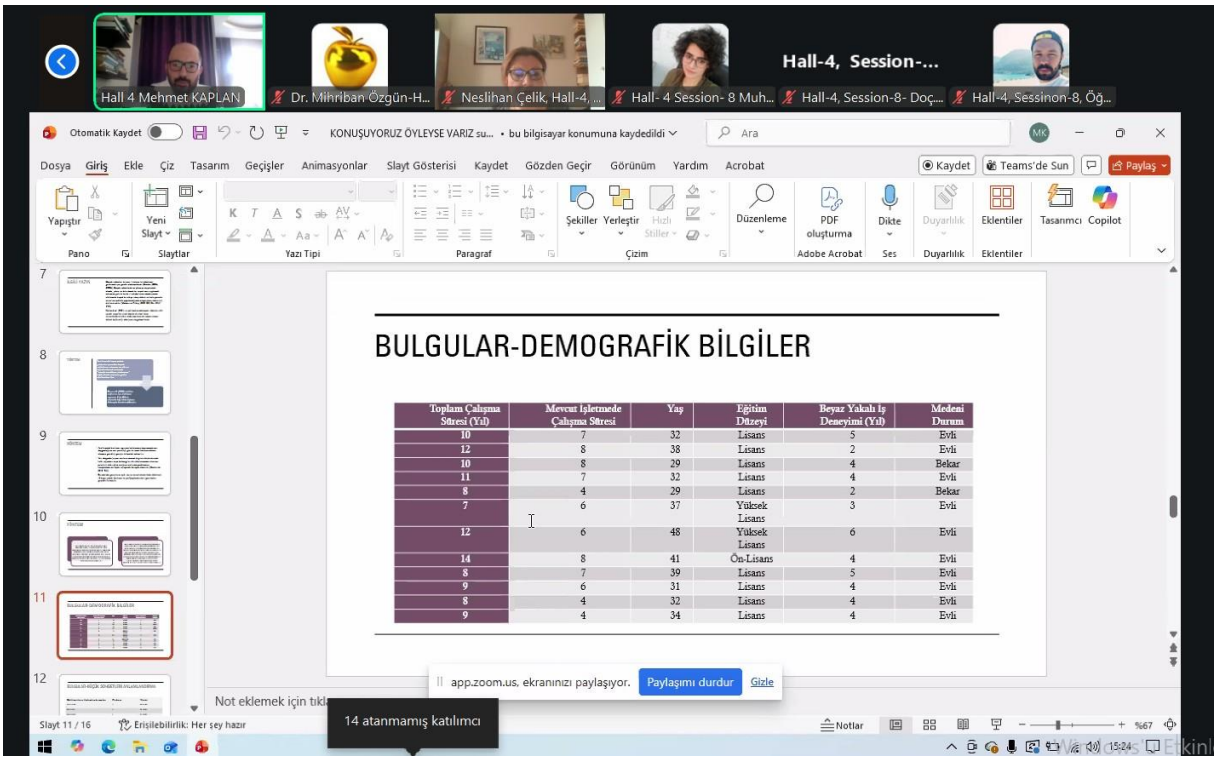

Hall-14, Mustafa Furka...
FUAT KARTAL
Hall-14 ilknur ozcelik
Hall-14, MALIK CEBRAIL
H14__Arslan KAPTAN
Simge
Enerjinin Yolculuğu
Aşındırıcı Su Jetini Fiziğin Gözünden Anlamak
Hidrodinamik ve Tribolojik Esaslara Dayalı Analitik Bir Yaklaşım


ISARC Melike KAYA
Metehan Kardelen
Hall-14, Mustafa Furkan K...
Hall-14 İlknur ozcelik
Hall-14, MALIK CEBRAIL
FUAT KARTAL
Sunu-MFurkanKeskenler - PowerPoint
Sorular & Cevaplar
Dinlediğiniz için teşekkür ederiz...
A New Convolutional Neural Network Model for Skin Cancer Detection in Dermoscopy Images

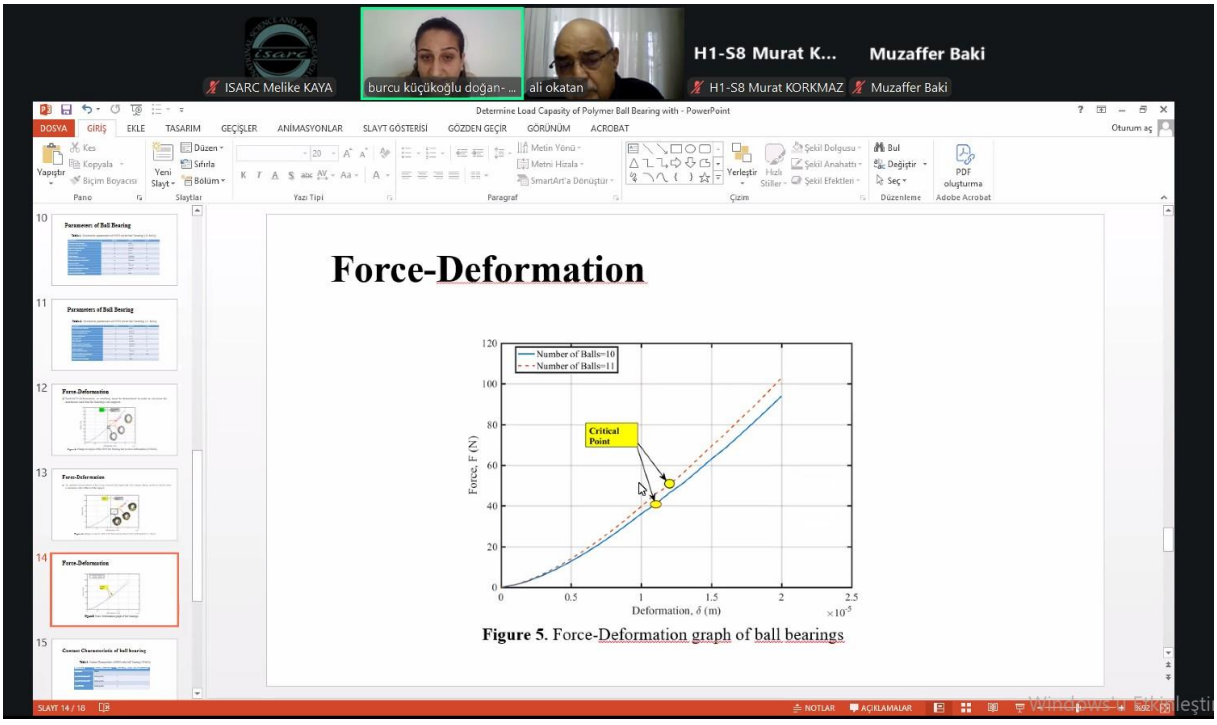

ISARC Melike KAYA
Kürşat Senger
Hall 15, MOD-Muham...
Hall-15, Zafer Gayretli
İlker ÖZMUTLU
İlker ÖZMUTLU
ALİ DOĞAN
bildiri çalışması - Microsoft PowerPoint
Geri Bildirimin Öğrenenin Gelişim Düzeyiyle Uyumuna İlişkin Bulgular
Geri bildirimin etkililiği, öğrenenin gelişim düzeyiyle uyumlu biçimde yapılandırılmasına bağlıdır. Öğrenmenin erken evrelerinde daha somut ve yönlendirici geri bildirimler etkili olurken, ileri evrelerde öğrenenin kendi performansını değerlendirmesine olanak tanıyan sınırlı geri bildirimlerin tercih edilmesi gerekmektedir. Gelişim düzeyiyle uyumsuz geri bildirim uygulamaları ise hatalı öğrenmelere ya da içsel geri bildirim becerilerinin sınırlanmasına yol açabilmektedir.
Not eklemek için tıklatın

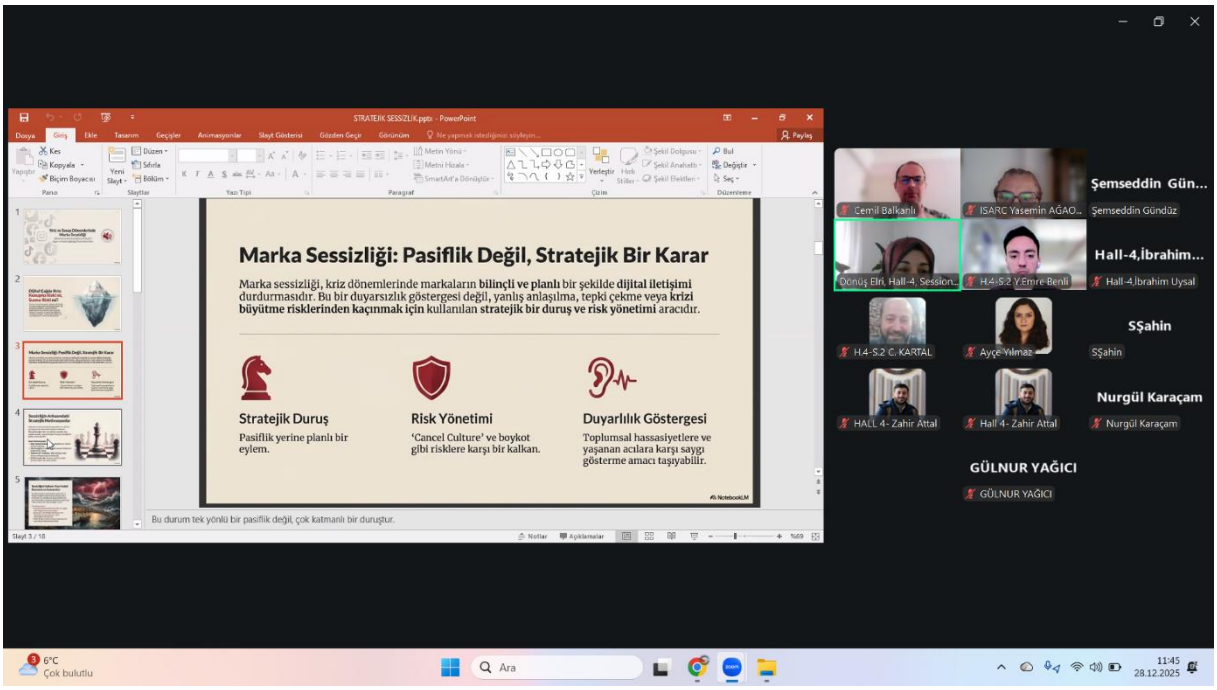

ISARC Melike KAYA
Hall 16- Şirin Kılıçdoğan
Hall 16- Rümeysa Çeti...
Gülsüm KORKUT
Zülal Şahin
Harun CEYLAN
Harun CEYLAN
Yeterince Ele Alınmayan Temel İhtiyaçlar
Güvenli ve Kesintisiz Kaldırım Düzenlemeleri
Fiziksel Erişilebilirlik
Kentsel Güvenlik
Uy un Fiyatlı ve Erişilebilir Konut Seçenekleri
Yerel yönetimlerin öncülleri, genellikle sosyal katılım gibi 'üst düzey' hedeflere odaklanıyor.
Ancak yaşlıların kent yaşamına bağımsız katılımını sağlayan temel altyapı unsurları ihmal ediliyor.
Not eklemek için tıklayın
1 atanmamış katılımcı


ISARC Melike KAYA
H17-S9 Süleyman De...
SİNAN ÖZYURT (Hall-17, ...
Hall 17,Abdurrahman ...
** Aşağıda Türkiye'de serebral palsili bireylerin yıllara göre dağılımını gösteren bir veri tablosu yer almaktadır. Veriler 2016-2022 yılları için ulusal sağlık sisteminden elde edilmiş olup, CP tanı sıklığı ve nüfus oranlarına dayanmaktadır.
Tablo 1. Türkiye'de CP Tanı Sayısı ve Yıllara Göre İnsidans (2016–2022)
Yıl | CP Tanı Sayısı | 18 Yaş Altı Nüfus | İnsidans (‰)
2016 | 25,634 | 24,223,372 | 1.05
2017 | 24,870 | 24,224,739 | 1.03
2018 | 20,928 | 24,258,266 | 0.86
2019 | 17,762 | 24,196,448 | 0.73
2020 | 10,800 | 23,979,485 | 0.45
2021 | 11,807 | 23,960,578 | 0.49
2022 | 11,268 | 23,823,305 | 0.47
1 atanmamış katılımcı



Toplam Çalışma Süresi (Yıl)	Mevcut İşletmede Çalışma Süresi	Yaş	Eğitim Düzeyi	Beyaz Yakalı İş Deneyimi (Yıl)	Medeni Durum
10	7	32	Lisans	5	Evli
12	8	38	Lisans	2	Evli
10	8	29	Lisans	4	Bekar
11	7	32	Lisans	4	Evli
8	4	29	Lisans	2	Bekar
7	6	37	Yüksek Lisans	3	Evli
12	6	48	Yüksek Lisans	6	Evli
14	8	41	Ön-Lisans	4	Evli
8	7	39	Lisans	5	Evli
9	6	31	Lisans	4	Evli
8	4	32	Lisans	4	Evli
9	4	34	Lisans	4	Evli




STRATEJİK SESSİZLİK.pptx - PowerPoint
Marka Sessizliği: Pasiflik Değil, Stratejik Bir Karar
Marka sessizliği, kriz dönemlerinde markaların bilinçli ve planlı bir şekilde dijital iletişimi durdurmasıdır. Bu bir duyarsızlık göstergesi değil, yanlış anlaşılma, tepki çekme veya krizi büyütme risklerinden kaçınmak için kullanılan stratejik bir duruş ve risk yönetimi aracıdır.
Stratejik Duruş
Pasiflik yerine planlı bir eylem.
Risk Yönetimi
'Cancel Culture' ve boykot gibi risklere karşı bir kalkan.
Duyarlılık Göstergesi
Toplumsal hassasiyetlere ve yaşanan acılara karşı saygı gösterme amacı taşıyabilir.
Bu durum tek yönlü bir pasiflik değil, çok katmanlı bir duruştur.
Cemil Balkanlı
ISARC Yasemin AĞAO...
Şemseddin Gün...
Şemseddin Gündüz
Dönüş Elri, Hall -4, Session...
H.4-S.2 Y.Emre Benli
Hall-4,İbrahim...
Hall-4,İbrahim Uysal
H.4-S.2 C. KARTAL
Ayçe Yılmaz
SŞahin
HALL 4- Zahir Attal
Hall 4- Zahir Attal
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28.12.2025

INTERNATIONAL SCIENCE AND ART RESEARCH CENTER

Konu: Kongre Katılımcı Bilgisi **31.12.2025**

İLGİLİ MAKAMA

5.ULUSLARARASI GAZİANTEP BİLİMSEL ARAŞTIRMALAR KONGRESİ 27-28 ARALIK 2025 tarihleri arasında GAZİANTEP'de ve online olarak 32 farklı ülkeden (Türkiye:448 ve diğer Ülkeler:458 ; Toplam:906 akademisyen/araştırmacıların katılımı ile gerçekleşmiştir. Kongre, 16 Ocak 2020 Akademik Teşvik Ödeneği Yönetmeliğine getirilen '' Tebliğlerin sunulduğu yurt içinde veya yurtdışındaki etkinliğin uluslararası olarak nitelendirilebilmesi için Türkiye dışından en az 5 ülkeden farklı tebliğ sunan konuşmacının katılım sağlaması ve tebliğlerin yarıdan fazlasının Türkiye dışından katılımcılar tarafından sunulması esastır. '' değişikliğine uygun düzenlenmiştir. Bilgilerinize arz edilir.
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Sefa Salih BİLDİRİCİ
HEAD OF İSARC

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COMPARATIVE ANALYSIS OF THE EFFECTIVENESS OF ENVIRONMENTAL AWARENESS FORMATION AMONG SCHOOLCHILDREN IN BELARUS AND THE UK THROUGH DIGITAL EDUCATIONAL RESOURCES

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Abstract
The global environmental crisis dictates the need to form a new type of ecological consciousness in the younger generation. In the digital era, this task is inseparably linked with the use of information and communication technologies that are native to modern schoolchildren.
The authors of the article make an attempt to identify effective digital tools for the development of environmental awareness as well as to foster the English language skills of secondary school students through the development and testing of an educational Telegram bot "EcoGuide".
The **object** of the study is the process of forming environmental awareness among schoolchildren.
The **subject** is the effectiveness of using a digital educational resource (Telegram bot) for the development of environmental awareness and English language skills.
The **practical significance** of the work lies in the implementation of the "EcoGuide" bot in the educational process of Belarusian schools, as well as in the system of additional education. The materials can be used in English lessons and extra curricular activities.
The authors of the article think that the use of a gamified digital educational resource (Telegram bot) in English will contribute to a greater increase in motivation to learn the English language and the formation of practical environmental habits compared to traditional methods of environmental education.
During the study, an empirical experiment was conducted to assess the effectiveness of using the "EcoGuide" bot in the process of forming students' environmental habits and fostering the English language skills.
Keywords: Telegram bot, environmental education, foreign language skills, extra curricular activities

Introduction

Digital technologies are becoming increasingly important in modern education. Digital educational resources are becoming an integral part of the learning process. They offer new ways to organize learning, help to increase students' motivation, and improve the quality of education.
One of the biggest advantages of digital education is that it makes education available to more people than ever before. Learners are no longer limited by where they live or the time. They can access educational resources from anywhere and at any time.
Digital education also allows for personalized learning. This means the education can be adapted to each student's specific needs. Using digital tools and platforms, teachers can change their teaching methods to suit individual learning styles and speeds. This creates a more effective and productive learning experience that helps students achieve their best.

Digital education also makes learning more engaging and interactive. From virtual simulations to gamification and multimedia content, digital tools and platforms offer a dynamic learning experience. It is both fun and effective. By involving students in the learning process, digital education helps them remember and understand the material better (S. Deterding, D. Dixon, R. Khaled, L. Nacke, 2011).

Digital Educational Resources are not just a translation of textbooks into electronic form, but a fundamentally new tool that offers interactive, gamified and adaptive learning. The advantages include: accessibility, visibility, interactivity, the ability to quickly update content and provide instant feedback.

Gamification, which involves the use of game elements in non-game contexts, is particularly effective in working with teenagers. Point systems, badges, leaderboards, and quests increase engagement and motivation. For environmental education, this is especially relevant, as it allows to translate abstract knowledge about the planet's problems into the plane of specific daily practices.

Messenger-based learning, in particular through Telegram bots, is a promising trend. Bots provide a direct channel of communication with students in a familiar information environment, allow you to automate the process of issuing tasks and checking answers, and provide a personal approach (Ecological Behavior, Environmental Attitude, and Feelings of Responsibility for the Environment. European Psychologist, Vol. 4, No. 2, June 1999).

In Great Britain environmental education is a major priority of state educational policy. It is proved by the National Curriculum in the field of education adopted in 1988. In the content of this Document there is a special paragraph devoted to the development of environmental education and its inclusion into the content of school education in general. British educators assert that environmental education should be interdisciplinary and lifelong. It means that every subject should content an information about nature protection harmonizing it in compliance with its logic and structure. The importance of environmental education, as the British educationalist explain it, is connected first of all with the preparation of a growing generation to make ecologically adequate decisions and to solve environmental problems (M. Andevski, 1997).

The UK is a leader in integrating digital technologies into education. The National Curriculum emphasizes not only the acquisition of environmental knowledge but also the development of skills for critical thinking and practical action.

A striking example is the "Digital Schoolhouse" program, which uses video games to teach various subjects, including the basics of ecology. Numerous online platforms offer British schoolchildren interactive quests and projects, such as calculating their own carbon footprint or creating a digital map of local environmental problems (Michael K. Stone and Zenobia Barlow (edc.), 2005).

The eco-blogosphere and social media activism are highly developed in the UK. Teenagers are actively involved in online discussions, support challenges like #PlasticFreeJuly, and use digital tools to organize real actions (e.g., the Fridays for Future movement). Thus, digital literacy and environmental awareness are fused together (Environmental Education and Culture).

One of the priority directions of the state policy of the Republic of Belarus is environmental protection and rational use of natural resources. The Constitution of the Republic of Belarus guarantees the right of every citizen of the country to a favorable environment, to ecologically safe living conditions for people; the right to receive, store and disseminate complete, reliable and timely information about the state of the natural environment, public participation in the adoption process decisions and access to justice in environmental matters (National Strategy of the Republic of Belarus for Sustainable Socio-Economic Development for the Period until 2030).

Of course, the government of Belarus makes an invaluable contribution to the development of ecology, but these steps are insufficient. Nowadays people of Belarus realize that without solving environmental problems, the life of the future generations will be in real danger. Many people understand that all people should unite their efforts to save the planet where they live, to make the world healthier and more beautiful. All people should be eco-conscious in order to save the nature. Both children and teenagers should be involved in this process (Moral and aesthetic culture of personality, 2007).

Thus, the ecological awareness should be paid much attention at schools. Such work should be aimed at environmental education and training, increasing the level of environmental literacy of the population, informing the population about the state of the environment and environmental protection work and increasing the share of the population involved in the process of "green" development. At present, environmental education in Belarus should be carried out at lessons, for example English lessons.

The Belarusian education system has a strong natural science foundation and a tradition of extracurricular environmental activities (e.g., competitions and research projects). The concept of continuous environmental education is fixed at the legislative level (“News & events in Belarus”).

However, the digitalization of environmental education is in its infancy. While schools are equipped with technical means, their application is often limited to presentations and video screenings. The potential of social networks and messengers for systematic work is not fully realized.

The analysis of the most popular educational materials in English (textbooks by Yukhnel N.V., Naumova E.G., etc.) shows that environmental topics are present but are often reproductive in nature. Project assignments are offered optionally, and their digital component is not developed. There is a request from students for a more modern and interactive format of interaction.

This creates a field for the implementation of digital tools that can complement the existing strong theoretical base with practical, gamified activities in English.

Materials and methods

A detailed study of Instagram, one of the most popular social networks among teenagers, was conducted. The main purpose of the study was to determine whether British and Belarusian teenagers actively discuss environmental issues and engage in eco-friendly behavior on social media and to assess the level of environmental awareness among young people in both countries.

Results and their discussion

The investigation began with British teenagers' Instagram profiles. The systematic search for posts using geographical tags specific to various regions of Britain combined with popular environmental hashtags such as #ecology, #environmentalprotection, #sustainableliving, and #climateaction was conducted.

As a result we revealed 390 active Instagram accounts managed by British teenagers that primarily focus on nature protection and environmental issues. This significant number indicates that a substantial portion of British youth is actively engaged in environmental matters and demonstrates eco-conscious behavior through their digital presence.

These young environmental advocates utilize their social media platforms as dynamic spaces for discussing and sharing ideas about ecological concerns. Their content covers a wide spectrum of environmental topics, ranging from practical lifestyle approaches like zero-waste living, minimalism, and plastic-free initiatives to broader global challenges such as climate change. Through their posts, they not only raise awareness but also provide practical guidance, helping their followers make informed decisions that benefit both society and the environment as a whole.

Subsequently, the same methodology was applied to analyze Instagram content created by Belarusian teenagers. During the study, using equivalent parameters and Belarusian-language environmental hashtags such as #экалогія and #аховапрыроды, were identified only 79 accounts maintained by Belarusian schoolchildren that regularly address environmental topics. This notable discrepancy in numbers – 390 accounts in Britain compared to 79 in Belarus – suggests that environmental awareness among Belarusian teenagers is less developed, and they pay comparatively less attention to ecological issues through their social media channels.

This clear contrast in social media engagement highlights the need for enhanced environmental education initiatives within the Belarusian educational system. The significantly lower level of digital environmental activism among Belarusian youth indicates an opportunity to strengthen ecological awareness through formal education channels, particularly in foreign language instruction where environmental topics can be integrated into the curriculum. This realization prompted our subsequent analysis of how environmental education is currently incorporated into English language courses in Belarusian schools, with the aim of identifying potential improvements and implementation strategies.

The level of penetration of environmental issues into the digital space of British youth is significantly higher and is of a practical nature. The Belarusian educational system has a solid foundation but needs greater integration with the digital practices of students. That’s why we invented the "EcoGuide" Telegram Bot to create a digital tool that bridges the gap between theoretical knowledge and daily practice, using a gamified format and the English language.

As a result of the study the bot's functionality was defined using the SamBot platform in Telegram. Then a 21-day "EcoChallenge" was developed in English. Each day's task of the challenge was aimed at forming a specific habit. For example, Day 1: Take a clear photo of your reusable water bottle/coffee cup. Write one sentence in English describing it: "My bottle is made of [material]."

Day 2: Find one product at home with excessive packaging. Describe it using 2 adjectives: "Too much plastic" or "Unnecessary cardboard", etc.

During the third stage of the research gamification was conducted: a system of points for completed tasks and progress badges were introduced.

When the bot was created using the Python language and the python-telegram-bot library "EcoChallenge" bot was tested during 3 weeks. 25 students in grade 9 were divided into two groups: experimental (13 people, using the bot) and control (12 people, traditional lesson on the topic "Ecology").

Before and after the experiment, both groups were given a questionnaire to assess their level of environmental responsibility and motivation to learn English.

In three weeks in the experimental group 84% of participants (n = 11) completed all 7 challenges. The post-experiment survey showed an average increase of 30% in scores on environmental responsibility questions. Students noted that completing tasks in English felt "like a real quest" and was not stressful.

In the control group the increase in scores on the questionnaire was about 8%. Motivation dynamics are insignificant.

The experiment confirmed the main hypothesis. The gamified digital format of the Telegram bot has shown high efficiency in increasing motivation and forming practical environmental skills in an English-language environment.

Conclusion. In the result of the research, we were able to achieve our aim. We can come to conclusion that it is important to pay attention to environmental education at school because it teaches children to be eco-friendly and eco-conscious, do the best to help the nature and take active part in practical activities aimed at improving the environment of their town, region or country.

The main obstacle to the effective formation of environmental awareness in Belarusian schoolchildren is the gap between theoretical knowledge and the lack of mechanisms for its translation into daily practice in a modern, engaging format.

The developed and tested prototype of the "EcoGuide" Telegram bot is an effective tool for solving this problem. It combines linguistic and environmental learning objectives, leveraging gamification and a familiar digital environment for students.

The "EcoGuide" Telegram bot can help to develop the students' environmental literacy and increase their motivation in learning foreign language. It can be used in the process of learning English at the lessons and during extra-class activities.

We have proved our hypothesis: the use of a gamified digital educational resource (Telegram bot) in English will contribute to a greater increase in motivation to learn the language and the formation of practical environmental habits compared to traditional methods of environmental education.

The results of the experiment showed a significant increase in motivation and the level of environmental responsibility in the experimental group compared to the control group.

Prospects for further research: Expansion of the bot's functionality (adding mini-games, a knowledge base, integration with school projects), as well as testing it in a wider audience and in the educational environment of the UK.

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SYNTHESIS AND CHARACTERIZATION OF THYMOL DERIVATIVES AS CORROSION INHIBITORS FOR CARBON STEEL IN ACIDIC ENVIRONMENTS: EXPERIMENTAL AND COMPUTATIONAL APPROACHES.

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ABSTRACT

The problem of corrosion in acidic environments, particularly for E24 steel, is a significant concern for various industries due to the aggressive nature of hydrogen ions in such conditions. This study explores two newly synthesized organic inhibitors—3-(3,4-dimethoxyphenyl)-5-((2-isopropyl-5-methylphenoxy)methyl)-4,5-dihydroisoxazole (TVM) and 3-(4-ethoxy-3-methoxyphenyl)-5-((2-isopropyl-5-methylphenoxy)methyl)-4,5-dihydroisoxazole (TVE)—which are based on a vanillin-thymol platform. These inhibitors were tested for their ability to prevent corrosion of E24 steel in a 1 M HCl solution, utilizing electrochemical techniques such as potentiodynamic polarization, electrochemical impedance spectroscopy, and surface analysis (SEM/EDS).

Both inhibitors showed high efficacy, with the TVM molecule achieving a maximum inhibition efficiency of 88.25% and the TVE molecule reaching 91.98%. Due to its superior performance, TVE was selected for further study, particularly focusing on its behavior across a range of temperatures (298–328 K) and over an immersion period of up to 24 hours.

The findings indicate that TVE acts as a mixed-type inhibitor, predominantly affecting the cathodic reaction, and remains highly effective even under harsh conditions. Thermodynamic analysis of adsorption suggests that the interaction between the inhibitor and the metal surface is spontaneous, following the Langmuir isotherm. Additional computational analyses, including DFT, DFTB, and MD simulations, confirmed the favorable adsorption affinity of TVE, highlighting its electronic and steric interactions with the metal surface.

Keywords: thymol, Corrosion Surfactant, Adsorption, Theoretical studies, MEB/EDX .

CULTURAL FOUNDATİONS AND THE ROLE OF ART İN ECONOMİC DEVELOPMENT

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Abstract
This article examines the multidimensional link between cultural foundations, the art sector, and the process of economic development. It seeks to demonstrate how cultural capital and artistic infrastructures can function as effective drivers of economic growth. Given the growing importance of the cultural economy and the expansion of creative industries in recent decades, this study analyzes the relationship between cultural capital, artistic capacities, and the economic performance of countries by employing both theoretical analysis and empirical evidence from 2010 to 2025. The research methodology is a mixed approach, combining frameworks from the OECD, institutional economics, the creative economy, and human development theory. The data used are drawn from international sources such as UNESCO, the World Bank, and OECD databases. The research findings indicate that the development of art and the strengthening of cultural capital contribute to economic growth through channels such as increased labor productivity, reinforcement of social capital, enhancement of innovation, expansion of tourism, and the creation of new markets. Moreover, countries that have adopted supportive cultural policies and invested in the advancement of creative industries have demonstrated better and more sustainable economic performance compared to countries with limited attention to culture.
The main contribution of this article is the presentation of an integrated analytical model that explains the simultaneous interaction of culture, creative economy, and supportive institutions, and demonstrates that sustainable economic development is not achievable without attention to cultural and artistic dimensions.
Keywords: Cultural economy, cultural capital, economic development, artistic infrastructure, cultural tourism.

Introduction

In recent decades, culture and the arts have assumed a central position in analyses of economic development and are increasingly recognized as key drivers of sustainable growth. The transformation of the global economy and the transition from an industrial economy to a knowledge-based economy, and subsequently to a creative economy, have elevated cultural and artistic industries to a core component of national economic structures. A substantial body of research in the field of the creative economy demonstrates that this sector is not merely a source of entertainment or aesthetic activity; rather, it possesses extensive capacity to generate employment, increase income, foster innovation, and strengthen social cohesion. Indeed, in many countries, culture and the arts have moved beyond a purely symbolic or expressive domain and have become a fundamental pillar of the national economy.
One of the most compelling indicators of the economic significance of culture and the arts is UNESCO's **2022** report, which estimates the global turnover of creative industries at more than USD **2.2** trillion and highlights that approximately 30 million jobs are directly linked to this sector. These figures indicate that cultural and artistic industries not only play a decisive role in

gross domestic product but are also among the fastest-growing sectors of the global economy. They encompass a wide range of fields, including cinema, music, handicrafts, design, video games, publishing, fashion, and architecture, all of which exhibit a strong capacity for value creation.

The experience of leading countries illustrates that intelligent cultural policymaking has played a crucial role in transforming culture and the arts into engines of economic growth. Countries such as South Korea, the United Kingdom, Japan, and France have successfully converted artistic activity into a competitive advantage through sustained investment in cultural infrastructure, support for artists, the training of skilled human capital, and the development of global markets. For instance, South Korea, through its "K-Culture" strategy, has transformed its music, film, and video game industries into multibillion-dollar export sectors. Similarly, the United Kingdom has generated a substantial share of employment through the expansion of creative industries and the establishment of supportive institutions. Japan, leveraging its cultural brand of "pop culture," has captured a significant share of global markets, while France, supported by an extensive system of cultural institutions and artist protection, has maintained its position as one of the world's leading cultural centers.

By contrast, many developing countries, despite possessing rich cultural resources, have not yet secured a significant share of global creative industries. The reasons for this gap include weaknesses in cultural policymaking, insufficient financial support, underdeveloped educational and technological infrastructure, limited attention to the creative economy in national planning, and the absence of effective international marketing networks. In many such contexts, culture and the arts are still viewed primarily as symbolic activities with limited economic impact, even though global experience demonstrates that without an economic perspective on culture, effective utilization of these capacities is unlikely.

The objective of this article is to analyze the relationship between cultural foundations and economic development. Within this framework, the study addresses the central question of how culture and the arts can function as drivers of economic development and which policies can strengthen this relationship. To this end, the article first examines the concept of the creative economy and the position of cultural industries within the global economic system. It then analyzes the role of culture and the arts in value creation and employment generation. The subsequent section presents the experiences of successful countries, followed by an examination of the challenges and constraints faced by developing countries in leveraging their cultural capacities. Finally, the article proposes a set of policy recommendations aimed at reinforcing the linkage between culture and economic development.

In analyzing the role of culture, the article emphasizes that culture is not merely a collection of symbolic values but constitutes a form of economic and social capital capable of enhancing development capacity. Culture contributes to development by fostering a sense of belonging, increasing social participation, shaping shared identities, and strengthening social capital. At the same time, the arts create innovative and creative spaces that enable the emergence of new ideas and support entrepreneurship. Artistic industries also generate substantial revenues through cultural tourism, the export of artistic products, and the creation of national cultural brands.

Cultural policymaking represents one of the central pillars of this analysis. International experience indicates that success in harnessing cultural potential is not possible without well-designed and coherent policies. Effective cultural policy should encompass financial support for artists, the development of cultural infrastructure, the training of specialized human capital, the expansion of creative industries, support for cultural exports, the creation of innovative spaces, and the establishment of coordinating institutions. Moreover, an organic linkage must

be established between cultural policy and broader economic policy, with culture explicitly defined as an integral component of national development strategies.

With regard to developing countries, the article stresses that their weaknesses are not limited solely to budgetary constraints; more fundamentally, they reflect deficiencies in strategic vision. In many cases, cultural and artistic capacities are utilized only in a limited or symbolic manner, and there is a lack of serious economic planning for the development of cultural industries. As a result, the cultural sector is frequently marginalized and fails to attain its rightful position within the national economy.

In its concluding section, the article proposes a range of measures to strengthen the role of culture in economic development. These include the formulation of a national creative economy policy, the establishment of financial support funds for artists and cultural enterprises, the development of cultural and digital infrastructure, specialized education in the fields of art and cultural management, support for cultural innovation and entrepreneurship, the expansion of international cultural relations, the reinforcement of national cultural branding, and the integration of cultural policies into economic development programs. Collectively, these measures can play a decisive role in transforming culture and the arts into one of the principal engines of economic development.

Conceptual Framework and Theoretical Foundations:

This section defines and analyzes the key concepts of cultural economics, creative industries, cultural capital, social capital, and artistic innovation, situating them within the relevant theoretical literature. The purpose of this section is to clarify how culture, art, creativity, and social and cultural capital play a fundamental role in shaping the economic growth trajectories of countries. In recent decades, the economic development literature has increasingly emphasized that cultural and social factors are not merely complementary to traditional economic variables such as investment, trade, and technology, but have themselves emerged as core sources of production and primary drivers of value creation.

1. Cultural Economics

Cultural economics is a branch of economics that examines the role and function of cultural, artistic, and creative activities within the economy. Rather than viewing culture solely as a social or symbolic phenomenon, this field conceptualizes it as an integral component of the production cycle, employment generation, consumption patterns, and economic value creation. Cultural economics investigates how cultural products such as film, music, visual arts, handicrafts, literature, design, fashion, and other artistic activities affect economic performance, as well as the factors that shape their production, distribution, and consumption.

This field also emphasizes how cultural and social capital influence consumer behavior, preference structures, social participation, and the organization of cultural markets. In recent years, cultural economics has gained growing prominence in economic policymaking, as cultural and creative industries have demonstrated their capacity to generate high income, create large-scale employment, and support sustainable economic growth.

2. Creative Industries

According to creative economy theory (UNCTAD, 2020), creative industries consist of a set of economic activities rooted in human creativity, artistic talent, and the production of cultural content. These industries include cinema, music, digital games, animation, industrial design, handicrafts, fashion, publishing, digital media, and other sectors in which ideas and creativity constitute the primary inputs of production.

The significance of creative industries in the modern economy derives from several fundamental characteristics:

High value added**:** A substantial share of the economic value generated by these industries originates from creativity and cultural content rather than raw materials, resulting in high profit margins.
Extensive employment generation: Creative industries have the capacity to create millions of jobs in areas such as design, content production, programming, arts, advertising, and marketing.
Strong export potential: Many cultural products are highly tradable in global markets and can strengthen national cultural branding.
Dependence on knowledge and innovation: Creative industries are more innovation-driven than most sectors, which closely links them to the digital economy.
According to UNCTAD reports, creative industries are among the fastest-growing sectors of the global economy, and many countries have succeeded in capturing a significant share of the knowledge-based economy through their development.

3. Cultural Capital

Drawing on Bourdieu's framework (1986), cultural capital refers to a set of knowledge, skills, competencies, tastes, symbols, and cultural assets that exist in three forms—embodied, objectified, and institutionalized each of which can influence individuals' economic behavior and social positioning.
Embodied cultural capital consists of mental habits, skills, language, lifestyle, artistic knowledge, and cognitive attributes that are internalized within individuals over time through socialization.
Objectified cultural capital appears in tangible forms such as artworks, books, musical instruments, paintings, historical artifacts, galleries, and museums. These forms possess not only symbolic but also economic value.
Institutionalized cultural capital refers to formal educational credentials, artistic certifications, and recognized cultural positions that confer social and economic legitimac
Cultural capital plays a central role in shaping cultural consumption, economic behavior, social participation, and the formation of cultural markets. Empirical studies show that societies with higher levels of cultural capital exhibit greater engagement in the production and consumption of cultural goods, higher innovation rates, and greater economic diversification.

4. Social Capital

Social capital encompasses networks of trust, shared norms, social relationships, social cohesion, and collective cooperation that facilitate economic interaction. It is a key factor in both cultural and economic development because:
Social trust increases citizen participation in cultural activities.
Strong social networks enable the expansion of artistic activities and innovative collaboration.
Collective cooperation reduces economic risk and enhances the performance of cultural markets.
Social capital complements cultural capital, as both contribute to participatory behavior, innovation enhancement, and the expansion of cultural production.

5. Artistic Innovation

Artistic innovation refers to the creation of new styles, novel techniques, innovative modes of artistic expression, and the application of new technologies in creative production. It is a foundational element of the creative economy because it:
Leads to the development of new markets;
Enhances the competitiveness of artistic products;
Increases the value added of cultural production;
Connects culture and the economy to technological advancement.
Today, many creative industries are built upon models that integrate art with science and technology, such as video games, digital animation, AI-generated art, and interactive design.

6. Conceptual Linkages Between Culture, Capital, and Economic Development

All the concepts discussed in this section—cultural economics, creative industries, cultural capital, social capital, and artistic innovation—ultimately converge into a broader conceptual network. This framework demonstrates that culture and creativity are not merely symbolic drivers but also powerful economic engines.

Recent economic studies indicate that:

Countries with higher cultural capital exhibit more dynamic patterns of cultural consumption;
These countries display higher innovation rates due to greater skills and readiness to adopt new ideas;
Strong social capital facilitates cultural and creative collaboration;
Creative industries thrive in such environments;
Ultimately, this cycle promotes economic diversification and reduces vulnerability to economic crises.

For these reasons, culture and creativity are increasingly recognized in contemporary development literature as sources of sustainable growth.

7. Findings from Recent Research

International studies conducted by organizations such as UNCTAD, UNESCO, the OECD, and the World Bank consistently demonstrate that:
Countries with high levels of cultural capital tend to have higher innovation rates;
Such countries typically experience greater economic diversification;
They show stronger resilience in the face of economic shocks;
The growth of creative industries fosters knowledge-based employment;
Cultural and social capital function as essential complements to sustainable development.

These findings underscore the importance of integrating culture and the arts into national economic strategies.

Literature Review and Theoretical Critiques

A substantial body of literature on cultural economics and creative industries including the works of Throsby **(2001),** Florida **(2005),** and reports by UNCTAD **(2018)** emphasizes that art, cultural activities, and creative industries represent some of the most powerful drivers of economic development worldwide. These studies demonstrate that cultural and artistic activities generate not only symbolic value but also economic value through innovation, new product creation, market expansion, and employment generation.

Florida's theory of the creative class explains how the presence of artists, designers, and creative professionals attracts investment, stimulates innovation, and fosters dynamic economic ecosystems. Similarly, Throsby argues that culture constitutes a form of economic capital with use, exchange, and symbolic value, capable of functioning as a type of sustainable capital that supports long-term economic growth. UNCTAD likewise identifies creative industries as one of the most rapidly expanding sectors of the global economy, emphasizing their role in exports, employment creation, digitalization, and national cultural branding.

Despite this extensive evidence, some more traditional economists largely influenced by neoclassical approaches argue that culture and the arts lack a direct economic function and are primarily "luxury" or "consumption-oriented" activities. They contend that cultural outputs are often difficult to measure, unpredictable, and poorly integrated into standard production functions, rendering their economic impact indirect and difficult to quantify. From this perspective, artistic activities are typically dependent on public or private subsidies and yield limited short-term financial returns, leading critics to claim that their developmental role is overstated.

However, this view has been strongly challenged in recent years. More recent studies, including Bakhshi and Cunningham **(2021)**, demonstrate that cultural capital constitutes a critical input in knowledge-based production functions and plays a significant role in enhancing innovation, entrepreneurship, and technological development. These studies confirm that creative industries are not merely producers of artistic goods but are also key drivers of technological innovation, digital transformation, platform development, and sustainable economic growth.

Critiques of the Existing Literature

Despite the broad consensus regarding the role of culture in the economy, a fundamental critique can be raised against much of the existing literature: many studies have overly simplified the relationship between culture and economic development. Early analytical models frequently treated culture as a single, homogeneous input within the production function, while paying insufficient attention to the complexity of cultural institutions, governance infrastructures, policy quality, and the broader institutional environment.

This simplification has led to several shortcomings:

The relationship between culture and economic development has often been assumed to be linear and unidirectional, whereas in reality it is multi-layered and interactive.

The impact of cultural governance quality has been largely overlooked, despite the fact that institutional weakness can lead to the misallocation or waste of cultural resources.

The role of arts education systems in nurturing creative human capital has received limited attention in empirical and analytical frameworks.

Differences between countries with strong cultural institutions and those with weak or inefficient institutional structures have frequently been neglected.

Recent studies emphasize that without adequate attention to the quality of cultural institutions, sustainable policymaking, intellectual property rights, and systems of support for artists, even high levels of cultural capital may fail to translate into meaningful economic development.

Discussion and Analysis of Findings

Based on the findings of the present study and a comprehensive review of the existing literature, it can be concluded that art and creative industries play multiple and complex roles in economic development. These roles can be categorized into four main dimensions:

1. Direct Contribution to Economic Value Creation

Art and creative industries produce goods and services that are tradable, exportable, and attractive to investment. Cinema, music, animation, handicrafts, video games, design, and fashion are all examples of cultural markets that generate economic value added. In countries such as South Korea, Japan, and France, investment in the arts has directly contributed to an increased share of the creative economy in GDP. Art markets, ticket sales, cultural tourism, and exports of creative products constitute some of the most important channels through which this value is generated.

2. Indirect Role in Enhancing Innovation

Through the expansion of imagination, creativity, critical thinking, and the creation of new styles, art enhances the broader innovation environment. Creative industries are often closely integrated with technology, which positions them as key drivers of digital innovation. Recent research indicates that cities with strong artistic infrastructure such as London, New York, Berlin, and Seoul—are simultaneously leaders in technological innovation. This reflects the fact that culturally rich environments foster entrepreneurship and innovation.

3. Social Role in Strengthening Social Capital

By encouraging public participation, creating shared cultural spaces, reinforcing collective identity, and increasing social interaction, art contributes to the accumulation of social capital. Higher levels of social capital, in turn, increase trust, reduce transaction costs, facilitate

cooperation networks, and improve the quality of economic interactions. As a result, art indirectly enhances overall economic productivity.

4. Cultural Role in Strengthening National Identity and Social Cohesion

Cultural identity is a key component of sustainable development. Countries with cohesive cultural identities tend to be more resilient in the face of crises. Art can strengthen national narratives, foster social cohesion, and enhance collective morale. These effects play an important role in cultural, social, and ultimately economic development.

The Importance of Cultural Institutions and Governance

One of the most significant findings of this research is that the impact of art on economic development is highly dependent on the quality of governance, institutional structures, and cultural policymaking. In countries where:

supportive institutions are weak or absent,
intellectual property rights are inadequately protected,
cultural and artistic spaces are poorly regulated,
arts education systems are underdeveloped, and artistic freedom and creativity are restricted,
the relationship between art and economic development is likely to fail.

Failure Scenarios in Cultural Policymaking

The study indicates that economic underperformance in the cultural sector is typically driven by the following factors:

1. Absence of Effective Support Institutions

The lack of funding mechanisms for artists, insufficient marketing for the export of creative products, and the absence of an innovation-friendly ecosystem reduce cultural productivity.

2. Weak Intellectual Property Rights

In countries where copyright protection is poorly enforced, incentives for creative production decline, and investment in cultural industries weakens.

3. Excessive Commercialization of Art

When art is reduced solely to an economic commodity, its cultural and creative value is undermined, leading to a decline in artistic quality. Over the long term, this hinders sustainable cultural and economic development.

4. Ineffective Arts Education Systems

If arts education fails to produce creative, skilled, and innovative human capital, creative industries stagnate and the economic impact of art remains limited.

5. Political Instrumentalization of Art

Analyses show that countries that use art primarily as a tool of political propaganda not only fail to achieve economic development, but also experience declining public trust, reduced creativity, and deteriorating artistic quality. Such policies weaken social capital, suppress innovation, and contribute to stagnation in creative industries.

Conclusion:

This article demonstrates that art and culture are not merely peripheral or decorative activities alongside the economy; rather, they constitute some of the most essential symbolic, identity-based, and social infrastructures of economic development. In other words, culture and the arts are not only components of the economic structure but also foundational forces that give meaning to development, foster social cohesion, strengthen national identity, and shape economic behaviors and attitudes. Within this framework, economic development that neglects cultural and artistic foundations is likely to result in growth that is fragile, fragmented, and lacking in depth.

The article emphasizes that the relationship between culture and the economy is neither linear nor one-dimensional. Instead, it is a multi-layered, interactive, and dynamic relationship in which art, cultural institutions, social structures, and economic policies mutually shape and

reinforce one another. This perspective is grounded in the theories of institutional economics, the creative economy, and human development, all of which argue that economic development becomes sustainable and effective only when financial and productive instruments are complemented by robust cultural, social, and identity-based infrastructures.

According to the findings of this study, one of the most critical factors strengthening the role of art and culture in economic development is the presence of effective cultural institutions. These institutions encompass organizations, policymaking frameworks, legal systems, artistic centers, educational structures, and all mechanisms that create an enabling environment for creativity and cultural production. The stronger, more coherent, and more supportive these institutions are, the greater the economic potential of art becomes. Countries such as South Korea, France, and the United Kingdom, which have developed advanced cultural institutions, have successfully transformed creative industries into key engines of economic growth.

The strengthening of arts education systems is another central factor highlighted in this article. Education systems generate creative, skilled, and capable human capital individuals who are able to move art beyond personal expression and integrate it into production, innovation, technology, entrepreneurship, and global markets. Countries with weak arts education systems typically face significant challenges in developing creative industries, as the lack of creative human capital constrains productive capacity and undermines global competitiveness. Long-term investment in arts education enhances skills, improves the quality of cultural production, and generates higher economic value added.

Investment in creative industries represents one of the article's most important policy recommendations. Creative industries including cinema, design, fashion, handicrafts, music, game development, digital publishing, animation, cultural tourism, and content production—possess substantial economic potential in addition to their cultural significance. Due to their knowledge-based and creativity-driven nature, these industries often generate returns that exceed those of traditional sectors. The findings indicate that countries adopting structured and long-term investment strategies in creative industries have experienced significant economic growth.

The article further argues that the existence of effective support frameworks is a necessary condition for transforming art into a driver of economic development. Such frameworks include supportive policies, financial instruments, intellectual property rights protection, export promotion mechanisms, transparent cultural governance, and the provision of technological infrastructure. In the absence of these frameworks, creative products struggle to become competitive, and cultural markets fail to realize their full economic potential.

A key contribution of the article lies in its presentation of empirical evidence showing that countries which regard art and culture as development capital perform more successfully in terms of innovation, economic diversification, employment growth, tourism attraction, and overall quality of life. A clear example is South Korea, which has transformed its cultural industries into core pillars of export performance and national identity through targeted policymaking. Similarly, the United Kingdom derives a substantial share of its GDP from creative industries.

By contrast, countries that adopt a purely instrumental, decorative, or narrowly constrained view of art tend not only to miss opportunities for economic growth, but also to experience weakened innovation, cultural stagnation, and the erosion of social capital. An instrumental approach reduces art to a short-term, political, or consumptive tool, thereby suppressing creativity and limiting its developmental impact. The article argues that this perspective constitutes one of the major barriers to cultural and economic development in countries with weak institutional structures.

In summary, the article contends that art and culture are not marginal sectors but fundamental pillars of sustainable economic development. Strengthening cultural institutions, expanding arts education systems, supporting creative industries, and establishing effective policy frameworks can significantly amplify the economic impact of art. Culture and the arts possess the capacity to generate meaning, motivation, innovation, social cohesion, and economic identity—elements without which no development model can achieve lasting success.

Empirical evidence reinforces this conclusion: countries that treat culture as development capital consistently outperform those that regard it as a cost rather than a strategic investment. Ultimately, the article underscores that economic development without culture is akin to constructing a building on unstable ground, whereas development rooted in art and culture yields more sustainable growth, stronger soft power, greater global integration, and a more resilient national identity.

Policy Recommendations:

Increase the share of cultural expenditure to **1** percent of GDP.

Allocating a stable and adequate portion of national income to culture can strengthen creative industries, enhance cultural infrastructure, and ensure long-term sustainability in cultural production.

Strengthen intellectual property rights and legal protection for artists.

Effective enforcement of copyright and related rights is essential to safeguard creative labor, encourage investment, and stimulate innovation within cultural and creative sectors.

Establish dedicated investment funds for creative industries.

The creation of specialized financial instruments and investment funds can support creative enterprises, reduce financing constraints, and promote the commercialization of cultural products.

Enhance cultural diplomacy and promote the export of cultural goods and services.

Expanding international cultural exchange, supporting creative exports, and leveraging national cultural branding can improve global market access and increase soft power.

Expand and strengthen arts education at school and university levels.

Integrating arts education into formal curricula is critical for developing creative human capital and fostering the skills required for innovation, entrepreneurship, and cultural production.

Develop and modernize urban cultural infrastructure.

Investment in cultural spaces such as museums, theaters, creative hubs, and digital platforms can stimulate local development, attract talent, and enhance urban competitiveness.

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TECHNOLOGY INVESTMENT AND PERFORMANCE OF BANKS IN ERA OF DISRUPTIONS IN NIGERIA

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Abstract
This study examined the effect of technology investment on performance of listed deposit money banks in era of disruption in Nigeria. To determine the relationship between technology investment and banks' financial performance, some key proxy variables were used in the study, namely; digitalization index and technology expense while banks financial performance on the hand was measured using return on equity. Two hypotheses were formulated to guide the investigation and the statistical test of parameter estimates was conducted using Panel least squares regression model. The research design used is Ex Post Facto design and data for the study were obtained from the published annual financial reports of listed deposit money banks on Nigerian Exchange Group spanning from 2019-2024. The findings of the study indicate that digitalization index has positive and significant effect on financial performance of listed deposit money banks in Nigeria at 5% level of significance. Also, technology expense was found to have positive and significant effect on banks financial performance in Nigeria at 1% level of significance. Based on this, the study concludes that technology investment ensures financial performance of listed deposit money banks in Nigeria. The study therefore recommends that listed deposit money banks in Nigeria should increase their investment in technological infrastructure as it has the potential to enable the financial performance of listed deposit money banks in Nigeria.

Keywords: Technology Investment; Digitalization Index; Technology Expense; Disruption

1. Introduction

Deposit Money Banks (DMBs) are a cornerstone of the Nigerian economy, providing essential services for savings mobilization, financial inclusion, and economic development (Ajape & Adelowotan, 2025). The global banking sector is undergoing a profound transformation driven by digitalization, and Nigerian banks are investing heavily in technological innovations such as digital accounting practices, cloud computing, and data analytics to streamline operations, enhance service delivery, and maintain competitive advantage (Ekwunife, 2025).

The emergence of financial technology (Fintech) has fundamentally altered the delivery of banking services, enhancing both customer experience and institutional efficiency. This evolution is particularly evident in the realm of digital accounting practices, which have moved beyond simple automation to encompass a suite of advanced technologies (Zhao et al., 2022). Nigerian banks now leverage a variety of digital tools, including cloud-based accounting systems, data analytics, machine learning (ML), and blockchain technology to streamline workflows, improve the accuracy of financial records, and meet regulatory requirements. These

technologies facilitate real-time financial analysis and secure transactions, thereby offering the potential for greater operational efficiency and lower costs.

Despite these substantial investments, the direct effect of specific technological tools on the financial performance metrics of listed DMBs in Nigeria is not fully established and remains a subject of debate among scholars and practitioners (Ajape & Adelowotan, 2025). While some research confirms a positive aggregate relationship, there is a lack of granular understanding. Many banks continue to grapple with operational inefficiencies, transaction delays, and errors, partly due to the persistence of outdated systems and a limited ability to leverage advanced data analytics for strategic decision-making. This inefficiency can erode stakeholder trust and hinder sustainable growth.

Furthermore, the existing literature often treats "technology adoption" as a broad concept, leaving a critical gap in empirical evidence on how individual components of digital accounting such as blockchain technology, machine learning, automated bookkeeping, and cloud-based systems distinctly influence key financial performance indicators like Return on Assets (ROA) (Abdullahi et al., 2025 2025). This ambiguity challenges the prevailing narrative that the Nigerian banking system is effectively utilizing advanced technologies and necessitates a focused study to isolate the impact of these specific technological investments. Therefore, the core problem is the unclear and insufficiently detailed link between discrete technology investments and the financial outcomes of listed deposit money banks in Nigeria especially in this era of technological disruption, which impedes the ability of bank management and policymakers to make optimally targeted and cost-effective technological decisions.

To achieve this purpose, we formulated the following hypotheses:

H_{01}: Digitalization index has no significant effect on financial performance of listed deposit money banks in Nigeria.

H_{02}: Technology expense does not significantly influence financial performance of listed deposit money banks in Nigeria.

2. Review of the Related Literature

2.1.1 Technology Investment

Technology investment encompasses several strategic approaches to deploying capital in digital tools and systems. From an operational perspective, technology investment refers to the capital expenditure allocated to new software and hardware, which is fundamentally aimed at implementing systems that enhance the quality of banking services. This spending drives the digital transformation of traditional activities, moving them from manual, branch-based processes to automated, digital channels to improve efficiency and customer satisfaction (Kiani et al., 2023).

According to Ekwunife (2025), it is a distinct domain focused not on a bank's internal systems, but on providing specialized financial services to technology companies. This involves strategic advisory for mergers and acquisitions (M&A) and facilitating capital raising for firms within the technology sector, thereby fueling innovation in the broader economy.

Technology investment constitutes the deployment of various digital solutions and foundational systems that financial institutions employ to streamline operations and drive innovation. This encompasses the entire suite of modern technologies such as artificial intelligence, blockchain, and cloud computing that are integrated into the bank's infrastructure to enhance security, enable new products, and improve the overall customer experience (Abdullahi et al., 2025).

2.1.1.1 Digitalization Index

A digitalization index is a quantitative tool designed to measure the extent and sophistication of a bank's or an entire banking system's adoption of digital technologies. One such index is formulated as a composite measure based on a set of indicators derived from data provided by institutions like the World Bank and individual commercial banks' financial statements. This type of index allows for a standardized comparison of digital maturity both across different banks and different national banking sectors, a progression that has been significantly accelerated by global shifts such as the COVID-19 pandemic (International Monetary Fund, 2021).

It is a comprehensive measurement model for digital and intelligent transformation across entire economies and specific industries, including banking. This index assesses the digital maturity of the banking sector within a country by tracking metrics such as the growth rate of spending on artificial intelligence and the progression of business cloudification, which refers to the migration of core operations to cloud-based platforms (Guo & Zhang, 2023).

According to Evident (2023), digitalization index serves as a global benchmark for AI maturity specifically within the banking industry. Rather than measuring digitalization as a whole, this index evaluates banks across four key pillars. Talent, Innovation, Leadership, and Transparency using over 70 individual indicators to provide a detailed picture of a bank's capability and progress in integrating artificial intelligence, a cornerstone of modern digital strategy.

2.1.1.2 Technology Expense

Technology expense focuses on the accounting treatment of technology costs. Banks categorize technology expenses as either Operational Expenditures (OpEx) or Capital Expenditures (CapEx). OpEx covers recurring costs necessary for daily operations, such as software subscriptions, cloud services, and maintenance fees, which are typically fully deductible in the year they are incurred. It is also referred to as a long-term investment in assets like servers or major software implementations, which are capitalized and depreciated over several years (Paul, 2024).

According to Abdullahi (2025), technology expense is not just a cost but an investment portfolio that must be strategically allocated. Technology expenses are a key component of overall operating expenses. These are the costs associated with running the bank’s daily operations and include specific items like digital banking platforms and cybersecurity. The study went further and note that the efficient management of these costs is crucial for maintaining profitability.

2.1.2 Financial Performance

This refers to the measurement of the results of a firm’s strategies, policies and operations in monetary terms. These results are reflected in the firm’s return on assets and return on investments. Financial performance provides a subjective measure of how well a company uses its assets from its primary mode of business and generate revenues.

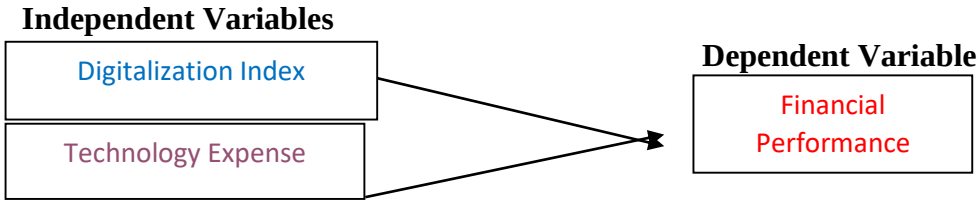
Financial performance is measured by revenues from operations, operating income or cash flow from operations or total unit sales. The analyst or investor may wish to look deeper into financial statements and seek out margin growth rates or any declining debt (Leah, 2021). Financial performance indicators in the form of ratios include profitability, liquidity, utilization financial structure and investment (Philip, 2022). Measure of profitability is by gross profit margin; the amount of money made after direct costs of sales have been taken into account, operating margin; lies between the gross and net measures of profitability and net profit margin; takes all costs into account.

According to Omaliko and Okpala (2022), corporate performance is the measuring of results of a firm’s policies and operations in monetary terms. These results are reflected in the firm’s

return on investment, return on assets, value added, return on equity, return on networth, return on total assets and return on capital employed. There are many different ways to measure financial performance, but all measures should be taken in aggregation. Line items such as revenue from operations, operating income or cash flow from operations can be used, as well as total unit sales. Furthermore, the analyst or investor may wish to look deeper into the financial statements and seek out margin growth rates or any declining debt.

Profit is a measure of managerial efficiency in controlling resources at their disposal. It is mostly viewed as return on investment made by the shareholders / owners. It is the main reason for establishing a business enterprise. For profit to exist, cash inflows into the firm must exceed the cash outflows (Brealey et al., 2023).

Figure 1: The Conceptual Model for the Study



Source: Researcher's Concept (2025)

2.2 Theoretical Framework

The theoretical framework which gives the meaning of a word in terms of the theories on technology investment and financial performance established in this study is Technology Acceptance Model. It assumes that both the knowledge and acceptance of this theory that this research work depends upon.

2.2.1 Technology Acceptance Model

The Technology Acceptance Model (TAM), introduced by Fred Davis in 1989, stands as one of the most influential and widely cited theories in the field of information systems. Its primary purpose is to explain and predict the determinants of user acceptance of a new technology within an organizational context. The model's enduring power lies in its parsimony, providing a robust yet straightforward framework for understanding the psychological mechanisms behind technology adoption.

The relationship between the Technology Acceptance Model (TAM) and the financial performance of banks is both critical and indirect, forming a vital causal chain that determines the return on technology investments. At its core, TAM explains the human factors that govern whether a technological innovation will succeed or fail, making it a fundamental predictor of whether a bank's financial investment in technology will ultimately enhance its bottom line or become a sunk cost.

According to Venkatesh and Davis (2000), a bank may allocate substantial capital to develop and deploy a state-of-the-art mobile banking application, an AI-driven customer service chatbot, or an advanced internal loan processing system. However, this technological investment, in itself, does not guarantee improved financial performance. The crucial link lies in adoption. This is where TAM provides indispensable insight. The model posits that the adoption of any new technology by its intended users whether they are retail customers or bank employees is driven primarily by two cognitive beliefs: perceived usefulness and perceived ease of use. For a customer, perceived usefulness is the belief that the mobile app will save time, provide valuable insights, or offer unique services not available elsewhere. Perceived ease of use is the sense that the app is intuitive and effortless to navigate. When both these perceptions are positive, the customer develops a strong intention to use the app, leading to sustained

adoption. The same principles apply to bank employees using a new internal platform; if they find it helpful for their daily tasks and easy to master, they will integrate it into their workflow (Venkatesh & Bala, 2008).

It is this widespread adoption, predicted and explained by TAM, that unlocks the financial benefits for the bank. When customers embrace digital channels, the bank achieves a significant reduction in operational costs by handling more transactions electronically rather than in physical, resource-intensive branches. Furthermore, a digital platform that is perceived as useful and easy to use fosters greater customer satisfaction and loyalty, which in turn deepens relationships and creates cross-selling opportunities for more profitable products like loans and investments (Davis, 1989).

Consequently, TAM serves as an essential strategic lens for bank management as it demonstrates that a technology's financial payoff is contingent upon its acceptance by end-users. A multi-million-naira investment in a sophisticated system is worthless if customers or employees find it confusing or unhelpful. Therefore, by applying the principles of TAM during the design, implementation, and marketing of new technologies ensuring they are genuinely useful and effortless to use banks can directly foster the high adoption rates necessary to drive the cost savings, revenue growth, and competitive advantage that ultimately translate into superior financial performance. Hence, the study was anchored on technology acceptance model.

2.3 Empirical Review

Laith et al. (2024) examine the relationship between financial technology and bank performance using panel data for 21 Arabian banks, from Bahrain, Jordan, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates, from 2015 to 2022. Financial technology was determined by the frequency with which digitalization terminology appeared in annual reports. Bank performance is measured by return on assets and return on equity. Ordinary least squares and two-stage least squares were applied to achieve the objective. The findings reveal that financial technology positively impacts the return on assets for Arabian banks, where a one-unit increase in fintech causes a 0.37 increase in ROA. In addition, financial technology positively impacts return on equity for Arabian banks, where a one-unit increase in fintech leads to a 0.29 increase in ROE. To confirm the study results, robustness was examined for the regression results using sub-period analysis before and during COVID-19. The results obtained using the two sub-periods show that financial technology positively impacts banks financial performance in the two sub-periods before and during COVID-19.

Okoro et al. (2024) examined the impact of financial technology on financial performance of Nigerian banks. The volume of ATM transactions, POS transactions and internet bank transactions were used to measure financial technology while liquidity ratio was used to measure financial performance. To achieve the objective of the study, ex-post facto was adopted. The data were collected through secondary source from CBN statistical bulletin. The data collected were analyzed using ordinary least multiple regression analysis. The result revealed that ATM transactions have positive impact on the performance of commercial banks in Nigeria. POS transactions have positive impact on the performance of commercial banks in Nigeria. Internet banking transactions have negative impact on the performance of commercial banks in Nigeria.

Odoyemi et al. (2024) analyzed the sustainable information technology (IT) practices in the Nigerian banking sector, focusing on environmental perspectives. The methodology for the study involves a comprehensive review of existing literature, including academic journals, industry reports, and case studies, to gather insights into the current state of sustainable IT in

Nigerian banking. The findings of the study revealed that while some Nigerian banks have begun to adopt green IT initiatives, such as paperless operations, energy-efficient data centers, and electronic banking services, the overall adoption rate is relatively low compared to global standards. The study identifies barriers to adoption, including lack of awareness, limited regulatory frameworks, and inadequate infrastructure. Despite these challenges, the study highlights the potential benefits of sustainable IT practices, such as reduced carbon footprint, operational cost savings, and enhanced corporate reputation. The study therefore concludes that for Nigerian banks to fully embrace sustainable IT practices, there needs to be a concerted effort involving policy formulation, awareness campaigns, and investment in green technologies.

Also, Okeke (2024) investigated the impact of information and communication technology (ICT) on firm performance in Nigeria. This study's goal is to review the effect of ICT on the financial performance of firms in the consumer goods sector as measured by their Return on Capital Employed (ROCE) with firm size added as a control variable. For a period of ten (10) years, from 2013 to 2022, the study used thirteen (13) listed consumer goods companies in Nigeria. An ex-post facto research approach was used, and secondary data were gathered from the companies' annual reports for the period under review. E-Views version 12 was used to do correlation and regression analysis. The findings show that Funding for ICT Hardware (FICTH) and Funding for ICT Software (FICTS) have a negative and insignificant effect on the financial performance of listed consumer goods firms in Nigeria. The study suggests that stakeholders, especially managers in the consumer goods sector should always review all options carefully before venturing into any procurement of additional computer hardware or software bearing in mind the negative impact of their ROCE.

Paul (2024) investigated the effect of artificial intelligence (AI) investments on the performance of deposit money banks (DMBs) in Nigeria. Using data from 14 listed DMBs over 11 years (2012-2022) and OLS, AI investments was proxied by computer software expenses and computer software book value, on the return on equity (ROE). The findings indicate that software expenses have an insignificant effect on ROE, while software book value has a significant negative impact. However, collectively, AI investments significantly affect the performance of DMBs. The study underscores the importance of AI in enhancing the efficiency and profitability of banks in Nigeria.

Mensah et al. (2023) conducted a study on the relationship between Information and Communication Technology (ICT) and the performance of rural banks in Ghana. Using panel data regression and data from 2018 to 2021, the study found that ICT cost efficiency significantly impacted the performance of rural banks, whereas investment in ICT had little effect. Based on these findings, the study suggests that instead of investing in new ICT facilities, rural banks should focus on utilizing their existing capacities by adjusting their financial products and services to enhance their performance and remain competitive in the rural banking industry.

Yaaqub and Rizgar (2023) investigated the impact of information technology on banking performance in Iraq. Data on five major banks in the Kurdistan Region of Iraq has been gathered. An ARDL model for estimation was been used. The results of the study showed that IT has a significant impact on performance in the short and long run.

Siphokazi (2022) investigated the impact of digital transformation on the financial performance of the traditional South African banks. The study used the quantitative research method where financial performance, was measured by return on assets (ROA) and digital technology (data analytics, artificial intelligence, cloud computing, and the Internet of Things). The data was collected using secondary data accessed from the traditional South African banks, namely;

ABSA, Standard Bank, FNB, and Nedbank's annual reports and full-year consolidated financial statements, from the year 2014-2021. Using regression model, the results indicate that there is a strong relationship between digital technology and business performance, meaning that digital transformation does have an impact on the business performance of the traditional South African banks.

3. Methodology

An *ex post facto* design was adopted in the study as a result of the nature of the data which already existed and cannot be controlled. The population of the study consists of 14 listed deposit money banks on Nigerian Exchange Group as at December 31, 2024, covering the period 2019-2024. The data for the study was collected from the annual accounts and annual accounts of the sampled banks. Panel least square regression model was used to examine the relationship between technology investment and financial performance of listed deposit money banks in Nigeria in era technological disruptions.

Table 1: Measurement and Operationalization of Variables

Variables	Symbol	Definition	Sources	A Priori Expectations
Independent Variable				
Technology Investment:				
Digitalization Index	DI	The percentage of online transactions, mobile banking and the use of digital tools	Abu et al. (2024), Paul (2024)	+
Technology Expense	TE	Log of technology expenses	Adiga et al. (2022), Odoyemi et al. (2024),	+
Dependent Variable				
Financial Performance				
Return on Equity	ROE	Net Profit After Tax/Equity	Leah (2021), Omaliko & Okpala (2022)	

Source: Researcher's Compilation (2025)

3.2 Model Specification and Justification

The present study designed a model in examining the effect of technology investment on financial performance of listed deposit money banks in Nigeria. The functional model for the study is therefore shown below as thus:

ROE = F(DI, TE)

The explicit form of the regression designed for the study is expressed as thus:

$$\mathbf{ROE_{it} = \beta_0 + \beta_1 DI_{it} + \beta_2 TE_{it} + \mu}$$

Where:

ROE = Return on Equity

DI = Digitalization Index

TE = Technology Investment

μ = Stochastic Term

$\beta_1 - \beta_2$ = Coefficient of Regression Equation

β_0 = Constant coefficient (intercept) of the model

'*A Priori*' is given as: $\beta_0, \beta_1, \beta_2 > 0$

Decision Rule: accept Ho if P-value > 1%-5% significant level otherwise reject Ho

4. Data Analysis and Results

Table 2: Descriptive Statistics

	ROE	DI	TE
Mean	4.08	6.77	0.61
Maximum	6.53	11.9	0.76
Minimum	0.86	4.67	0.12
Std. Dev.	0.12	0.21	0.57
Skewness	2.33	2.38	2.39
Kurtosis	1.22	2.19	2.35
Jarque-Bera	3.36	5.36	2.12
Probability	0.78	0.23	0.48
Sum	221	712	0.96
Sum Sq. Dev.	1765	175	19.2
Observations	**84**	**84**	**84**

Source: E-View 12 Computational Results (2025)

From Table 2 above, the mean (average), maximum values, minimum values, standard deviation and Jarque-Bera Statistics (Normality Test) were shown. The results provide some insight into the nature of the listed deposit money banks in Nigeria used in this study. First, it can be observed that on the average, in a 6-year period (2019-2024), the sampled banks were characterized by a positive return on equity (ROE) value of 4.08. This implies that banks with ROE values of 4.08 and above have enabling investments in technology. The distribution is platykurtic since the kurtosis (1.22) is less than 3, implying that the outliers are few. The Jarque-Bera probability of 0.78 is greater than 0.05, which means that the distribution of return on equity comes from a normal distribution.

The average digitalization index (DI) for the sampled banks was 6.77. This means that banks with DI values of 6.77 and above have higher performance at a degree risk of 0.21. There is also a high variation in maximum and minimum values of DI which stood at 11.9 and 4.67 respectively. This wide variation in DI values among the sampled banks justifies the need for this study that banks with higher DI values have higher performance than those banks with lower DI values. The distribution is platykurtic since the kurtosis (2.19) is less than 3, implying that the outliers are few. The Jarque-Bera probability of 0.23 is greater than 0.05, which means that the distribution of digitalization index is not different from a normal distribution.

The mean value of technology expense (TE) for the sampled banks was 0.61 with a standard deviation value of 0.57. This means that banks with TE values of 0.61 and above have higher performance and also investment in technology. There is also a high variation in maximum and minimum values of TE which stood at 0.76 and 0.12 respectively. This wide variation in TE values among the sampled banks justifies the need for this study that banks with higher TE values have higher performance than those banks with lower TE values. The distribution is platykurtic since the kurtosis (2.35) is less than 3, implying that the outliers are few. The Jarque-Bera probability of 0.48 is greater than 0.05, which means that the distribution of technology expense does not deviate from a normal distribution.

4.1: Test of Hypothesis

Table 3: Result on Effect of Technology Investment on Performance of Listed Deposit Money Banks in Era of Disruption in Nigeria.

Dependent Variable: ROE

Method: Panel Least Squares

Date: 10/28/25 Time: 3.02
Sample: 2019 -2024
Periods included: 6
Cross-sections included: 14
Total panel (balanced) observations: 84

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DI	0.409827	0.110931	3.694432	0.0331
TE	0.109813	0.020953	5.240920	0.0000
C	0.290387	0.029837	9.732446	0.0000

R-squared	0.670292	Mean dependent var	2.987632
Adjusted R-squared	0.610931	S.D. dependent var	3.320827
S.E. of regression	2.309784	Akaike info criterion	7.984562
Sum squared resid	20.09387	Schwarz criterion	7.214524
Log likelihood	290.8897	Hannan-Quinn criter.	7.988576
F-statistic	9.894874	Durbin-Watson stat	2.002632
Prob(F-statistic)	0.000000		

Source: E-View 12 Computational Results (2025).

4.2: Discussion of Findings.

The coefficient of determination R^2 shows 0.67 indicating that the overall model explained 67 percent of the total variations in the dependent variable. Thus, shows that these variables (DI & TE) can only explain 67 percent of change in banks' financial performance leaving 33 percent unexplained. This is to say that there are other factors that could led to firm sustainable growth other than investment in technology. The sig. (or p-value) is .0000 which is below the .01 level; hence, we conclude that the overall model is statistically significant, or that the variables have a significant combined or joint effect on the dependent variable. With this, the researcher affirms the validity of the regression model adopted in this study.

The results of the regression are therefore slated below as follows:

H_{01}: Digitalization index does not significantly influence financial performance of listed deposit money banks in Nigeria.

This hypothesis was tested and the result of this regression as exposited on table 3 indicates that the relationship between DI and ROE is positive and significant; this can be justified with the P-value (significance) of 0.0331 which is less than the 5% level of significance adopted. Likewise the result of positive coefficient of 0.409 indicates that an increase in digitalization index in the banking sector increases banks financial performance by 40.9%. Thus, implies that digitalization index enables banks financial performance in era of technological disruptions in Nigeria. We therefore accepted the alternate hypothesis which contends that digitalization index has significant effect on financial performance of listed deposit money banks in Nigeria.

H_{02}: Technology expense does not significantly influence financial performance of listed deposit money banks in Nigeria.

This hypothesis was tested and the result of this regression as exposited on table 3 indicates that the relationship between TE and ROE is positive and significant; this can be justified with the P-value (significance) of 0.0000 which is less than the 1% level of significance adopted. Likewise the result of positive coefficient of 0.109 indicates that an increases in technology

expense as other variables remain constant increases banks financial performance by 11%. We consequently accepted the alternate hypothesis which contends that technology expense has significant effect on financial performance of listed deposit money banks in Nigeria.

5. Conclusion and Recommendation

The study having examined the effect of technology investment on financial performance of listed deposit money banks in Nigeria in era technological disruptions, found that digitalization index and technology expenses in the listed deposit money banks in Nigeria have positive and significant effect on financial performance of listed deposit money banks in Nigeria. thus, the study concludes that technology investment ensures banks financial performance in Nigeria in this era of technological disruptions. The study therefore recommends that listed deposit money banks in Nigeria should increase their investment in technological infrastructure as it has the potential to enable the financial performance of listed deposit money banks in Nigeria.

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EFFECTS OF PHENOLS, FLAVONOIDS, AND SAPONINS FROM BOSS YAM PEELS (DIOSCOREA ROTUNDATA) ON AFLATOXIN PRODUCING FUNGI

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Abstract
Yams (Dioscorea spp.) are vital root crops in West Africa, providing food, income, and cultural value. Dioscorea rotundata (boss yam) is widely cultivated, yet large volumes of nutrient-rich peel byproducts are discarded during processing. This study investigated the effects of phenols, flavonoids and saponins from boss yam peels Dioscorea rotundata on aflatoxins producing fungi. Phytochemicals including phenols, flavonoids, and saponins were isolated from yam peel powder using solvent extraction to assess their capacity to inhibit aflatoxins growth. The extracts were quantitatively evaluated for antioxidant activity through Ferric Reducing Antioxidant Power (FRAP) and 2,2-diphenyl-1-picrylhydrazyl (DPPH) assays, and antifungal activity was assessed against Aspergillus flavus, A. niger, and A. fumigatus using the agar well diffusion method. Results showed that the saponin fraction had the highest yield (0.128 ± 0.003), followed by phenols (0.077 ± 0.002) and flavonoids (0.052 ± 0.001). Antioxidant activity was concentration-dependent, with the flavonoid extract showing the highest FRAP and DPPH values (62.13 ± 0.64; 53.00 ± 1.25), while the saponin fraction of boss yam exhibited the strongest antifungal effect (39.00mg/mL), particularly against A. fumigatus. These findings demonstrate that D. rotundata peels possess valuable antioxidant and antifungal potentials, suggesting their use as natural, eco-friendly agents for aflatoxin inhibition and sustainable waste utilization.

BIOTECHNOLOGICAL POTENTIAL OF *MENTHA PIPERITA* L. EXTRACT IN ENHANCING THE NUTRITIONAL AND PHYSICOCHEMICAL QUALITY OF POSTHARVEST TOMATO

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Abstract
Natural plant extracts have emerged as sustainable alternatives to synthetic preservatives for maintaining the quality of fruits after harvest. In this study, the antioxidant, antimicrobial, and preservative properties of an aqueous extract of *Mentha piperita* were assessed in the postharvest treatment of *Solanum lycopersicum* (tomato). The ment extract exhibited a strong antioxidant activity (IC_{50} = 2 mg/mL) and was rich in total polyphenols (432 mg GAE/mL) and flavonoids (45 mg QE/mL), confirming its high bioactive potential. Antimicrobial analyses revealed significant antifungal effects, while no inhibitory activity was observed against bacterial strains. When applied to tomato fruits, the extract effectively maintained essential physicochemical parameters including pH, titratable acidity, firmness, and weight throughout the storage period. These results indicate that bioactive compounds derived from basil not only provide antioxidant and antifungal protection but also contribute to preserving the nutritional and physical quality of tomatoes after harvest, underscoring their promise as natural agents for food preservation and health promotion.
Keywords: *Mentha piperita*, postharvest tomato quality, physicochemical attributes

HERITAGE RESOURCES AND TOURISM DEVELOPMENT IN SOUTHWESTERN NIGERIA: FOCUSSING ON CHALLENGES AND THE WAY FORWARD.

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Abstract
Ekiti State is endowed with multitudinous cultural heritage resources, which include traditional ceremonies, historical objects, sites and monuments, local games, local industries, oral traditions, traditional institutions, traditional costumes, local foods, religion and belief system. They have become major catalysts for community and national development, especially through tourism. Despite the opportunistic efficacies derived from these heritages, they are not without shortcomings that could affect the attainment of sustainable tourism development. This study centred on disclosing the challenges facing cultural heritage resources and tourism activities in Ekiti State and how they could be minimised. Qualitative method of research design was incorporated in which in-depth interviews with 160 informants and direct observation were methods of data collection. The challenges revealed include low publicity, irregular stakeholders' interest, poor preservation, intrusion of Christianity, dearth of research and documentation, poor planning and implementation, rural-urban migration, weak policy, inadequate social amenities and infrastructures. The way forward include comprehensive documentation, public awareness, regular funding, adequate social amenities and infrastructures, effective security management, active policies, hybridisation of local and modern preservative measures, religious tolerance and active involvement of stakeholders and volunteers. The outcome of the study would help heritage promoters, policymakers, custodians, and other stakeholders to plan and implement heritage and tourism activities in more sustainable way.
Keywords: Heritage resources; tourism development; Ekiti State, south western; Nigeria

EFFECTS OF CONSTRUCTİVE PLAY STRATEGY ON PRİMARY TWO PUPİLS' ENGLİSH LANGUAGE SKİLLS ACHİEVEMENT İN MAİDUGURİ METROPOLİS, BORNO STATE, NİGERİA

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ABSTRACT
The study investigated the effects of constructive play strategy on primary two pupils' English language skills achievement in Maiduguri Metropolis, Borno State, Nigeria. The researchers formulated two research questions and two hypotheses to guide the study. The study used quasi-experimental research design, specifically the pre-test and post-test non-equivalent control group research design. The population of the study was 21,986 primary two pupils from the 49 public primary schools in Maiduguri Metropolis, Borno State. The sample consisted of 85 primary two pupils from the 49 public primary schools, selected by using simple random sampling technique. The study used two research questions and two null hypotheses to guide the study. Instrument used was titled English Language Skills Achievement Test (ELSAT) to collect data from the pupils. The instrument was validated by three experts; one from Educational Psychology Unit, one from Research Measurement and Evaluation Unit and the other person from English language, Department of Arts Education Unit all from Faculty of Education, University of Jos. The instrument was tested by using test re-test method to determine the reliability of the instrument and the reliability index was 0.87. Constructive play strategy was used to teach the experimental group for eight weeks while conventional method was used to teach the control group. Data were analysed by using statistical package for social services (SPSS). Mean and standard deviation were used to answered the research questions while Analysis of Covariance (ANCOVA) was used to test the hypotheses at 0.05 level of significance. The findings of the study revealed that constructive play significantly improved primary two pupils' reading and writing skills in public primary schools in Maiduguri Metropolis of Borno State. The experimental group achieved significantly higher mean score than the control group. There was a significant difference in post-test reading and writing skills mean scores of primary two pupils in experimental and control groups in Maiduguri Metropolis of Borno State. The researchers recommended that the Ministry of Education of Borno State should ask teacher to use constructive play in teaching and learning English language. Curriculum developers should in cooperate constructive play into the primary school English language curriculum studies.

KEYWORDS: Constructive Play Strategy, English Language Skills, Achievement.

INTRODUCTION
Primary education refers to the education given to primary school pupils aged 6-11 years plus. It is in the primary school that the pupils learn the fundamental basic skills in English language subject that prepares the pupils for long life learning. One of the objectives of primary education is to inculcate permanent literacy, numeracy, and ability to communicate effectively. It is a foundation upon which other levels of education such as secondary and tertiary educations are built. The education the pupils receive at this level is known as basic education.

One of the challenges that is facing primary education in Nigeria is acquiring proficiency in English language skills (Oyetunde, Ojo, Korb Babudoh 2016). It is believed that decline in educational quality in Nigeria has a lot to do with the quality of teaching English language skills in public primary schools (Moyi and Galadima, 2020). Studies have shown that academic achievement of public primary schools in English language skills in Maiduguri Metropolis is low and this could lead to decline in educational quality because learning other subjects depend on understanding English language skills (Olatuji, 2024). English language is an instrument for

change, it is an act of acquiring knowledge that has formative skills on the mind, character and physical ability of an individual (Ghafar, Hazaymeh, Raad & Anjum, 2025). These formative skills are the bedrock of English language as a subject, without these skills English language would have not been what it is today in Nigeria and the world at large, these formative skills which are reading and writing have led the Federal Government of Nigeria to make English language one of the compulsory subjects in schools in the National Policy of Education (Samaila, Omede & Haggai, 2025). Developing these English language skills early in the children will be of great importance to them to function well in the society they found themselves.

English language skills achievement are skills that help the pupils to convey their ideas with clarity and precision. Anidi (2021) stated that these skills which are considered crucial encompass various aspects of communication including reading and writing. These skills are necessary for effective learning as they help pupils to use English language effectively in practical situations and in classroom to understand new information, ideas or enjoy foreign culture through reading and writing and to communicate what they want, share how they feel or discuss opinions and ideas (Samaila, Omede & Haggai, 2025; Olatuji,2024; Ugwuanyi Chukwu, 2016). English language skills achievement could also help pupils with the knowledge of vocabulary and grammar to play an active role in building their ability and confidence to communicate among children (Ogayi, 2020; Rao, 2019; Ojetunde, 2013). Diwhu and Ereke (2025) opined that proficiency in English language skills are often seen as an essential skill for career advancement for national and international development.

The Federal Republic of Nigeria, F. G. N (2014) in the National Policy on Education provides language as a compulsory subject, which must be learnt at the primary level to enable the pupils to passed the common entrance examination to enter institutions of higher learning. Developing English language skills which are reading and writing could provide the pupils with the tools to access a wide range of educational materials including textbooks, internet, instructional contents to help pupils process their learning (Halilu and Lawal, 2025). It is believed that if children achieved these skills early it will go a long way to assist them in learning other subjects with relative ease as they advance in their educational pursuit (Miller, 2006). That is why it is crucial to pay attention to English language skills achievement to help children who are beginning formal learning (Moyi Galadima,2020). These children will not remain at primary two but will grow up to be adults in the society to shoulder responsibilities in their communities, Nigeria and the entire globe are using English language as a means of communication (Ugwuanyi and Chukwu, 2016). It is expected that they will be role models in the society, therefore, instilling the English language skills in them early could enhance their national development (Adeyemi, 2018).

English language is used as the official language in schools in Nigeria (Clifford, 2010; Obiegbu, 2015; Olagbaju Akinsola,2021). It is the language that is widely spoken and written around the world. It serves as a common language of communication among speakers of different native language. English language often described as a world language or global lingua franca (Rao, 2019) has become a dominant language in international business, science and technology, diplomacy and entertainment (Obiegbu, 2015). In the context of Nigeria, English language plays a significant role due to the historical and colonial influences. During the colonial period, Nigeria was under the British rule, and English language became the official language. Since gaining independence in 1960, English language retained its status as the official language serving as a unifying medium of communication among Nigeria's diverse ethnic and linguistic groups. The relevance of English language in Nigeria cannot be over emphasized. First, it is the official and administrative language (Owojecho, 2020). Official documents, laws and communication from government bodies are typically in English language. English language is also the medium of instruction in schools across Nigeria (Owojecho, 2020). Academic success often depends on proficiency in English language skills and it is a prerequisite for higher education and many

professional opportunities (Wang, 2020; Kule, 2024; Vula, Tyfekci, & Biblekaj, 2025). In addition, many business transactions, contracts and negotiations are conducted in English language. English language is the primary language used in the media including newspapers, televisions, radio and the internet (Kule, Tumwesigye Mugabe, & 2024). Many popular Nigerian movies, music and literatures are produced in English language contributing to its widespread use and understanding. Furthermore, English language facilitates communication with the rest of the world. It opens up opportunities for Nigerians to engage into global trade, diplomacy and collaboration in various fields.

Examination bodies like West African Examination Council (WAEC), National Examination Council (NECO), Joint Admissions and Matriculation Board (JAMB), National Business and Technical Education Board (NABTEB) and Common Entrance Examination (CEE) in Nigeria pay attention to English language skills during examinations. Questions are being developed on these skills to test the ability of the examinees to see their performance in English language skills for further use. This will help the children to be acquainted with the use of the skills to be successful in their examinations. These skills are listening, speaking, reading and writing. Reading skill is an important English skill, it involves the ability of the pupils to comprehend, understand, decode and interpret written language and texts (Owens, 2020). Proficient reading is essential for acquiring knowledge, comprehending information and engaging with various types of written materials. The major components of reading skill include decoding which is the ability of the pupils to translate written words into spoken language by recognizing and understanding the sounds represented in letters or group of letters (Olson, 2024). Another component of reading skill is fluency which is the ability of the pupils to read with accuracy, speed and natural expression that could allow them have smooth and efficient comprehension. Comprehension is another one which is the ability of the pupils to understand the meaning of written texts including main ideas, detail and the relationships between different parts of context clues and the use of surrounding information within a text to infer the meaning of unfamiliar words or phrases (Adebayo, 2019; Olson, 2024). Reading is very crucial because it exposes pupils to variety of words, sentence structures, language patterns contributing to their overall language development.

Another essential skill is writing skill, writing skill as a fundamental component of English language skill encompasses the ability of the pupils to express ideas, thoughts, and information in a coherent and organized manner through written communication (Xhama, 2017). Writing is a form of human communication by means of setting visible marks that are related to structural level of language (Xhama, 2017). It uses a set of symbols and rules to encode aspect of spoken language such as lexicon and syntax. It is a cognitive and social activity involving neuropsychological and physical process. Writing is a powerful activity which enhances pupils' language skills to develop their metacognitive skills, confidence, independence and interpersonal skills which are very essential for their cognitive and social development in general. This involves the proper use of grammatical rules and punctuation marks to convey meaning and ensure clarity in writing. Sentence structure is one of the basic needs in writing skill that involves construction of sentences with proper syntax, varied lengths with clear sentence structures to convey logically, organizing and arranging ideas in a logical order and coherent manner including the use of paragraphs and semantics (Vietmans,2024; Skowronsk, 2024). Writing skills complement oral communication by allowing the pupils to express themselves in a different medium and encourages critical thinking as the pupils articulate and organize their thoughts on paper, fostering analytical skills and the ability to express reasonable arguments.

The idea of constructive comes from the constructivist Jean Piaget's view of development and learning. This is an approach to early childhood education and is about responding to children who are by nature exploring discovering and building theories in everything they do. Piaget believed that education involves children taking an active role in their

education by building on top of what they already know to deepen their understanding of new concepts and ideas. As the children participate actively, learning remains permanent in their cognitive and social developments (Piaget, 1969). Constructive play is when children use toys, sand, clay, flashcards and loose parts of materials to build or create something new (Crum, 2025). Successful construction requires various skills such as planning, cutting, assembling, moulding, stacking, drawing and testing (Callagher and Sherwood, 2024). Constructive play is an important stage in the development of skills in children and cognitive development. It often takes the form of hand-on learning where children are posing questions, testing ideas and making decisions when experimenting with varieties of learning materials.

Children involved in exploratory play to use their senses for investigation and to explore and discover new things which Piaget said it is an important stage for children to develop cognitive skills to give them higher chance of future academic success. In this type play, children learn to manipulate objects or materials to generate creative thinking which they need in this generation for self-reliance (Klien, Wirth & Linas, 2023). Piaget's theory of play helps to underpin constructive play since it acknowledges that play will aid children to construct their own knowledge to developed cognitive abilities. Shroff (2023); Garcia (2024) explained that constructive play is suitable for school age children and involves a wide range of difficulties that may occur during their development but the children have the ability to choose what to do from a wide variety of materials and toys such as sand, clay, dolls, flashcards, beads and puzzles. The teacher encourages the children to experiment and express themselves freely. It is an essential alternative for intervention in major child-related problems. In addition, constructive play aids children with coping strategies, resilience, problem solving skills gross and fine motor skills, social skills, physical development and it enhances academic achievement of the children.

Public primary schools are run with public funds. They are usually free or subsidized for the pupils. The government employs the teachers and conducts the monitoring. Public primary school pupils in Nigeria referred to children who attend government-owned primary schools in the country. These pupils come from diverse backgrounds representing various ethnicities, cultures and socioeconomic statuses (Amadi, Nnamani, & Ani (2022). The Nigerian education system is designed to provide basic education like literacy, numeracy and ability to communicate effectively. Children typically starting from age six and lasting for six years at the primary level (Federal Republic of Nigeria, FRN; 2014). However, public primary schools in Nigeria faced various challenges including insufficient resources, overcrowded classrooms and disparities in educational quality across different states (World Health Organization, 2015). Despite these challenges, primary education is a right and fundamental to the academic and personal development of Nigerian children.

AIM AND OBJECTIVES

The aim and objectives of this study was to determine the effects of constructive play strategy on primary two pupils' English language skills achievement in Maiduguri Metropolis, Borno State, Nigeria. The specific objectives were to:

1. establish the effects of constructive play strategy on reading skills in English language achievement mean scores of primary two pupils in Maiduguri Metropolis of Borno State.
2. examine the effects of constructive play strategy on writing skills in English language achievement mean scores of primary two pupils in Maiduguri Metropolis of Borno State.

RESEARCH QUESTIONS

The research questions are:

1. What are the pre-test and post-test reading skills mean scores of primary two pupils' in the experimental and control groups in Maiduguri Metropolis of Borno State?
2. What are the pre-test and post-test writing skills mean scores of primary two pupils' in the experimental and control groups in Maiduguri Metropolis of Borno State?
3.

HYPOTHESES

The hypotheses are:

1. There is no significant difference between the pre-test and post-test reading skills mean scores of primary two pupils in the experimental and control groups in Maiduguri Metropolis of Borno State.
2. There is no significant difference between the pre-test and post-test writing skills mean scores of primary two pupils in the experimental and control groups in Maiduguri Metropolis of Borno State.

METHODOLOGY

The study used quasi-experimental design, specifically the pre-test post- test non-equivalent control group design. The population of the study were 21,986 pupils from the 49 public primary schools in Maiduguri Metropolis, Borno State. The sample for this study were 85 pupils from two of the 49 public primary schools. The sample consisted of 43 pupils from experimental group, 21 males and 22 females while the control group had 42 pupils, 20 males and 22 females by using simple random sampling technique. The study used two objectives, two research questions and two hypotheses tested at 0.05 level of significance to guide the study. The instrument used to collect data was test titled: English Language Skills Achievement Test (ELSAT). Test re-test reliability was used to test the stability and the instrument was subjected to three experts one in Educational Psychology unit, one in Research Measurement and Evaluation unit and the third one in English language unit Faculty of Education, University of Jos, Plateau State, Nigeria. The reliability index was 0.87. Pre-test was administered to both the experimental and the control groups before the six weeks of the administration of treatment using constructive play to the experimental group. After the treatment post-test was also administered to both the experimental and the control groups. Pearson Product Moment Correlation was used to determine the relationship of pre-test and post-test. Mean and standard deviation were used to analysed the data from the two research questions while the two hypotheses were tested by using analysis of co-variance (ANCOVA) by using the SPSS statistical package.

RESULTS

Research Question One

What are the pre-test and post-test reading skills achievement mean scores of primary two pupils' in the experimental and control groups in Maiduguri metropolis of Borno State?

Table 1

Pre-test and Post-test Reading Skills Achievement Mean Scores of Pupils in the Experimental and Control Groups

Group	N	Pre-test		Post-test		Mean Gain	Mean Gain Difference	Post-test Mean Difference
		Mean	SD	Mean	SD			
Experimental	43	8.44	2.99	15.74	2.49	7.30	6.38	6.72
Control	42	8.10	2.69	9.02	2.69	0.92		

Table 1 presents results on the pre-test and post-test reading skills mean scores of primary two pupils in the experimental and control groups. In the experimental group the post-test reading skills mean scores was 15.74 and standard deviation of 2.49, higher than the pre-test mean scores of 8.44 and standard deviation of 2.99 with a mean gain of 7.30, indicating that there was improvement in the reading skills after treatment. In the control group the mean score was 8.10

and a standard deviation of 2.69 at the pre-test. This means that at the pre-test the students in both groups had poor reading skills. The finding shows that the results of the post-test mean score of pupils was 9.02 and a standard deviation of 2.69 with a mean gain of 0.92. This means that pupils in the experimental group had a higher reading skill mean score (15.74) after treatment using constructive play strategy than those in the control group (9.02) who were not given treatment with a mean gain difference of 6.38 and post-test mean difference of 6.72 meaning the treatment given to experimental group was effective. This implies that constructive play strategy had improved primary two pupils' reading skills in Maiduguri Metropolis, Borno State.

Research Question Two

What are the pre-test and post-test writing skills achievement mean scores of primary two pupils' in the experimental and control groups in Maiduguri metropolis of Borno State?

Table 2

Pre-test and Post-test Writing Skills Achievement Mean Scores of Pupils in the Experimental and Control Groups

Group	N	Pre-test		Post-test		Mean Gain	Mean gain Difference	Post-test Mean Difference
		Mean	SD	Mean	SD			
Experimental	43	9.09	2.16	17.67	2.52	8.58	7.12	7.19
Control	42	9.02	2.69	10.48	6.86	1.46		

Table 2 shows the results on the pre-test and post-test writing skills mean scores of primary two pupils in the experimental and control groups. In the experimental group the post-test writing skills mean scores was 17.67 and standard deviation of 2.52, higher than the pre-test mean scores of 9.09 and standard deviation of 2.16 with a mean gain of 8.58, indicating that there was improvement in the writing skills after treatment. In the control group the pre-test mean score was 9.02 and a standard deviation of 2.69, the post-test mean score of pupils was 10.48 and a standard deviation of 6.86 with a mean gain of 1.46. This means that at the pre-test the students in both groups had poor writing skills. The finding shows that pupils in the experimental group had a higher writing skill mean score (17.67) after treatment using constructive play strategy than those in the control group (10.48) who were not given treatment with a mean gain difference of 7.12 and post-test mean difference of 7.19, meaning the treatment given to experimental group was effective. This implies that constructive play strategy improves pupils' writing skills.

Hypothesis One

There is no significant difference between the pre-test and post-test reading skills mean scores of primary two pupils in the experimental and control groups in Maiduguri Metropolis of Borno State.

Table 3

ANCOVA Result on Pre-test and Post-test Reading Skills Mean Scores of Pupils in the Experimental and Control Groups

Source	Type III Sum of Squares	Df	Mean Square	F	P-value
Corrected Model	2261.493[a]	2	1130.747	96.463	.000
Intercept	1204.810	1	1204.810	102.781	.000
Covariate	13.883	1	13.883	1.184	.280
Group	2217.471	1	2217.471	189.170	.000
Error	961.213	82	11.722		
Total	17458.000	85			

Corrected Total	3222.706	84

a. R Squared = .702(Adjusted R Squared = .694)

Analysis of Covariance (ANCOVA) was conducted to determine if a significant difference existed in the pre-test and post-test reading skills mean scores of primary two pupils in the experimental and control groups. Table 3 shows that F (1,82) = 189.17, $p < 0.05$ and since the p-value of 0.000 is less than 0.05 level of significance, the null hypothesis was rejected. The result further reveals an adjusted R squared value of .694 which means that 69.4 percent of the variation in the dependent variable which is reading skills is explained by variation in the treatment of constructive play strategy, while the remaining is due to other factors not included in the study, indicating there was a significant difference in the effect of constructive play strategy on reading skills of primary two pupils. Hence, this finding shows that there is a significant difference in the pre-test and post-test reading skills mean scores of primary two pupils in the experimental and control groups in Maiduguri Metropolis of Borno State.

Hypothesis Two

There is no significant difference between the pre-test and post-test writing skills mean scores of primary two pupils in the experimental and control groups in Maiduguri Metropolis of Borno State.

Table 4

ANCOVA Result on Pre-test and Post-test Writing Skills Mean Scores of Pupils in the Experimental and control Groups

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	26688.572[a]	2	13344.286	270.591	.000
Intercept	2074.565	1	2074.565	42.067	.000
Covariate	738.280	1	738.280	14.971	.000
Group	26257.398	1	26257.398	532.440	.000
Error	4043.851	82	49.315		
Total	259845.000	85			
Corrected Total	30732.424	84			

a. R Squared = .868 (Adjusted R Squared = .865)

Analysis of Covariance (ANCOVA) was conducted to determine if a significant difference existed in the pre-test and post-test writing skills mean scores of primary two pupils in the experimental and control groups. Table 4 shows that F (1,82) = 532.44, $p < 0.05$, since the p-value of 0.000 is less than 0.05 level of significance, the null hypothesis was rejected. The result further reveals an adjusted R squared value of .865 which means that 86.5 percent of the variation in the dependent variable which is writing skills ls is explained by variation in the treatment of constructive play strategy, while the remaining is due to other factors not included in the study, indicating that there was a significant difference in the effect of constructive play strategy on writing skills of primary two pupils. Hence, this finding shows that there is a significant difference in the pre-test and post-test writing skills mean scores of primary two pupils in the experimental and control groups in Maiduguri Metropolis of Borno State.

DISCUSSION

The findings of the study showed that pupils in the experimental group who were taught using the constructive play strategy achieved a higher mean score in reading skills compared to the control group with a mean gain difference of 6.38. This suggests that the intervention was effective in enhancing reading skills among primary two pupils in Maiduguri Metropolis of Borno State. The significance difference between the pre-test and post-test reading skills mean

scores of the experimental and the control groups underscores the positive impact of the constructive play strategy on early reading achievement. These results align with prior researches demonstrating that play-based and interactive instructional strategies improved reading skills among young learners. For example, Neha and Rule (2018) found that imaginative play significantly supported reading achievement development in Grade R learners inKwaZulu-Natal, enabling children to make sense of texts and transfer comprehension to new contests. Similarly, Colinares and Derasin (2023) observed that play-based literacy interventions improved reading readiness among Grade 1 pupils in the Philippines. Sitorus, Siregar and Sari (2025) also reported that play-based learning activities enhance early literacy skills, including decoding, comprehension, and fluency by engaging learners in multisensory and interactive experiences.

The findings of the study revealed that pupils in the experimental group, who were taught using the constructive play strategy, achieved a higher mean score in writing skills compared to the control group, which did not receive the treatment. This suggests that the intervention was effective in enhancing writing abilities among Primary Two pupils in the Maiduguri Metropolis of Borno State. The significant difference between the pre-test and post-test writing skill mean scores of the experimental and control groups highlights the positive impact of the constructive play strategy on early writing development in Maiduguri Metropolis of Borno State.

These results are consistent with prior research demonstrating that play-based and interactive instructional strategies can improve writing skills among young learners. For example, Kaya Tekman and Yeniasır (2023) found that play-based learning settings significantly improved primary pupils' writing skills by fostering creativity and engagement. Ejekwu (2025) reported that specific types of play in Nigerian early childhood classrooms had a significant positive effect on writing skill development. Similarly, Nzwala (2020) observed that learning through play enhanced emergent writing skills by promoting self-expression and vocabulary use. Wang (2020) highlighted that teacher-facilitated play provides structured opportunities for children to practice writing in meaningful and collaborative contexts, improving both the quality and quantity of written output. The mechanisms underlying the effectiveness of constructive play in writing development include peer interaction, guided storytelling, and dramatization of scenarios that stimulate idea generation, organization, and narrative skills (Crum., 2025). These activities not only enhance cognitive and language skills but also motivate learners to experiment with new vocabulary, sentence structures, and writing conventions in a supportive environment (Kaya Tekman & Yeniasır, 2023; Nzwala, 2020).

CONCLUSION

The study investigated the effectiveness of the constructive play strategy in improving primary school pupils' reading and writing skills in public primary schools. The findings revealed that pupils who participated in constructive play strategy performed significantly better than those taught through the conventional method. The experimental group demonstrated higher post-test scores in both the reading and writing skills showing that constructive play strategy positively influenced their ability to read and write effectively. This suggested that when learning is interactive, engaging, and collaborative pupils become more active to participate in learning process leading to the improvement of language skills development. The results further highlighted that constructive play provides opportunities for meaningful communication and social interaction which are essential for language skills achievement. The study concluded that the constructive play strategy is an effective approach to enhancing reading and writing skills among primary school pupils. It is therefore, recommended that teachers should incorporate play-based activities into their English language skills lessons to create conducive environments for learners-centered to support the holistic achievement of English language skills in Borno State and Nigeria.

RECOMMENDATIONS

The following recommendations were given:

1.Borno State Government should train primary school teachers on how to use constructive play strategy to help in improving English language skills achievement of primary school pupils through workshops.

2. Federal Ministry of Education and Curriculum Developers should include constructive play strategy into the English language studies curriculum in Nigeria.

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EFFECT OF FEEDBACK ON STUDENTS' ACHIEVEMENT IN ECONOMICS IN SENIOR SECONDARY SCHOOLS IN JOS NORTH, PLATEAU STATE, NIGERIA

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ABSTRACT
The study delved into the effect of feedback on students' achievement in economics in senior secondary schools in Jos North Local Government Area of Plateau State. The research put forward three research questions and corresponding hypotheses, which were answered and tested using mean and standard deviation and ANCOVA respectively. The study employed a quasi-experimental design, specifically the non-equivalent pre-test/post-test control group design. The population was made up of 1640 students from 22 secondary schools in Jos North LGA. The sampling technique adopted for the selection of schools was a simple random sampling technique. A sample of 42 senior secondary school students from two intact classes was used for the study. The test-retest reliability method was used to estimate the stability of the EAT and a reliability of 0.88. The hypotheses revealed that there is a significant effect of feedback strategies on students' achievement in Economics. There is no significant difference between the post-test mean achievement scores of male and female students in the experimental group. Nonetheless, it was recommended among others that a feedback strategy should be used by teachers as an enriching feature and complementary approach to conventional indoor methods of teaching Economics in secondary schools. Teachers should always identify topics and themes in Economics that students find difficult while teaching and should give feedback to students after each assessment to ensure that students are conversant with areas, they find difficult. This is to help improve students learning of Economics.

Keywords: Feedback, Economics, Students' Achievement

INTRODUCTION
Economics is the social science that analyzes the production, distribution, and consumption of goods and services. It is concerned with human behaviour, particularly how individuals earn a living and make choices among alternatives to satisfy their wants. Economics focuses on the activities of individuals, firms, and governments whose actions are geared toward the production and distribution of goods and services for the satisfaction of human needs. Since Economics is concerned with human behaviour, it is classified as a social science, and like other sciences, its reasoning procedures are methodological, systematic, and empirically verifiable. Specifically, secondary school education plays a crucial role in developing Nigeria's future manpower for sustainable national development. At this level, students are offered subjects in Economics, arts, social sciences, languages, and vocational and technical fields to provide opportunities for harnessing their intellectual and practical potentials. In recognition of this role, successive governments in Nigeria have implemented reforms such as increased budgetary allocation, policy restructuring, teacher professional development, and infrastructural improvement in the education sector.

Despite sustained efforts to improve secondary school education, students' academic achievement at the senior secondary school level remains a concern, particularly in the mathematical and quantitative aspects of **Economics**. Evidence from the West African Senior School Certificate Examination (WASSCE) between **2021 and 2024** indicates that achievement in Economics has been uneven, with many students experiencing difficulty in areas that require numerical computation, equation manipulation, and graphical analysis. These challenges have

contributed to a situation in which a significant proportion of candidates are unable to attain credit-level passes (A1–C6**)** in Economics. This pattern of achievement is closely linked to the nature of Economics as a school subject. Economics is a core subject in the Senior Secondary School (SSS) curriculum and integrates Economics theory, Economics statistics, and Economics mathematics. Effective performance in the subject therefore requires both sound conceptual understanding and adequate numerical competence. However, examination outcomes over the years suggest that while some students demonstrate reasonable understanding of theoretical concepts, many struggle with quantitative tasks such as calculations, data interpretation, and diagram construction. Weaknesses in these areas often reduce students' overall scores and negatively affect their achievement in the subject.

Reports from the West African Examinations Council (WAEC) Chief Examiners for the period 2021–2025 consistently highlight students' difficulties in the mathematical components of Economics. Commonly identified problems include poor manipulation of economic equations, inaccurate drawing and interpretation of graphs, and weak performance in topics such as price elasticity of demand, cost and revenue analysis, total and marginal cost, and quantity analysis. Many candidates either avoided numerical questions or attempted them unsuccessfully. These recurring weaknesses have been identified as major factors responsible for students falling short of the credit pass mark in Economics, despite partial mastery of theoretical content. The continued low achievement in these quantitative aspects has implications for students' academic progression, as credit passes in Economics are often required for admission into higher education programmes and related fields of study.

In the classroom setting, students' achievement in Economics is largely influenced by the quality of feedback provided during instruction and assessment. Feedback is fundamental to learning, as it enables learners to recognize their strengths and weaknesses and make necessary adjustments for improvement. Naylor, Baik, Asmar, and Watty (2014) emphasized that timely and detailed feedback whether formal or informal, enhances learning by helping students understand their current performance and what is required to improve. Recent studies have further affirmed that effective feedback is one of the most powerful instructional strategies for improving academic achievement across subjects, including Economics (Wisniewski, Zierer, & Hattie, 2022; Panadero, 2023).

Empirical studies have consistently shown that feedback has a significant positive effect on students' academic achievement. Dyer (2020) found that feedback positively influences students' achievement, while Sessenrath (2018) reported that delayed feedback may be more effective than immediate feedback in certain learning contexts. Boonruang (2016) observed that students exposed to positive feedback performed better in subsequent assessments than those in control groups. More recent evidence supports these findings, indicating that explanatory and corrective feedback significantly improves students' achievement in problem-solving and quantitative subjects such as Economics (Shute & Rahimi, 2022; Wisniewski et al., 2022).

Santrock and Ross (2017) noted that poorly delivered feedback can negatively affect academic outcomes, whereas constructive feedback enhances learning. Supporting this view, Carless and Winstone (2023) reported that feedback that is specific, task-focused, and improvement-oriented leads to higher achievement than feedback that is vague or judgmental. Feedback has been conceptualized as information provided by an agent—such as a teacher, peer, book, or experience—regarding aspects of a learner's performance or understanding (Timperley & John, 2017). In secondary school classrooms, teachers play a central role in providing feedback that supports learning and enhances achievement. Contemporary research emphasizes that feedback should move beyond indicating correctness to providing guidance that promotes deeper understanding and skill development (Kulhavy, 2019; Panadero & Lipnevich, 2023).

Providing detailed feedback is particularly important for students who experience difficulty in learning complex concepts. Macdonald (2019) described feedback as a process through which

teachers respond to students' work by identifying strengths, highlighting weaknesses, and suggesting areas for improvement. McLaughlin and Kelley (2012) emphasized that feedback should be provided promptly to reinforce learning. Recent studies corroborate that prompt, formative feedback improves students' achievement by enabling timely correction of errors (Winstone & Boud, 2022).

Theoretical support for the role of feedback in learning is grounded in Thorndike's Law of Effect, which posits that responses followed by positive reinforcement are strengthened, while those followed by negative consequences are weakened. This principle aligns with the stimulus response theories of learning advanced by Skinner, Pavlov, Hull, and Thorndike, which emphasize reinforcement as central to learning. Contemporary learning theories also recognize feedback as a critical component of self-regulated learning and achievement improvement (Zimmerman, 2022).

Prompt feedback enables learners to compare their actual performance with expected standards and adjust their learning strategies accordingly. Beard (2018) noted that providing students with feedback on test performance serves as an instructional aid that facilitates learning. Recent research supports this view, indicating that feedback enhances academic achievement by improving students' understanding of expectations and performance criteria (Hattie, 2023).

Given the persistent low achievement of students in Economics and the established importance of feedback in enhancing learning outcomes, there is a need to empirically investigate the role of feedback in improving students' achievement in Economics. Consequently, this study seeks to examine the effect of feedback on students' achievement in Economics in senior secondary schools in Jos North Local Government Area of Plateau State, Nigeria.

AIM AND OBJECTIVES OF THE STUDY

The aim of the study is to examine the effect of feedback on students' achievement in economics in senior secondary school in Jos North LGA. Specifically, the objectives of the study are to;

1. determine the pretest and posttest achievement mean scores of students in economics in the experimental and control groups
2. find out the pre-test and post-test achievement mean score of male and female students in the experimental group.
3. examine the interaction effect of treatment and gender on the achievement of students in economics?

RESEARCH QUESTIONS

The following research questions were constructed by the researchers as a guide to this study.

1. What are the pretest and posttest achievement mean scores of students in economics in the experimental and control groups?
2. What is the pre-test and post-test achievement mean score of male and female students experimental group?
3. What is the interaction effect of treatment and gender on achievement of students in economics?

HYPOTHESES

The study formulated the following hypotheses was tested at a 0.05 level of significance.

1. There is no significant difference in the pre-test and posttest achievement mean scores of students in Economics in the experimental and control groups.
2. There is no significant difference in the pre-test and post-test achievement mean score of male and female students in the experimental and control groups
3. There is no significant interaction effect of treatment and gender on achievement of students in Economics.

METHODOLOGY

The study adopted a quasi-experimental research design, specifically the non-equivalent pre-test and post-test control group design. The population for this study consisted of 1640 SS II students

(730 males & 910 females) in 22 public secondary schools in Jos North Local Government Area of Plateau State in 2023/2024 academic session. The sample for the study consisted of two public senior secondary schools in Jos North LGA having 42 SS II students, with 22 students (12 males & 10 females) in the experimental group and 20 students (9 males & 11 females) in the control group. The sampling technique used in this study was a simple random sampling to select two public secondary schools The instrument for data collection was an Economic Achievement Test having 40 multiple- choice items with four options (A, B, C, & D). The content validity of EAT was established by three experts, one from Research Measurement and evaluation unit and two from Economics Education unit. The stability of the EAT was estimated using test-retest method of reliability and a coefficient of 0.88 was obtained. A pretest was given to both the experimental and control group. The experimental group was exposed to teaching of economics and assessment with feedback for 6 weeks. The assessment involves providing students with feedback on each work, assignments, or performance. Both the experimental and control groups will be given a post-test. Descriptive statistics of mean, standard deviation and graphs were used to answer the research questions. Inferential statistics of Analysis of Covariance (ANCOVA) was used to test the hypotheses. The analysis was carried out using SPSS software

RESULTS

Research Question One

What are the pretest and posttest achievement mean scores of students in economics in the experimental and control groups?

Table 1

Pre-test and post-test Achievement Mean Scores of Students in the Experimental and Control Groups

Group		Pre-test		Post-test		Mean Gain	$\bar{x}$- difference	Post-test mean difference
	N	Mean	SD	Mean	SD			
Experimental	22	40.23	4.253	67.23	9.720	27	19.5	
Control	20	39.55	3.364	47.05	7.667	7.5		

Table 1 reveals the pre-test and post-test achievement mean score of students in the experimental and control groups. In the experimental group the post-test achievement mean score was 67.23 and standard deviation of 9.72, higher than the pre-test mean score of 40.23 and standard deviation of 4.25 with a mean gain of 27, indicating that there was improvement in the achievement of students after treatment. Also, for the control group the mean score was 39.55 and a standard deviation of 3.36 at the pretest. The post-test mean score of students was 47.05 and a standard deviation of 7.67. The findings show that students in the experimental group had a higher attitude mean score (67.23) after treatment using feedback than those in the control group (47.05) who were not given feedback with a mean difference of 19.5. This means that at the pre-test the students in both groups had a poor achievement, but after the intervention the experimental group performed better than the control group. It can be deduced that feedback does change students' achievement in Economics.

Research Question Two

What is the pre-test and post-test achievement mean score of male and female students experimental group?

Table 2
Pre-test and Post-test Achievement Mean score of Male and Female Students in the Experimental Group

Group	Gender		Pretest		Post-test			
		N	Mean	SD	Mean	SD	Mean Gain	X-difference
Experimental	Male	12	40.42	4.522	70.25	8.68	29.83	6.23
	Female	10	40.00	4.137	63.60	10.08	23.6	

Table 2 reveals the results of analysis on the pre-test and post-test achievement mean score of male and female students in the experimental group. From the result, male students had a mean score of 40.42 and standard deviation of 4.52 at the pre-test, male students had a post-test mean score of 70.25 and a standard deviation of 8.68 and a mean gain of 29.83. Also, female students had a mean score of 40 and standard deviation of 4.14 at the pre-test and a post-test mean score of 63.60 and a standard deviation of 10.08 with a mean gain of 23.6. The mean difference was6.23, indicating that there was a change in the attitude mean score of male and female students after treatment with male having a higher achievement mean score than the female

Research Question Three

What is the interaction effect of treatment and gender on achievement of students in Economics?

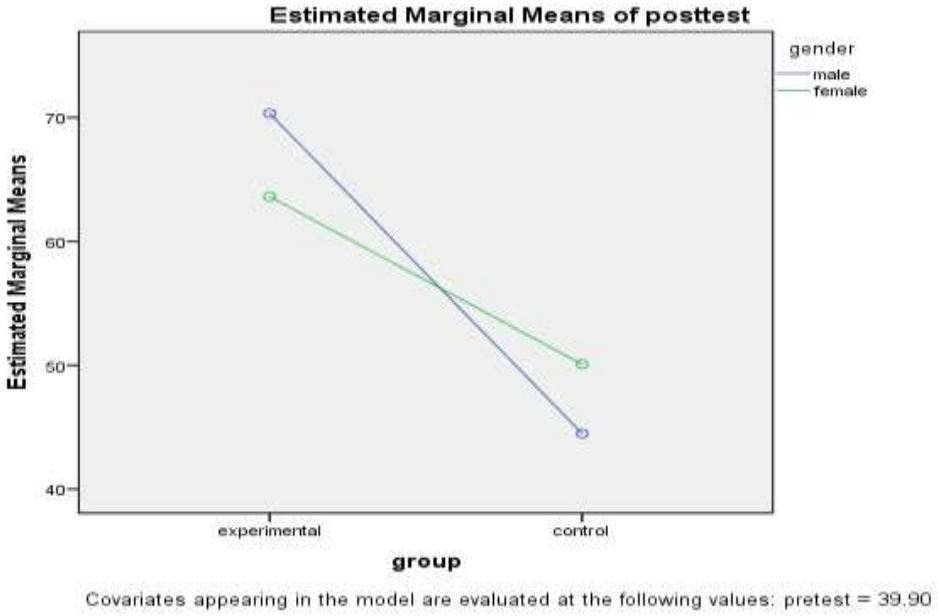


Figure 1: Interaction Effect of Treatment and Gender on Students' Achievement towards Economics

Figure 1 presents the profile plot showing the interaction effect of treatment on achievement of male and female students towards Economics. The estimated marginal means plot indicates an interaction effect between treatment and gender on students' achievement in Economics. In the experimental group, male students achieved higher post-test scores than female students, suggesting that the treatment had a stronger positive effect on male students. However, in the control group, both male and female students recorded lower post-test scores, with female students performing slightly better than male students. The non-parallel and intersecting lines on the graph show that the difference in achievement between male and female students varies across the experimental and control groups. This implies that the effect of the treatment on

students' achievement in Economics is influenced by gender, as male and female students responded differently to the treatment.

Testing of Hypotheses

Hypothesis One

There is no significant difference in the posttest achievement mean scores of students in economics in the experimental and control groups.

Table 3

ANCOVA Result on Posttest Achievement Mean Scores of Experimental and Control Groups

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	4272.345[a]	2	2136.172	26.930	.000	.580
Intercept	1403.432	1	1403.432	17.693	.000	.312
Covariate	7.254	1	7.254	.091	.764	.002
Group	4262.334	1	4262.334	53.735	.000	.579
Error	3093.560	39	79.322			
Total	146804.000	42				
Corrected Total	7365.905	41				

a. R Squared =.580 (Adjusted R Squared = .558)

Analysis of Covariance (ANCOVA) was conducted to determine if a significant difference exists in the posttest achievement mean score of students given feedback and those not given. Table 3 shows that $F(1,39) = 53.74$, $p < 0.05$, since the p-value of 0.000 is less than 0.05 level of significance, the null hypothesis was rejected, indicating that there was a significant effect of feedback on achievement of students in Economics. The result further reveals an adjusted R squared value of .558 which means that 55.8 percent of the variation in the dependent variable which is achievement in Economics is explained by variation in the treatment of feedback, while the remaining is due to other factors not included in this study. This means that feedback can help improve students' achievement in Economics

Hypothesis Two

There is no significant difference in the pre-test and post-test achievement mean score of male and female students in the experimental and control groups

Table 4

ANCOVA Result on Effect of Gender on Achievement of Students Experimental Group

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	279.375[a]	2	139.688	1.557	.236	.141
Intercept	1472.402	1	1472.402	16.413	.001	.463
Covariate	38.162	1	38.162	.425	.522	.022
Gender	250.276	1	250.276	2.790	.111	.128
Error	1704.488	19	89.710			
Total	101413.000	22				
Corrected Total	1983.864	21				

a. R Squared =.141 (Adjusted R Squared = .050)

Analysis of Covariance (ANCOVA) was conducted to determine if there is a significant effect of gender on achievement of students in Economics when given feedback. Table 4 shows that the main effect of gender yielded $F(119,) = 2.79$, $p > 0.05$, since the p-value of 0.111 is greater than 0.05 level of significance, the null hypothesis was rejected, indicating that there was no significant effect of gender on the achievement of students in Economics when given feedback. The result further reveals an adjusted R squared value of .050 which means that 5 percent of the variation in the dependent variable which is achievement in Economics is explained by gender, while the remaining is due to treatment and other factors not included in this study. It implies

that giving students feedback can help improve achievement in Economics for both male and female students.

Hypothesis Three

There is no significant interaction effect of treatment and gender on achievement of students in economics

Table 5

Interaction of Treatment and Gender on Achievement of Students in Economics

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	4672.285[a]	4	1168.071	16.045	.000	.634
Intercept	1465.530	1	1465.530	20.131	.000	.352
Covariate	12.646	1	12.646	.174	.679	.005
Treatment	3995.518	1	3995.518	54.883	.000	.597
Gender	3.221	1	3.221	.044	.835	.001
Treatment* Gender	392.397	1	392.397	5.390	.026	.127
Error	2693.620	37	72.801			
Total	146804.000	42				
Corrected Total	7365.905	41				

a. R Squared = .634 (Adjusted R Squared = .595)

Analysis of Covariance (ANCOVA) was conducted to determine if there is an interaction effect of treatment and gender achievement in Economics. Table 5 shows the main effect of treatment $F(1,37) = 54.88$, $p < 0.05$, since the p-value of 0.000 is less than 0.05 level of significance, the null hypothesis was rejected, indicating that there was a significant effect of treatment on the achievement of students in Economics. Again, the main effect of gender yielded $F(1,37) = .044$, $p > 0.05$, since the p-value of 0.835 is greater than 0.05 level of significance, the null hypothesis was retained, indicating that there was no significant effect of gender on the achievement of students in Economics. The result also reveals that $F(1,37) = 5.39$, $P < 0.05$, since the p-value of 0.026 is less than 0.05 level of significance, the null hypothesis was rejected, indicating that there was a significant interaction effect of treatment and gender on achievement of students in Economics.

DISCUSSION

The study investigated the effect of the feedback on student's achievement in economics in senior secondary schools in Jos North LGA of Plateau State. The findings on pre-test and post-test mean achievement scores of students taught with feedback strategy and those taught with conventional methods revealed that at the pretest both groups were at the same level of achievement, but at the post-test, the experimental group had a higher mean score than the control group. This is to say that the feedback strategy as a teaching tool initiates better achievement than conventional methods. The implication of this is that the feedback method should be used as instruction in economics teaching. Additionally, the post-test achievement test mean scores were higher than the initial. This implies an upward change in the level of achievement. Meaning that after the introduction of treatment, students became more interested in studying economics than in mere conventional teaching strategies which do not stimulated interest in students. This is in line with the works of Osunnaiye and Abara (2021) who found that the feedback approach was responsible for effective learning, increased achievement, and initiated better-thinking qualities in the students; and that gender was insignificant in determining any part of students' academic performance. This study corroborated the findings of Essien, Akpan, and Obot (2017) who viewed that when achievement and motivation increase, they influence students' academic achievement strongly.

It was found that there was a slight departure from the nominal achievement of both genders in the experimental group. This is because the male mean score improved slightly better than the female gender. This indicated that a small fraction of male students scaled up to meet those who

already performed better and this added up to create the change in better achievement of the male gender. This number of male students that performed better increased slightly above the number of female students in the experimental group. In another way, it can be stated that feedback influences both genders to competitively perform better than average. This is in line with the work of Salihu (2017) on the effects of educational feedback on the academic performance of senior secondary school Economics students in Kaduna State. The study discovered no significant difference between male and female experimental group students in their mean academic performance.

The findings indicate that there is an interaction effect between treatment and gender on the achievement of male and female students in Economics. This implies that the effect of the treatment on students' achievement varies according to gender. The intersection of the mean plots shows that male and female students responded differently to the treatment across the experimental and control groups. Therefore, the influence of the treatment on achievement cannot be interpreted independently of gender, as both variables jointly affect students' academic performance. Research has shown that gender can moderate the effectiveness of instructional interventions, with males and females responding differently to feedback and teaching strategies (Schoenfeld, 2021; Smith & Lee, 2023). Additionally, feedback-based interventions have been found to influence achievement outcomes differentially across gender groups, highlighting the importance of considering learner characteristics in educational evaluation (Ramirez & Kim, 2022; Zhou et al., 2024). More so, analysis of covariance revealed that there is a significant effect of a feedback on students' achievement in economics. This implied that feedback is one of the best approaches to be used in Nigerian schools to teach economics for better achievements. There was no difference in the achievement of male and female students in the experimental group. Upon this, it can be inferred clearly that the use of the feedback proves to be reliable in the teaching of economics and improvement of students' achievement.

CONCLUSION

From the findings of research questions and hypotheses, it was revealed that there is a significant effect of feedback on students' achievement in Economics. This meant that, the achievement of students studying economics in senior secondary schools was positively affected when feedback are given to students. It exposed the students to a direct learning environment where teachers view only come as complementary points to what students have gathered as facts in the process of exploration. Also, the achievement of students given feedback in the experimental group was not the same with those not given feedback. As the feedback was introduced as a treatment mechanism for the experimental group, the achievement of students in economics improved better than when these students were not given feedback. To this end, it was established that the feedback enhanced the achievement of students in economics and did not reduce the performance of students within the same group. It was shown through facts that there is just a slight or negligible difference between the achievement of the male and female students in economics unlike the difference between the experimental and control group which was described by wide disparity. Feedback has a significant positive effect on the achievement of students in Economics in secondary schools. The implication of this is that the giving of feedback should be incorporated into the teaching of economics to foster the academic state of students.

RECOMMENDATIONS

The following recommendations are put forward as valid foundations of the findings to concretize most claims made.

1. School management should adopt the use of a feedback for influencing the achievement of students in studying economics.
2. Other conventional methods like discussion, questions, textbook methods, and so on, should be complemented with a feedback as an enriching feature that will balance both teacher's role and students' activities in the teaching and learning process.

3. Teachers should always identify topics and themes in economics that students find difficult while teaching and should give feedback to students after each assessment to ensure that students are conversant with areas they find difficult. This is to help improve students learning of economics.

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ANALYSİS OF THE IMPLEMENTATİON OF FİNAL INCOME TAX RATES FOR MSMES ON THE GROWTH OF MİCRO, SMALL, AND MEDİUM ENTERPRİSES

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ABSTRACT
Micro, Small, and Medium Enterprises (MSMEs) contribute significantly to the Indonesian economy, contributing over 61.9% to GDP and absorbing 97% of the workforce. Under Law No. 20 concerning MSMEs, this sector is classified into micro, small, and medium enterprises based on net worth and turnover criteria. With over 64 million business units, MSMEs are the main foundation of national economic growth. The government supports this sector through the Final Income Tax (PPh) policy for MSMEs, initially regulated through Government Regulation No. 46 of 2013, then simplified to a rate of 0.5% through Government Regulation No. 23 of 2018 and reaffirmed in Government Regulation No. 55 of 2022. This policy aims to simplify tax administration, increase liquidity, and encourage the formalization of the informal sector. The implementation of a low rate has been shown to increase formal compliance, NPWP registration, and SPT reporting, in line with previous research findings. Although the 0.5% rate has a positive impact on cash flow and business expansion opportunities, the turnover-based tax remains a burden for MSMEs with low profit margins. Other challenges include low tax literacy, inadequate business record-keeping, and limited tariff validity periods. MSME growth is also influenced by external factors such as access to financing, digitalization, and managerial capacity.

Keywords: Income Tax, Final Income Tax, MSMEs

1. INTRODUCTION
As the backbone of the Indonesian economy, MSMEs play a crucial role, contributing over 61.9% to Gross Domestic Product and absorbing over 97% of the workforce (Ministry of Cooperatives and SMEs, 2022). Given this dominance, tax policy for MSMEs plays a strategic role in influencing the growth and sustainability of this industry. With over 64 million business units, the MSME sector is a key indicator of domestic economic health and a foundation for equitable social welfare. Therefore, the government has developed various policies to increase MSME capacity, including financing, market access, and the tax system.

Final Income Tax (PPh) for MSMEs is a crucial tax instrument. It was first established through Government Regulation No. 46 of 2013 at a rate of 1% of turnover, but was changed to 0.5% of turnover through Government Regulation No. 23 of 2018 to improve compliance and reduce the tax burden on business actors. This rate reduction is expected to increase the liquidity of small and medium enterprises (MSMEs), which in turn will lead to increased working capital, production activities, and ultimately business growth (Sari & Nugroho, 2020). At the same time, the turnover-based final rate is considered to simplify tax administration because MSMEs do not need to prepare complex financial reports or calculate net profit.

However, the implementation of Final Income Tax for MSMEs has several issues. After the final rate expired, some business actors still lack understanding of their tax obligations, including the turnover calculation mechanism, reporting timelines, and the transition to the general scheme (Ramadhan, 2021). Furthermore, sales-based tax collection without considering net profit is often considered a challenge for small and medium-sized enterprises (MSMEs) with low profit

margins. Conversely, a lower final rate increases compliance, reduces the secret economy, and improves business perceptions of the government (Pradana & Cahyono, 2019). Furthermore, the impact of the Final Income Tax rate on MSME growth depends on external factors, such as national economic growth, financing availability, and the business's ability to manage cash flow and operational costs. While lowering the tax rate can increase investment capacity and working capital, these benefits will only be maximized if supported by a favorable business environment. Therefore, it is crucial to further investigate whether the Final Income Tax policy actually helps MSME growth or actually burdens MSMEs.

Based on the issues outlined, this research is crucial to gain a better understanding of the implementation of the Final Income Tax rate for MSMEs and how it impacts MSME economic growth. An in-depth analysis is needed to determine the extent to which this policy supports MSME performance and to uncover the components that influence their success. This research is expected to assist the government in developing more flexible, fair, and sustainable tax policies for MSMEs.

2. LITERATURE STUDY AND RESEARCH METHODS

2.1 Literature Study

2.1.1 Micro, Small, and Medium Enterprises (MSMEs)

According to Law Number 20 concerning Micro, Small, and Medium Enterprises Article 1, micro enterprises are productive businesses owned by individuals or bodies that meet the criteria of micro enterprises, and small enterprises are independent productive economic enterprises carried out by individuals or bodies that are not subsidiaries or branches of companies owned by medium-sized or large businesses, while medium-sized enterprises are independent productive economic enterprises carried out by individuals or bodies that are not subsidiaries or branches of companies owned by small or large businesses. Overall, MSMEs are a group of productive economic enterprises owned and managed by individuals or independent bodies and are not subsidiaries or branches of larger businesses in accordance with the criteria stipulated in the law.

2.1.2 Final Income Tax for MSMEs

Based on Government Regulation Number 55 of 2022, the final income tax rate is 0.5% of gross turnover. Subjects of Final Income Tax include individual taxpayers and corporate taxpayers in the form of cooperatives, limited partnerships, firms, limited liability companies, and Village-Owned Enterprises (BUMDes) that obtain gross turnover of no more than IDR 4,800,000,000.00 in one tax year. This Final Income Tax rate has a period of use, namely 7 years for individual taxpayers, 4 years for corporate taxpayers in the form of cooperatives, limited partnerships, firms, BUMDes, and individual companies established by one person, and 3 years for corporate taxpayers in the form of limited liability companies. For individual taxpayers, there is a Non-Taxable Income (PTKP) of IDR 500,000,000.00 in one tax year.

2.1.3 Tax Compliance Theory

Economic Approach

This theory is based on the assumption that taxpayers are rational individuals. They will weigh the costs and benefits of tax compliance or non-compliance. Allingham and Sandmo (1972), in their article entitled " Income Tax Evasion: A Theoretical Analysis," emphasize that taxpayers act rationally by weighing the trade-offs between complying with and avoiding taxes. Compliance arises from the risk of audits and the threat of sanctions, so taxpayer behavior is seen as a calculative economic decision.

Psychological Approach

This approach focuses on internal factors of taxpayers, such as attitudes and morals. Graetz and Wilde (1985) in their article entitled " The Economics of Tax Compliance: Facts and Fantasy ", stated that tax compliance should be driven by tax morale, where tax compliance is influenced by how taxpayers view the use of tax funds by the state. If collected taxes are used for the benefit

of society at large and have a positive impact, such as for infrastructure development, education, health, and public services, then trust will be created that encourages voluntary compliance. Conversely, if collected taxes are not used for the benefit of society, such as through corruption, there will be a tendency for taxpayers to avoid their tax obligations, because they feel there is no return for the taxes they pay.

Combination of Economic and Psychological Approaches

In his book, "The Economic Psychology of Tax Behavior," Erich Kirchler (2007) developed a theory of tax compliance by presenting a shift in perspective from an economic approach to a behavioral psychology approach, combining the factors of power of authority and trust in authority. Kirchler 's Slippery Slope Framework theory asserts that increasing tax compliance depends not only on supervision and punishment (coercive power), but also on building relationships based on trust, transparency, and perceptions of fairness. This balance between power and trust creates more stable voluntary compliance.

2.2 RESEARCH METHODS

This research is a qualitative study with a descriptive approach. The data used are secondary data from previous studies related to the topic discussed by the author. The secondary data used in this study were obtained from relevant academic research. Data collection techniques in this study were conducted through documentation studies, and data analysis techniques used were data reduction, data presentation, and systematic conclusion drawing, following the model of Miles and Huberman (1992).

3 RESULTS AND DISCUSSION

3.1 Implementation of Final Income Tax Rates for MSMEs on Growth and Its Impact on MSME Tax Compliance

The implementation of low rates is believed to be a major driving factor in increasing formal compliance among MSMEs, particularly in terms of NPWP registration and SPT reporting. Research by Andriani (2020) in Alam et al. (2025) shows that Government Regulation No. 23 of 2018 significantly impacts MSME tax compliance in Indonesia. DGT data in recent years shows an increasing trend in formal compliance among MSMEs, partly due to the simpler and easier to calculate Final Income Tax rates. The MSME Final Income Tax rate has been in effect since the enactment of Government Regulation No. 46 of 2013 and was updated through Government Regulation No. 23 of 2018. This is based on the government's goal of creating a simple and accessible tax system, as well as encouraging formalization of the informal sector. Given that small businesses have limited profit margins and volatile cash flows, the policy of reducing the rate from 1% to 0.5% is considered a tool to reduce the compliance burden and increase MSME liquidity. Ministry of Finance data shows an increase in the number of registered MSME taxpayers following the implementation of lower rates, indicating that the turnover-based final tax policy is relatively effective in attracting businesses to the formal tax system. However, fiscal policy analysis indicates that the success of this rate implementation depends heavily on easy-to-understand reporting procedures, MSMEs' understanding of taxation, and the effectiveness of the Directorate General of Taxes' (DGT) tax education campaigns.

Studies on MSME taxpayer compliance show that compliance behavior is not solely influenced by a single policy variable, but rather results from the interaction between internal and external factors within taxpayers. Kumaratih, Cinantya, and Ispriyarso (2020) emphasized that internal factors, such as individual characteristics and tax awareness, play a crucial role in driving compliance. Meanwhile, external factors, such as fiscal policy, economic conditions, and the social environment, have an additional influence on the extent to which taxpayers are able and willing to fulfill their tax obligations. These researchers also emphasized that tax revenue growth, as a budgetary function, is largely determined by the awareness and ability of MSMEs to fulfill their tax obligations, so internal factors cannot be ignored in compliance analysis.

In the context of changes in final income tax rates, most studies indicate a positive relationship between rate reductions and increased taxpayer compliance. Fadhila and Sanjaya (2022) found that changes in final income tax rates had a positive and significant impact on MSME compliance in Medan Denai District. These findings suggest that a rate policy perceived as fairer and more proportional can increase MSMEs' incentives to fulfill their tax obligations, both due to a lighter tax burden and an increased perception of fiscal fairness.

Similar findings were reported by Yusrizal et al. (2023) in their research at the Pekanbaru Senapelan Tax Office (KPP Pratama). The reduction in the final income tax rate was shown to have a positive impact on MSME taxpayer compliance, in line with the research findings of Widodo (2019) and Fatoni (2020). This consistent finding suggests that lower tax rates can expand MSMEs' financial space, enabling them to allocate resources more effectively and ultimately increasing compliance levels. However, Yusrizal, Firdaus, Tanjung, Sudarno, & Wati (2023) also noted a discrepancy in their results with Syafrul's (2019) research, which concluded that the rate reduction had no impact on compliance. This difference indicates heterogeneity in socio-economic conditions and variations in tax literacy levels across regions, which may influence taxpayer responses to rate changes.

On the other hand, research by Wulandari and Putra (2024) provides a different perspective. The study showed that tariff changes did not significantly impact MSME taxpayer compliance at the Jakarta Kalideres Tax Office (KPP Pratama), as indicated by a significance value of 0.258, which is above the 0.05 threshold. This insignificance is thought to be influenced by taxpayers' lack of understanding of the new tariff policy and the economic conditions of some MSMEs, which prevent them from paying taxes even though the tariff has been reduced. This finding strengthens the argument that fiscal policy cannot be implemented effectively without the understanding, readiness, and economic capacity of MSMEs themselves.

Overall, the literature shows that the effect of changes in final income tax rates on MSME taxpayer compliance is heterogeneous. While some studies demonstrate a positive and significant relationship, others indicate that rate reductions do not automatically increase compliance. This confirms that the effectiveness of rate reduction policies depends on other variables, particularly the level of tax understanding, taxpayer awareness, and the economic conditions of MSMEs. Thus, a lower tax rate policy can serve as a compliance stimulus, but its impact will be optimal if accompanied by strengthening tax literacy, improving the quality of policy dissemination, and supporting interventions for MSMEs to increase their economic capacity. This multidimensional approach is necessary for fiscal policy to deliver consistent and sustainable results in improving MSME taxpayer compliance.

In addition to tariff factors and MSME taxpayer compliance, the Directorate General of Taxes (DGT) also noted that, although MSMEs contribute more than 61.9% to GDP and employ up to 97% of the workforce, their contribution to national tax revenue remains very small. This indicates that the policy of lowering the tax threshold set for MSMEs is ineffective. According to the DGT, Indonesia's tax ratio in 2022 was only 10.39%, the lowest in Southeast Asia. One reason for this is the low level of tax compliance among small and medium enterprises (MSMEs). Previous studies have shown that low final income tax rates can increase formal compliance, such as NPWP registration and SPT filing, but do not automatically increase the tax revenue base nationwide. Many small and medium enterprises (MSMEs) have not yet fully utilized the 0.5% final income tax scheme due to poor tax understanding, lack of business records, and a persistent informal sector. Therefore, the success of the final income tax policy depends not only on the rate but also on the ability of MSMEs to integrate into the formal tax system and properly record their business activities.

Furthermore, the Directorate General of Taxes (DGT) emphasized that the government's efforts to increase the tax ratio through administrative simplification and digitization of the tax system must be accompanied by increased public understanding of taxes. Even low tax rates will not

significantly contribute to state revenues without improvements in the administrative capacity of MSMEs. In other words, the 0.5% Final Income Tax policy will only be effective if supported by education, business mentoring, and improvements in the quality of recording and reporting by MSMEs. This reaffirms that low rates are not the only policy component that influences MSME compliance and growth, but rather part of a broader policy system.

3.2 Challenges and Limitations of the Final Income Tax Rate Policy for MSMEs

Although the 0.5% final income tax rate simplifies administration and reduces the tax burden, its implementation faces numerous challenges. According to the official DGT article "MSMEs, Coretax, and the Tax Ratio," one of the main issues is the low contribution of MSMEs to national tax revenue. Most small and medium enterprises (MSMEs) remain in the informal sector, thus not being registered as taxpayers or failing to report their tax obligations regularly. This occurs despite MSMEs' significant contribution to GDP and employment. As a result, Indonesia's tax ratio in 2022 was only 10.39%, lower than that of other ASEAN countries. The declining tax ratio indicates that the low-tax policy has not been successful in attracting MSMEs to the formal tax system. Tax literacy poses additional challenges. Many micro and small businesses do not understand the gross turnover mechanism, the capped final tax rate, and the obligations after Government Regulation 23 of 2018 expires. Because most MSMEs still operate without adequate bookkeeping, low literacy directly impacts the quality of business records. As a result, many small and medium-sized enterprises (MSMEs) still struggle to accurately report their income, despite simplified tax rates. This means that the implementation of the final rates is ineffective in improving compliance.

In addition to knowledge issues, the gross turnover-based tax scheme is considered to not reflect the actual business capabilities, especially for MSMEs with very low profit margins or experiencing business losses. In such situations, tax obligations persist even though the business is not making a profit. For MSMEs, which are sensitive to fluctuations in production costs, the turnover-based tax burden is often perceived as unfair and burdensome, thus reducing their motivation to remain in the formal tax system. Another limitation is the validity period of the 0.5% Final Income Tax rate, which is only valid for a few years. This provision raises concerns for small and medium enterprises (MSMEs), as they must switch to the general tax scheme, which requires more complex administration and bookkeeping. Due to this uncertainty, some business actors hesitate to maintain long-term compliance, especially those who are not financially and administratively prepared.

Therefore, the final income tax rate policy for MSMEs faces challenges and obstacles not only from the tariff provisions themselves, but also from structural factors such as a lack of tax knowledge, limited business record-keeping, a large informal sector, and limitations of turnover-based tax schemes. To achieve optimal results, the final rate policy must be accompanied by ongoing education, business record-keeping assistance, and integration with the tax administration system.

CONCLUSION

Based on a comprehensive analysis of various studies and supporting data, the policy of reducing the Final Income Tax rate, specifically to 0.5%, essentially provides administrative convenience and fiscal relief for MSMEs. The simplification of the calculation mechanism and the reduction in the tax burden have been proven to help improve cash flow and allow MSMEs to focus more resources on operational activities and business development. Various studies, such as those by Fadhila and Sanjaya (2022) and Yusrizal et al. (2023), show that this rate reduction has a positive and significant impact on taxpayer compliance, thus contributing to the growth and sustainability of MSMEs by improving compliance and reducing fiscal burden efficiency.

However, the effectiveness of this policy is not universal. Research by Wulandari and Putra (2024) revealed that rate changes had no significant impact on MSME compliance when tax

understanding was low and business actors' economic conditions were inadequate. Furthermore, the turnover-based tax structure is not always appropriate for MSMEs with low profit margins, so the 0.5% final rate does not always provide the same incentive for all business groups. These findings align with the views of Kumaratih, Cinantya, and Ispriyarso (2020), who emphasized that taxpayer compliance is the result of an interaction between internal factors, such as individual awareness and characteristics, and external factors, such as fiscal policy and the economic environment.

Overall, the implementation of the 0.5% Final Income Tax rate can be said to encourage MSMEs in terms of simplifying administration, reducing the tax burden, and potentially increasing compliance. However, the impact is varied and uneven, so this policy cannot be considered a single instrument to guarantee increased compliance or MSME growth. To achieve optimal effectiveness, the final rate policy needs to be balanced with increased tax literacy, assistance with business registration, more intensive policy socialization, and adjustments that take into account the diversity of MSME margins and economic capacity. With this integrative approach, the 0.5% Final Income Tax rate has the potential to provide a more significant, consistent, and sustainable boost to MSME development.

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FACTORS IMPACT ON CONSUMERS' ONLINE FOOD PURCHASE BEHAVIOR IN CAN THO CITY VIETNAM

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ABSTRACT

Online shopping has experienced substantial growth in recent years. E-commerce platforms provide a diverse range of products as well as flexible payment methods, enabling consumers to make purchases quickly and conveniently. With approximately 49.3 million online shoppers, Vietnam currently records the highest rate of e-commerce participation in Southeast Asia. The proportion of internet users engaged in online shopping increased from 77% in 2019 to more than 90% in 2024. The value of Vietnam's retail e-commerce market is projected to reach US$32 billion by 2025 (E-commerce White Paper, 2025), with an annual growth rate of around 20%. Despite the advantages of online food shopping, various risks persist, including delivery failure, personal data breaches, and complex payment processes. In this context, examining the factors that influence consumers' online food purchasing behavior in Can Tho City, Vietnam, is essential. This study draws on primary data collected through a survey of more than 200 online consumers. The research employs descriptive statistics, Cronbach's Alpha for reliability testing, and exploratory factor analysis. Moreover, a regression model was used to identify the determinants of purchasing behavior, including the dependent variable (online food purchasing behavior) and the independent variables: TD (attitude), CQ (subjective norms), AT (quality and safety), GC (price), DV (service quality), DU (website responsiveness), HI (perceived usefulness), and RR (perceived risk). Based on the empirical findings, the study proposes several solutions to enhance the development of online food shopping channels that align with consumer preferences. These recommendations are expected to improve the effectiveness of online food retailing and support enterprises in developing more efficient online food business models in the future.

Keywords: online purchasing behavior, factor analysis, food

1. INTRODUCTION

Online shopping has experienced rapid growth in recent years, driven by the expansion of e-commerce platforms that offer a wide variety of products and flexible payment options, enabling consumers to shop quickly and conveniently. With approximately 49.3 million consumers engaging in online shopping activities, Vietnam has emerged as the country with the highest rate of e-commerce participation in Southeast Asia. Moreover, the proportion of internet users participating in online shopping increased from 77% in 2019 to 88% in 2020, while the size of Vietnam's retail e-commerce market reached USD 11.8 billion in 2020 (E-commerce White Paper, 2021). These figures underscore the rapid diffusion of online shopping and its growing importance within the national economy.

Can Tho City is a centrally governed city located in the lower Mekong River basin and serves as the economic center of the Mekong Delta region. As the most dynamic and developed city in the region, Can Tho has experienced rapid economic and population growth, leading to increasing demand for food in both quantity and quality. Alongside this development, e-commerce activities in the city have expanded considerably, particularly in the online food retail segment. Food is an essential commodity consumed daily, and its online distribution became especially prominent during the COVID-19 pandemic. During periods of social distancing, supermarkets in Can Tho

intensified online sales through various channels, including telephone ordering and mobile applications. Major retail systems such as MM Mega Market Vietnam, GO! Can Tho, Co.opmart, and LOTTE Mart expanded their digital sales platforms through websites, mobile applications, social media channels, and third-party delivery services such as GrabMart. Notably, during the peak of the COVID-19 pandemic, LOTTE Mart Can Tho recorded a 500–600% increase in online orders compared to normal periods (Can Tho Online Newspaper, 2021). As a result, online grocery shopping has become increasingly embedded in consumers' daily routines, not only as a means of reducing health risks but also due to its convenience, time efficiency, and cost-saving potential.

Despite these advantages, online food purchasing also presents significant challenges and risks. In an increasingly competitive market, ensuring food safety and quality remains difficult. Consumers face various concerns, including non-delivery of goods, personal data breaches, and complicated payment procedures. More critically, food quality is often difficult to verify because purchase decisions are largely based on images, while information on product origin may be unclear. As food is a perishable commodity, improper storage and transportation can result in spoilage, and the use of preservatives or chemical additives becomes more likely. Furthermore, the rapid expansion of online food sales has enabled unlicensed sellers lacking food safety certifications to operate easily on social media platforms, thereby increasing risks to consumers. Food is essential for human survival, and the consumption of unsafe or contaminated products can directly harm consumer health, leading to foodborne illnesses and poisoning. According to national statistics, during the first six months of 2021, 42 food poisoning incidents were recorded nationwide, affecting 92 individuals and resulting in five fatalities (General Statistics Office, 2024). These concerns highlight the critical importance of food safety in online purchasing decisions.

Against this backdrop, an important question arises: what factors motivate consumers to purchase food online despite potential risks related to food safety and quality? Addressing this question is both theoretically and practically significant. Accordingly, the objective of this study is to analyze consumer behavior and identify the factors influencing online food purchasing decisions in Can Tho City. Based on empirical evidence, the study aims to provide insights into current online food shopping practices and propose solutions to develop online food retail channels that better meet consumer needs. In doing so, the research contributes to improving the effectiveness of online food sales and supporting the sustainable development of online food business activities for enterprises in the future.

2. RESEARCH METHODOLOGY

2.1. Data collection method

Sample and Sampling Procedure

The study population comprises individuals aged 18 years and above with diverse occupational backgrounds and sufficient awareness of online food purchasing. Eligible respondents include individuals who intend to purchase, have previously purchased, or are currently purchasing food online in five districts of Can Tho City.

A convenience sampling technique was employed in this study. This non-probability sampling method allows the researcher to select respondents who are readily accessible and possess characteristics relevant to the research objectives. Participants were recruited based on their availability and willingness to participate until the required sample size was achieved. Convenience sampling was selected due to its practicality, ease of access to respondents, and efficiency in reducing data collection time (Pham Le Thong, 2022).

Data Collection

Data were collected using a structured questionnaire administered through two channels: (i) online surveys designed using Google Forms and distributed via social media platforms, and (ii)

direct, face-to-face surveys. The use of both online and offline survey methods aimed to broaden the respondent base and increase sample diversity.

Although convenience sampling may limit the representativeness of the sample due to its non-random nature, several measures were implemented to mitigate this limitation. Specifically, data were collected at different times and across multiple locations within the five districts of Ninh Kieu, Cai Rang, Binh Thuy, O Mon, and Thot Not. Direct surveys were conducted at various consumer touchpoints, including traditional markets, supermarkets, and retail chains such as Bach Hoa Xanh and WinMart+, in order to capture respondents with heterogeneous demographic and consumption characteristics.

Sample Size Determination

The required sample size was determined based on established guidelines for factor analysis and multiple linear regression. For exploratory factor analysis (EFA), the minimum recommended sample size is five times the number of observed variables included in the model (Nguyen Dinh Tho, 2011). As the proposed research model comprises 37 observed variables, the minimum sample size required for EFA is 185 observations (37 × 5).

For multiple linear regression analysis, the minimum sample size is calculated using the formula $n = 50 + 8m$, where m represents the number of independent variables (Nguyen Dinh Tho, 2011). With eight independent variables included in the model, the minimum required sample size for regression analysis is 114 observations.

To satisfy both methodological requirements and to reduce potential data collection errors, the study targeted a sample size exceeding the minimum threshold. Accordingly, a total of 220 questionnaires were distributed and collected for analysis.

Measurement Scale

All constructs in the questionnaire were measured using a five-point Likert scale, where 1 represents *strongly disagree* and 5 represents *strongly agree*. This scale was selected due to its suitability for capturing respondents' attitudes, perceptions, and behavioral intentions in consumer behavior research.

2.2 Data analysis

Descriptive Statistics

Descriptive statistics are employed to summarize and describe the basic characteristics of the data collected in the study. Together with inferential statistics, descriptive statistics provide concise summaries of sample characteristics and measurement variables. When combined with basic graphical analysis, they constitute the foundation of quantitative data analysis. Understanding descriptive statistical methods is essential for interpreting empirical phenomena and supporting informed decision-making.

Descriptive statistics are commonly classified into three main groups: measures of central tendency, measures of position, and measures of variability (Pham Le Thong, 2022). Measures of central tendency indicate the value around which a dataset is concentrated and are considered representative of the entire distribution. The most frequently used measures include the mean, median, and mode. Measures of position, such as percentiles and quartiles, describe the relative standing of a particular value within the dataset. Measures of variability capture the degree of dispersion in the data and include the range, interquartile range, variance, standard deviation, and coefficient of variation.

Reliability Analysis: Cronbach's Alpha

Cronbach's Alpha is used to assess the internal consistency reliability of measurement scales by evaluating the degree of correlation among observed variables within the same construct. A high Cronbach's Alpha coefficient indicates that the observed variables consistently measure the underlying concept and adequately reflect the characteristics of the latent factor.

The Cronbach's Alpha coefficient ranges from 0 to 1, with higher values indicating greater reliability. However, excessively high values (approximately 0.95 or above) may suggest

redundancy among items, implying that several variables measure nearly identical aspects of the construct (Nguyen Dinh Tho, 2011). In evaluating scale reliability, the following criteria are commonly applied. An observed variable is considered acceptable if its Corrected Item–Total Correlation is greater than or equal to 0.3 (Nunnally, 1978). Regarding overall scale reliability, Cronbach's Alpha values are interpreted as follows (Hoang Trong & Chu Nguyen Mong Ngoc, 2008): values from 0.8 to 1.0 indicate very good reliability; values from 0.7 to below 0.8 indicate good reliability; and values of 0.6 or above are considered acceptable for exploratory research.

Exploratory Factor Analysis (EFA)

Exploratory Factor Analysis (EFA) is employed to assess the construct validity of the measurement scales, specifically convergent validity and discriminant validity. EFA belongs to the group of interdependence techniques, meaning that it does not distinguish between dependent and independent variables but instead examines the correlation structure among observed variables.

The primary objective of EFA is to reduce a set of k observed variables into a smaller number of latent factors (F, where $F < k$) that capture the underlying structure of the data. This dimensionality reduction is based on the assumption that observed variables are linearly related to a smaller set of common factors.

In this study, the Principal Components Analysis extraction method combined with Varimax rotation is used, as this approach is widely applied in social science research. Factor loadings indicate the strength of the relationship between observed variables and latent factors. According to Hair et al. (1998), factor loadings greater than 0.3 meet the minimum acceptable level, loadings above 0.4 are considered important, and loadings exceeding 0.5 demonstrate practical significance.

To ensure the appropriateness of EFA, several statistical conditions must be satisfied. Factor loadings should exceed 0.5; the Kaiser–Meyer–Olkin (KMO) measure should lie between 0.5 and 1.0, indicating sampling adequacy; and Bartlett's test of sphericity must be statistically significant (Sig. < 0.05), confirming that correlations among variables are sufficient for factor analysis. In addition, the cumulative variance explained by the extracted factors should exceed 50%, indicating that the model accounts for a substantial proportion of the total variance in the observed variables.

Multiple Linear Regression Analysis

Following EFA, multiple linear regression analysis is employed to test the research hypotheses and examine the causal relationships between independent variables and the dependent variable (Cooper & Schindler, 2003). All statistical hypotheses are tested at a 5% significance level.

Several diagnostic criteria are used to evaluate the adequacy of the regression model. The adjusted R-squared statistic measures the proportion of variance in the dependent variable explained by the independent variables. The Durbin–Watson statistic is used to detect first-order autocorrelation in the residuals, with values close to 2 indicating no serial correlation. The F-test assesses the overall significance of the regression model, with a Sig. value below 0.05 indicating a good model fit.

Multicollinearity among independent variables is examined using the Variance Inflation Factor (VIF). VIF values greater than 10 suggest serious multicollinearity, whereas values below 2 indicate that multicollinearity is not a concern. Finally, standardized residuals are analyzed to verify the assumption of normality. A bell-shaped distribution with a mean approximately equal to zero and a standard deviation close to one indicates that the residuals are normally distributed, satisfying a key assumption of linear regression.

To write the linear regression equation, the author uses a multiple regression model in the form:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + ... + \beta_{iXi} + \alpha$$

Where: Y: Dependent variable, β0: Regression constant, βi: Estimated coefficient, measuring the change in the probability of an event occurring, with a 1-unit change in the independent variable Xi, Xi: Independent variables, α: Error

Based on theoretical foundations, empirical studies, and collected database information, the author synthesizes and presents the factors affecting the online food purchasing behavior of consumers in Can Tho city, with the regression model constructed as follows:

$$HV = \beta_0 + \beta_1 TD + \beta_2 CQ + \beta_3 AT + \beta_4 GC + \beta_5 DV + \beta_6 DU + \beta_7 HI + \beta_8 RR + \alpha$$

In which: The dependent variable HV is the online food purchasing behavior variable, including observed variables such as "I will introduce online food purchasing to friends and relatives," "I will proactively search for and purchase food online in the near future," and "I will continue to buy food from quality product websites." These criteria have been found in many different studies. However, in this study, the author based the proposed observed variables on the research of Nguyen Dinh Yen Oanh and Pham Thuy Bich Uyen (2017). The factors TD (attitude), CQ (subjective norm), AT (quality and safety), GC (price), DV (service quality), DU (website responsiveness), HI (perceived usefulness), RR (perceived risk).

3. RESULTS AND DISCUSSION

3.1 Description of the research sample

The survey results indicate that respondents who purchase food online exhibit considerable diversity in terms of age. The sample of 167 respondents is distributed across four age groups. The 18–25 age group accounts for the largest proportion, with 114 respondents (68.3%), followed by the 26–35 age group with 36 respondents (21.6%). The 36–45 age group comprises 12 respondents (7.2%), while respondents aged over 46 represent the smallest group, with only 5 individuals (3.0%). These findings suggest that online food purchasing is most prevalent among younger consumers, with participation declining as age increases. This pattern may be attributed to younger individuals' greater familiarity with digital technologies, higher acceptance of online shopping, and stronger inclination toward exploring new consumption channels. In contrast, older consumers may remain more accustomed to traditional shopping practices and exhibit greater reluctance toward adopting online purchasing behaviors.

Regarding gender composition, the sample shows a notable imbalance between female and male respondents. Specifically, 119 respondents are female, accounting for 71.3% of the sample, while male respondents represent 28.7%. This indicates that online food purchasing in Can Tho City is predominantly undertaken by female consumers. This distribution may partly reflect the use of convenience sampling, which facilitated greater access to female respondents during data collection. Additionally, food purchasing and preparation responsibilities are traditionally more often associated with women, which may contribute to their higher participation rate. Nevertheless, the proportion of male consumers engaging in online food purchasing remains relatively substantial.

In terms of educational attainment, the majority of online food buyers hold a university degree, with 112 respondents (67.1%). Respondents with education at or below the high school level account for 35 individuals (21.0%), followed by those with vocational or college education at 14 respondents (8.4%). Postgraduate respondents represent the smallest group, with 6 individuals (3.6%). This distribution suggests that online food purchasing is more prevalent among consumers with higher educational levels, who may possess greater digital literacy and confidence in online transactions.

Marital status analysis reveals that most respondents are single, accounting for 127 individuals (76.0%). This result is consistent with the demographic structure of the sample, in which students constitute a large proportion. Married respondents without children account for 5.4%, while those married with children represent 16.2% of the sample. Divorced respondents form the smallest group, with 4 individuals (2.4%).

With respect to occupation, students from colleges and universities constitute the largest group of respondents, with 85 individuals (50.9%). This finding suggests that students are particularly inclined toward online food purchasing, likely due to the availability of diverse products, flexible pricing, and convenience that aligns with limited budgets and time constraints. Civil servants and office workers represent the second-largest occupational group at 22.2%, reflecting the suitability of online shopping for individuals with fixed working hours and limited time for traditional shopping. The remaining respondents are distributed across smaller occupational categories, including small business owners, factory workers and freelancers, housewives, and other professions such as healthcare workers, chefs, and delivery personnel.

In addition to demographic characteristics, the survey results highlight diversity in online food purchasing channels. E-commerce platforms are the most commonly used channel, accounting for 42.4% of purchases, followed by social media platforms at 37.6%. Dedicated online shopping websites account for the remaining 20.0%. Regarding purchasing frequency, the largest group of respondents reported purchasing food online two to three times per month (37.1%), while weekly purchases represent the smallest proportion (9.6%). These findings suggest that most consumers engage in online food purchasing on a periodic rather than frequent basis, often concentrating purchases during promotional or discount periods.

Finally, the types of food products purchased online also vary considerably. Pre-packaged foods, such as sweets and dried fruits, are the most frequently purchased category, reflecting their ease of transportation, longer shelf life, and clear product information. Functional foods rank second, accounting for 20.0% of online purchases and sharing similar advantages. In contrast, processed foods (e.g., canned and frozen products) and fresh foods (e.g., meat, fish, vegetables, and fruits) are less commonly purchased online, accounting for 19.7% and 13.0%, respectively. This pattern can be explained by the challenges associated with preservation, transportation, and spoilage risks, which may discourage consumers from purchasing these categories through online channels.

3.2 Results of factor analysis and regression

Cronbach's Alpha results indicate that the measurement scales for the eight proposed constructs—comprising 34 observed items related to online food purchasing behavior—demonstrated satisfactory internal consistency. Accordingly, all retained items were subjected to exploratory factor analysis (EFA) to further assess the underlying factor structure.

However, the initial EFA did not yield a stable solution, as the rotated component (factor) matrix failed to converge. After diagnostic review, several problematic items (e.g., items with weak loadings, substantial cross-loadings, or inadequate communalities) were removed to improve model identification and interpretability. Following item refinement, the revised EFA was conducted on seven constructs: (1) Attitude, (2) Quality and Safety, (3) Price, (4) Service Quality, (5) Website Responsiveness, (6) Perceived Usefulness, and (7) Perceived Risk.

Table 1. KMO and Bartlett tests of independent variables

KMO		
Kaiser-Meyer-Olkin		0,902
Bartlett's test of the scale	Chi-square value	3605.586
	df	435
	Sig.	0.000

Source: Survey data

The KMO coefficient is 0.902, which satisfies the condition $0.5 \leq KMO \leq 1$. This result indicates that the observed variables in the population are correlated with each other, and the exploratory factor analysis (EFA) is acceptable for the research data. Bartlett's test (Sig. = 0.000 ≤ 0.005) confirms that the factor analysis is appropriate.

Table 2. Factor rotation matrix of independent variables

Observed Variables	Factor

	1	2	3	4	
HI1	0.863				
HI3	0.853				
HI5	0.842				
HI2	0.824				
HI4	0.808				
GC4	0.806				
DU4	0.804				
GC3	0.744				
GC2	0.710				
DU2	0.697				
DU1	0.676				
DU5	0.665				
DU3	0.573				
RR2		0.819			
RR3		0.797			
RR4		0.765			
RR5		0.745			
RR1		0.731			
RR7		0.719			
RR6		0.665			
TD4			0.762		
TD2			0.745		
TD1			0.727		
TD3			0.723		
AT1				0.828	
AT3				0.771	
AT2				0.718	
DV1					0.889
DV2					0.817
DV3					0.814
Eigenvalues	1.240	1.885	2.300	3.831	11.117
Variance extracted	4.133	6.282	7.666	12.769	37.055
Total Variance extracted	67.906%				

Source: Survey data

Eigenvalues = 1.240 ≥ 1, and the total variance extracted using the factor analysis method yielded 5 factors from 30 observed variables. The extracted variance is 67.906 ≥ 50% (indicating that the extracted factors explain 67.906% of the variation in the survey data), thus meeting the requirements. The rotated factor matrix results show that the 30 observed variables are grouped into 5 factors, all with factor loading coefficients > 0.5. Based on the rotated factor matrix results, the variables meeting the requirements with factor loading coefficients > 0.5 are grouped into 5 different factors. These factors are grouped as follows:

The first factor: a new factor created from 3 factors: perceived usefulness, responsiveness of the website, and price. Based on the common characteristics of these three groups, the author named the new factor "Benefits of buying food online" and grouped them using the average command:
LI = MEAN(HI1, HI2, HI3, HI4, HI5, DU1, DU2, DU3, DU4, DU5, GC2, GC3, GC4)
Second factor: Perceived risk, grouped using the average command
RR = MEAN(RR1, RR2, RR3, RR4, RR5, RR6, RR7)
Third factor: Attitude, grouped using the average command
TD = MEAN(TD1, TD2, TD3, TD4)
Fourth factor: Quality and safety, grouped using the average command
AT = MEAN(AT1, AT2, AT3)
Fifth factor: Service quality, grouped using the average command: DV = MEAN(DV1, DV2, DV3)

Exploratory Factor Analysis (EFA) for the dependent variable

The KMO coefficient = 0.746, which satisfies the condition $0.5 \leq KMO \leq 1$. This result indicates that the observed variables in the population are correlated with each other, and the exploratory factor analysis (EFA) is acceptable for the research data.
Bartlett's test (Sig. = 0.000 ≤ 0.005) confirms that the factor analysis is appropriate.

Table 3. KMO and Bartlett tests for the dependent variable

KMO		
Kaiser-Meyer-Olkin		0.746
Bartlett's test of the scale	Chi square	282.973
	Df	3
	Sig.	0.000

Source: Survey data

Table 4. Factor rotation matrix analysis of online food purchasing behavior.

Observation	Extracted factors
	1
HV2	0.916
HV3	0.904
HV1	0.896
Eigenvalues	2.458
Total Variance Extraction	81.948%

Source: Survey data

The Eigenvalues = 2.458 ≥ 1, and the total variance extracted using the extraction and rotation methods, along with factor analysis, yielded one factor from three observed variables. With an extracted variance of 81.948% ≥ 50%, the requirements were met.
Thus, through the reliability analysis using Cronbach's Alpha coefficient and exploratory factor analysis (EFA), five factors influencing online food purchasing behavior of consumers were extracted. The number of observed variables for these five factors is 30. To date, the established conditions have been well met. Therefore, the research model proceeds to the next analysis phase: Linear Regression analysis.
After factor analysis, the study continues with linear regression analysis to estimate the influence of these factors on online food purchasing behavior of consumers in Can Tho City. Based on the theoretical research model in the theoretical basis section, we have the following linear regression equation:

$$HV = \beta 0 + \beta 1TD + \beta 2AT + \beta 3DV + \beta 4LI + \beta 5RR$$

Where: βk: regression coefficients (k = 0, 1, 2, 3, 4, 5....), Dependent variable: HV is online food purchasing behavior, Independent variables: LI is the benefit of buying food online, RR is perceived risk, TD is attitude, AT is quality and safety, DV is service quality

Hypotheses:

Hypothesis H1: Consumer attitudes have a positive impact on online food purchasing behavior.

Hypothesis H2: Quality and safety have a positive impact on online food purchasing behavior.

Hypothesis H3: Service quality has a positive impact on online food purchasing behavior.

Hypothesis H4: Benefits of online shopping have a positive impact on online food purchasing behavior.

Hypothesis H5: Perceived risk has a negative impact on online food purchasing behavior.

The Variance Inflation Factor (VIF) reached its maximum value of 1.944 (less than 10), indicating that these independent variables are not strongly related to each other, thus preventing multicollinearity. Therefore, the relationship between the independent variables does not significantly affect the explanatory results of the regression model.

Table 5. Statistical analysis of regression coefficients

Model	Unstandardized coefficients		Standardized coefficients	t	Sig.	Multicollinearity statistics	
	B	Sta. Err	Beta			Tolerance	VIF
Constant	0,232	0,329		0,705	0,482		
LI	0,421	0,081	0,378	5,213	0,000	0,533	1,877
RR	0,005	0,053	0,006	0,102	0,919	0,924	1,082
TD	0,245	0,073	0,248	3,364	0,001	0,514	1,944
AT	0,234	0,066	0,239	3,562	0,000	0,625	1,600
DV	0,035	0,049	0,038	0,714	0,476	0,992	1,008

Source: Survey data

Hypothesis Testing Results

To evaluate the proposed relationships, the study tests the statistical significance of regression coefficients in the estimated multiple regression model. For each hypothesis, the null and alternative hypotheses are specified as $H_0: \beta_i = 0$ versus $H_1: \beta_i \neq 0$. Statistical inference is conducted at the 5% significance level.

H1: Attitude → Online food purchasing behavior (positive)

The estimated coefficient for Attitude is positive and statistically significant ($\beta_1 = 0.248$, $p = 0.001 < 0.05$). Therefore, H_0 is rejected, supporting H1. Holding other variables constant, a one-unit increase in consumer attitude is associated with a 0.248-unit increase in online food purchasing behavior.

H2: Quality and safety → Online food purchasing behavior (positive)

The coefficient for Quality and Safety is also positive and statistically significant ($\beta_2 = 0.239$, $p < 0.001$). Thus, H_0 is rejected, supporting H2. Ceteris paribus, a one-unit increase in perceived quality and safety is associated with a 0.239-unit increase in online food purchasing behavior.

H3: Service quality → Online food purchasing behavior (positive)

The coefficient for Service Quality is not statistically significant ($p = 0.476 > 0.05$). Accordingly, H_0 fails to be rejected, and H3 is not supported. This result suggests that service quality does not have a statistically detectable effect on online food purchasing behavior in the presence of the other predictors in the model.

H4: Perceived benefits of online food purchasing → Online food purchasing behavior (positive)

The coefficient for Perceived Benefits is positive and statistically significant ($\beta_4 = 0.378$, $p < 0.001$). Hence, $H_0$is rejected, supporting H4. All else equal, a one-unit increase in perceived benefits is associated with a 0.378-unit increase in online food purchasing behavior.

H5: Perceived risk → Online food purchasing behavior (negative)

The coefficient for Perceived Risk is not statistically significant ($p = 0.919 > 0.05$). Therefore, H_0fails to be rejected, and H5 is not supported. In other words, perceived risk does not exhibit a statistically significant association with online food purchasing behavior in this sample once other factors are controlled for.

4. CONCLUSIONS AND RECOMMENDATIONS

This study investigates the factors influencing online food purchasing behavior among consumers and provides a comprehensive overview of current consumption patterns as well as the determinants shaping this behavior. Based on the empirical findings, the study also proposes managerial and policy-oriented solutions aimed at improving the quality of online food purchasing and enhancing operational efficiency for businesses operating in this sector.

Survey data were collected from 215 respondents, including 167 individuals who had experience purchasing food online and 48 individuals who had never engaged in online food purchases. Respondents exhibited substantial diversity in terms of age, educational attainment, marital status, income, and occupation. Descriptive statistical analysis indicates that the largest proportion of respondents resided in Ninh Kieu District (92 respondents). Regarding purchasing channels, most respondents reported using e-commerce platforms (42.2%), followed by social media platforms (37.6%) and online sales websites (20.0%). Nearly half of the respondents (45.5%) had between one and three years of online shopping experience, and 154 respondents had accessed e-commerce websites within the month preceding the survey. The most common purchasing frequency was two to three times per month (37.1%).

In terms of product categories, pre-packaged foods (46.0%) and functional foods (20.0%) were the most frequently purchased items, with average expenditure per transaction remaining below VND 300,000. Cash on delivery was the dominant payment method (51.9%), followed by internet banking (27.8%) and electronic wallets (20.4%).

The initial research model proposed eight factors influencing online food purchasing behavior, including Attitude, Subjective Norms, Quality and Safety, Price, Service Quality, Website Responsiveness, Perceived Usefulness, and Perceived Risk. Reliability testing using Cronbach's Alpha and exploratory factor analysis (EFA) resulted in the consolidation of 30 observed variables into five latent factors: Benefits of online food purchasing (a composite factor combining price, website responsiveness, and perceived usefulness), Perceived Risk, Attitude, Quality and Safety, and Service Quality. Multivariate regression analysis revealed that three factors exert a statistically significant influence on online food purchasing behavior, namely Benefits of online food purchasing (β = 0.378), Attitude (β = 0.248), and Quality and Safety (β = 0.239). Additionally, difference testing for control variables indicated a significant variation in online food purchasing behavior between male and female consumers.

Based on these findings, the study proposes several managerial implications to stimulate online food purchasing. Businesses are encouraged to diversify sales channels, prioritize the development of pre-packaged and functional food products, expand digital payment options, and implement targeted advertising and marketing strategies to enhance consumers' purchase intentions. Firms may also facilitate experiential opportunities for customers, such as offering discount codes through physical stores, providing special incentives for first-time online buyers, and introducing promotional campaigns designed to reduce psychological barriers to online purchasing. Such initiatives can increase customer familiarity with online shopping and potentially convert first-time users into long-term customers.

To further improve quality of online food purchasing and support sustainable business development, enterprises should capitalize on the inherent advantages of online retailing,

including convenience, time efficiency, and product variety. Online food platforms should be regularly upgraded and maintained, with emphasis on attractive interface design, high-quality product images and videos, and functional features such as shopping cart updates, order tracking, and customer review systems. Competitive pricing strategies, coupled with frequent promotions and discounts, remain critical. Moreover, businesses must prioritize transparency by providing comprehensive information on product quality, food safety certifications, and regulatory compliance. Adequate knowledge of food preservation, storage, and transportation is also essential to ensure product freshness, nutritional value, and overall consumer satisfaction.

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ENTREPRENEURSHİP OR EMPLOYMENT? A PHENOMENOLOGİCAL INQUİRY İNTO THE LİVED EXPERİENCES OF ENTREPRENEURSHİP STUDENTS' CAREER DECİSİON-MAKİNG

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ABSTRACT

The decision between pursuing corporate employment and venturing into entrepreneurship is a pivotal moment for graduating students interested in entrepreneurship. This phenomenological study explores the lived experiences of ten 10 graduating students as they navigate this critical career choice. Data were gathered through semi-structured interviews, allowing participants to share their personal meanings, interpretations, and reflections. Through thematic analysis, the study uncovered that many students perceive corporate employment as a transitional phase—a stepping stone that provides financial security and skill development—before pursuing entrepreneurial ventures. Hopes for financial freedom shape their decision-making, their desire to apply their education, and their perceptions of employment stability amid limited job opportunities. Yet tensions also emerged as students grappled with financial constraints, uncertainty, and questions about passion and purpose. The essence of their experience reflects a balance between pragmatism and aspiration, highlighting the push-and-pull between stability and autonomy. By capturing these lived realities, the study contributes to a deeper understanding of how entrepreneurship education shapes students' worldviews and provides insights for academic institutions in guiding students toward informed and meaningful career paths.

KEYWORDS: Employment, Entrepreneurship, Entrepreneurship Students, Career Decision, Phenomenology

NANOSCALE SYNERGY OF POLYMERS AND METAL NANOPARTİCLES İN PLANT-MEDİATED DİABETİC WOUND DRESSİNGS

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Abstract

Chronic diabetic wounds pose a significant clinical burden due to delayed healing, persistent inflammation, oxidative stress, and microbial infection. Nanostructured wound dressings integrating polymers and metal nanoparticles have emerged as promising alternatives to conventional therapies. This work unpacks the nanoscale roles of polymer–metal nanoparticle systems synthesized using plant extract–assisted green approaches for diabetic wound healing applications. Biopolymeric matrices such as carboxymethyl cellulose and related polymers serve as flexible, hydrophilic scaffolds that enhance moisture retention, biocompatibility, and controlled release of bioactive agents. Embedded metal nanoparticles, particularly silver-based systems, provide broad-spectrum antimicrobial activity while modulating oxidative stress and inflammatory responses at the wound site. Plant extracts used during synthesis act as natural reducing and stabilizing agents, introducing phytochemicals that further contribute antioxidant, anti-inflammatory, and tissue-regenerative effects. At the nanoscale, the synergistic interaction between polymer networks, metal nanoparticles, and plant-derived compounds regulates cellular events including fibroblast proliferation, keratinocyte migration, angiogenesis, and collagen deposition, which are essential for effective diabetic wound closure. These multifunctional nanocomposite dressings demonstrate enhanced healing efficiency with reduced cytotoxicity, highlighting their potential as sustainable, next-generation wound dressings for diabetic wound management.

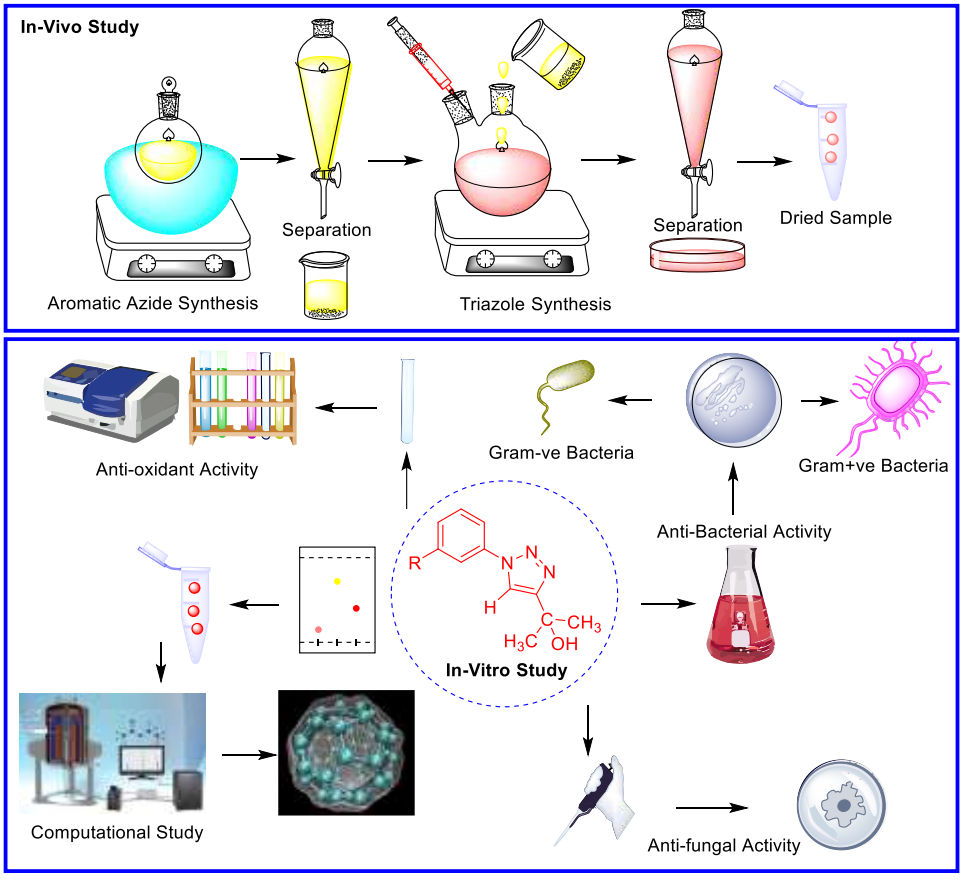
Key words: *Diabetic foot ulcer, Polymer-metal nanocomposite, Green synthesis, Wound dressings.*

COPPER-CATALYZED SYNTHESİS, BİOACTİVİTY, AND IN SİLİCO STUDY OF 1,2,3-TRİAZOLE HYBRİDS

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Abstract
The triazole structure is a crucial and widely endorsed heterocycle, frequently pioneer in numerous natural compounds and therapeutic agents. The extensive and powerful effects of triazoles and their derivatives have positioned them as eloquent pharmacological frameworks and have vast biological activities like anti-oxidant, anti-bacterial and anti-fungal activities. The primary heterocyclic rings found in different medicinal compounds are 1, 2, 4-triazoles. We developed a series of efficaciously substituted triazoles commencing from modified anilines and alkyne, highlighting the importance of structural alterations to ameliorate biological effectiveness. Characterization through NMR spectroscopy, FT-IR and UV-Visible Spectroscopy verified their molecular architecture, highlighting the effectiveness of spectroscopic methods in elucidate these biologically active compounds. The Compound 3-ETP show maximum anti-oxidant activity and compound 3-MTP and 4-MTP show maximum anti-bacterial activity.

Graphical Abstract



EFFECT OF HYDROSTATİC PRESSURE ON THE RADİATİVE CURRENT DENSİTY OF AlGaN / GaN MULTİPLE QUANTUM WELL LASER DİODES

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Abstract. In this paper, a numerical model is used to analyze photovoltaic parameters according to the electronic properties of InGaN/GaN multiple-quantum-well laser diode (MQWLD) under hydrostatic pressure. Finite difference techniques have been used to acquire energy eigenvalues and their corresponding eigenfunctions of AlGaN/GaN MQWLED and the hole eigenstates are calculated via a 6×6 k.p method under applied hydrostatic pressure[1,2]. All symmetry-allowed transitions up to the fifth subband of the quantum wells (multi-subband model) are considered [3]. The linewidth due to the carrier-carrier and carrier-longitudinal optical (LO) phonon scattering are also considered. A change in pressure up to 10 GPa increases the intraband scattering time up to 38fs for heavy holes and 40fs for light holes, raises the height of the Lorentz function(Fig.1), reduces the excitonic binding energy, and decreases the spontaneous emission rate up to $1.5\times10^{26}cm^{-3}s^{-1}eV^{-1}$ and radiative current density up to $85A/cm^2$. The multi-subband model has a positive effect on the radiative recombination rate.
Keywords: spontaneous emission, Laser diode, multi-quantum well, radiative current

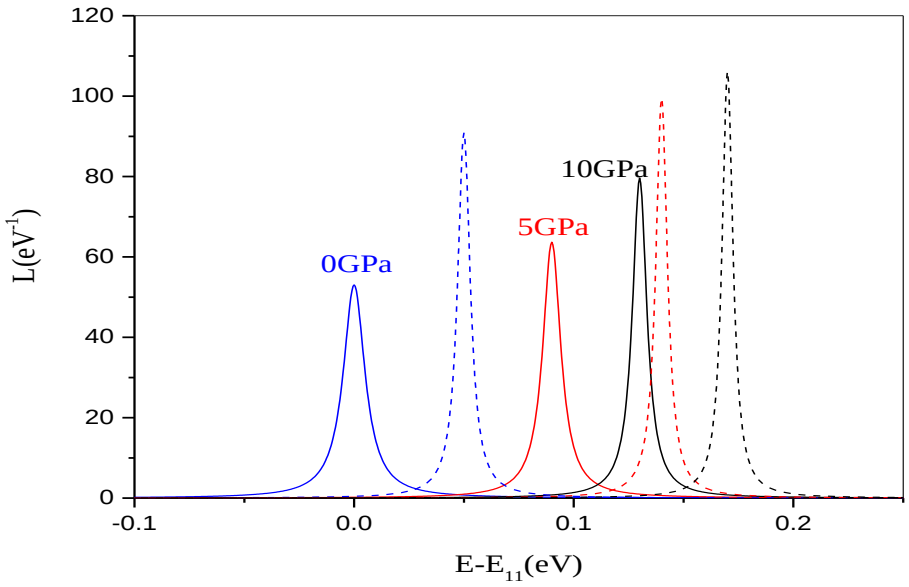


Fig. 1 Heavy hole (solid line) and light hole (dashed line) Lorentzian function versus of the energy difference under different hydrostatic pressures for AlGaN/GaN MQW laser diode, In which the energy transition between the first subbands of electron energy levels with holes are considered.

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EXTREMİSM ACCORDİNG TO SOME DEMOGRAPHİC VARİABLES AND THE EFFECTİVENESS OF REALİSTİC COUNSELİNG TO REDUCE THE COGNİTİVE AND EMOTİONAL COMPONENTS OF TEACHERS UNDER TRAİNİNG

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Abstract: This research aims to identify the extremism level among university students in Iraq, and its components. according to some demographic variables. To identify the effectiveness of reality counseling . The study follows the descriptive and experimental methods. The results show that there are a general level of statistical extremism, especially in both cognitive and emotional components. There is no extremism in the behavioral component. The sample has extreme beliefs, thoughts, feelings and desires, but does not reach the degree of executional behavior. According to the demographic variables (gender, age, time, place of residence) there are no statistically significant differences. The program is designed and implemented according to the theory of counseling by reality (William Glaser model). The program is effective after testing the statistical hypotheses.

Key word : Extremism - Components (behavioral - cognitive - emotional) - Reality counseling - Teachers under training .

ملخص: يهدف هذا البحث إلى التعرف على مستوى التطرف لدى طلبة الجامعة في العراق ومكوناته وفقاً لبعض المتغيرات الديموغرافية، والتعرف على فاعلية برنامج الإرشاد بالواقع. اتبعت الدراسة المنهج الوصفي والتجريبي. أظهرت النتائج وجود مستوى عام للتطرف الإحصائي، وخاصة في البعدين المعرفي والانفعالي. لا يوجد تطرف في البعد السلوكي. لدى العينة معتقدات وأفكار ومشاعر ورغبات متطرفة، ولكنها لا تصل إلى درجة السلوك الإجرائي. وفقاً للمتغيرات الديموغرافية (الجنس، العمر، الزمان، مكان الإقامة) لا توجد فروق ذات دلالة إحصائية. تم تصميم البرنامج وتنفيذه وفقاً لنظرية الإرشاد بالواقع (نموذج ويليام جلاسر). أثبت البرنامج فعاليته بعد اختبار فرضياته الإحصائية.

الكلمات المفتاحية: التطرف - مكوناته (السلوكي - المعرفي - الانفعالي) - الإرشاد بالواقع - المعلمون تحت التدريب.

INVESTIGATION OF QUANTUM CONFINEMENT–INDUCED BAND GAP VARIATIONS IN SYNTHESIZED QUANTUM MATERIAL

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Abstract. Quantum materials have physical properties that are mostly determined by quantum-mechanical effects which makes them to work for next-generation optoelectronic devices. This study involved the synthesis of TiGaN nanomaterials and a systematic analysis to clarify their quantum confinement behavior through optical band gap analysis. The structural and optical properties of the TiGaN quantum materials produced were examined using appropriate characterization techniques. Research on optical absorption demonstrates significant variations in the band gap corresponding to changes in particle size where the quantum confinement effects are very strong. As the material gets closer to the nanoscale, the electronic energy levels become more discrete. This is why the band gap energy is higher than that of bulk materials. These results confirm that quantum confinement has a significant effect on the optical properties of TiGaN, supporting its classification as a quantum material. The study highlights the promise of TiGaN quantum materials for application in optoelectronic devices, sensors, and energy technologies.
Keywords: Quantum Material, Nano material, quantum confinement, Optical absorption, Band gap,

AN AMBEDKARİTE ANALYSİS OF *DHADAK 2* AND THE POLİTİCS OF DALİT VULNERABİLİTY İN CONTEMPORARY HİNDİ CİNEMA

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Abstract
This paper examines *Dhadak 2* through the critical lens of Dalit Studies and Ambedkarite theory, foregrounding caste as a structural and institutional force that governs social relations, access to justice, and the politics of intimacy. Departing from mainstream Hindi cinema's tendency to romanticize inter-caste love while erasing caste realities, *Dhadak 2* presents caste discrimination as an everyday, normalized experience embedded within educational institutions, legal systems, and public spaces. Drawing upon B. R. Ambedkar's critique of graded inequality, social endogamy, and the failure of liberal reformist frameworks, the study argues that the film exposes the illusion of social mobility and equality promised by modern democratic institutions. The analysis situates the Dalit male protagonist's body as a site of surveillance, vulnerability, and symbolic violence, where love becomes a catalyst for caste-based retaliation rather than emancipation. Further, the paper explores how silence, humiliation, and deferred justice operate as narrative strategies that reflect the structural denial of dignity faced by marginalized communities. By emphasizing institutional complicity rather than individual prejudice, *Dhadak 2* aligns itself with Ambedkarite concerns regarding the persistence of caste within ostensibly progressive spaces such as education and law. The paper highlight that *Dhadak 2*, despite the constraints of mainstream cinema, functions as a significant cultural reflection that challenges romantic idealism and contributes to contemporary discourses on caste, representation, and resistance.

Keyword: Dalit Studies; Ambedkarite Theory; Caste and Hindi Cinema; Inter-caste Love; Institutional Discrimination

Introduction: Caste, Cinema, and the Question of Representation

Cinema in India has long functioned as a powerful ideological apparatus, shaping popular consciousness while simultaneously reflecting dominant social hierarchies. Hindi cinema, in particular, has historically remained complicit in the erasure of caste, privileging narratives of class mobility, nationalism, and romantic individualism over structural inequality. While poverty and social marginalization are frequently depicted, caste as a system of graded oppression is often rendered invisible or displaced onto abstract notions of backwardness and tradition. As B. R. Ambedkar famously observed, "caste is not merely a division of labour but a division of labourers," sustained through social practices, cultural norms, and institutional sanction (Ambedkar, 1936/2014).

Dalit representation in Hindi cinema has been sporadic and largely mediated through savarna perspectives, where Dalit characters appear either as passive victims or symbolic figures devoid of political agency. Gopal Guru argues that such representations reduce Dalit experience to "spectacle without subjectivity," denying the oppressed the authority to speak for themselves (Guru, 2009). Unlike Dalit literature, which foregrounds lived experience, resistance, and self-representation, mainstream Hindi cinema has hesitated to confront caste violence directly. Even films addressing social injustice tend to universalize suffering, thereby obscuring the specificity of caste-based discrimination. Sharmila Rege argues that without acknowledging caste as a structural reality, narratives of suffering risk becoming "depoliticized humanism" rather than instruments of social critique (Rege, 2013).

Situating ***Dhadak 2*** within Dalit Studies

Dhadak 2 emerges as a notable intervention in this cinematic landscape by foregrounding caste as a lived and institutional reality rather than a residual social prejudice. Adapted from the Tamil film *Pariyerum Perumal* (2018), the film shifts the focus from romantic fulfilment to the asymmetrical costs of inter-caste relationships. The Dalit protagonist's entry into an elite

educational space exposes him to systemic humiliation, symbolic violence, and physical threat, revealing how caste persists within modern institutions that claim neutrality and progress. This portrayal aligns with Shailaja Paik's assertion that institutions such as education often function as "sites of both aspiration and punishment for Dalits," where mobility is promised but dignity is routinely denied (Paik, 2014).

Drawing on Ambedkar's assertion that political democracy in India rests upon an undemocratic social foundation, this paper argues that *Dhadak 2* critiques the myth of post-caste modernity. Ambedkar warned that without social democracy grounded in liberty, equality, and fraternity, constitutional guarantees remain fragile and performative (Ambedkar, 1947/2016). The film demonstrates how education, law, and public morality fail to protect Dalit lives, reinforcing Ambedkar's insistence that dignity is the cornerstone of social justice. By centering Dalit vulnerability rather than savarna benevolence, *Dhadak 2* invites an Ambedkarite re-reading of love, justice, and resistance in contemporary Hindi cinema, foregrounding what Kancha Ilaiah Shepherd describes as the persistent conflict between Brahminical social order and Dalit assertions of equality (Ilaiah Shepherd, 1996).

Research Gap

Existing scholarship on caste and Indian cinema has largely focused on regional cinemas—particularly Marathi and Tamil films—where caste critique is more explicit and politically grounded. Studies on Hindi cinema, by contrast, often highlight the systematic erasure or dilution of caste in favor of class-based narratives or universalized humanist themes. Even when inter-caste relationships are represented, mainstream Hindi films tend to aestheticize romance while marginalizing the lived realities of caste violence, humiliation, and institutional exclusion.

Moreover, critical engagements with recent Hindi adaptations of caste-centric regional films remain limited, especially from an Ambedkarite theoretical perspective. *Dhadak 2*, despite its explicit engagement with caste discrimination, has not yet been adequately examined as a cultural text that foregrounds Dalit vulnerability within educational and legal institutions. This paper addresses this gap by offering a Dalit Studies–oriented analysis of *Dhadak 2*, situating it within Ambedkar's critique of social democracy and the persistence of caste in modern India.

Objectives of the Study

The objectives of this study are:

1. To analyze *Dhadak 2* through the theoretical framework of Dalit Studies and Ambedkarite thought.
2. To examine how caste operates structurally within institutions such as education and law in the film.
3. To explore the representation of the Dalit body as a site of vulnerability, surveillance, and symbolic violence.
4. To interrogate the politics of inter-caste love as an unequal and asymmetrical social relation.
5. To assess the significance and limitations of mainstream Hindi cinema in addressing caste-based oppression.

Discussion and Analysis

Caste as Structure, Not Prejudice: An Ambedkarite View

A central intervention of *Dhadak 2* lies in its insistence on caste as a **structural and institutional force**, rather than a matter of individual bias or moral failing. This position resonates directly with B. R. Ambedkar's foundational argument that caste constitutes a "system of graded inequality," sustained through social arrangements that assign differential value, dignity, and access to resources (Ambedkar, 1936/2014). For Ambedkar, caste survives not through isolated acts of discrimination but through its embedding within institutions such as education, law, and family—an insight that *Dhadak 2* powerfully visualizes. "The very first scene starts with a sight

of the couple spending time together, while the camera slowly highlights the door where 'Jai Bhim' is written prominently, to publicly assert Ambedkarite ideology" (*Naskar, 2025*).

The film repeatedly demonstrates how humiliation, violence, and exclusion faced by the Dalit protagonist Neelesh are routinized within spaces that claim to be progressive and meritocratic. On the law university campus, Neelesh is ridiculed for his English proficiency and publicly marked as a 'quota student' reinforcing what Ambedkar identified as the caste-coded nature of merit. Ambedkar argued that claims of merit in a caste society are deeply ideological, as privileges are sanctified as merit while disabilities are treated as personal failure (Ambedkar, 1947/2016). Neelesh's remark—"*Free ki badi keemat chukaani padti hai*" ("One pays a heavy price for anything labelled free")—captures this paradox succinctly, revealing how reservations, rather than dissolving caste stigma, often intensify surveillance and resentment against Dalit bodies (*Roy 2025*).

This everyday humiliation operates as a precursor to overt violence. As Gopal Guru (2009). argues, humiliation is not a minor social injury but a distinct mode of violence that normalizes inequality and prepares the ground for physical brutality. *Dhadak 2* captures this continuum with precision: ridicule escalates into public shaming, social isolation, and bodily harm, exposing caste violence as cumulative rather than episodic. In doing so, the film rejects liberal narratives that frame caste discrimination as an aberration and instead presents it as a systemic condition of Dalit existence.

Institutional Violence and the Failure of Liberal Democracy

The film's sustained focus on institutional complicity aligns closely with Ambedkar's warning that political democracy in India is hollow without the realization of social democracy. Ambedkar cautioned that constitutional equality cannot survive in a society where social relations remain governed by hierarchy and exclusion (Ambedkar, 1947/2016). Despite Neelesh studying law—a discipline traditionally associated with justice, rights, and equality—legal institutions in the film remain distant, evasive, or compromised. The absence of meaningful legal recourse underscores the gap between constitutional ideals and lived realities. This failure of liberal democracy is further illuminated through the film's engagement with campus politics. The character of Shekhar, "is based on Rohith Vemula, a Dalit PhD scholar at Hyderabad Central University (HCU), whose institutional murder in 2016 sparked nationwide protests"(Nisha, 2025), represents Dalit assertion within higher education. His suspension, isolation, and eventual silencing recall what Ambedkar described as the "organized negation of dignity," wherein institutions discipline dissent while preserving the appearance of neutrality. *The film* captures "the scholarship crisis, issues of disbursal, and how brutally that affects SC/ST/OBC students," situating Dalit suffering within bureaucratic violence rather than individual misfortune (*Naskar 2025*).

Shailaja Paik's analysis of Dalit engagement with education is particularly relevant here. Paik argues that institutions often demand Dalit compliance and gratitude while withholding substantive protection, turning education into a space of "conditional inclusion" rather than empowerment (Paik, 2014). Although some critics contend that Shekhar's character is narratively softened, his marginalization nonetheless exposes how institutions punish political assertion while legitimizing caste power through procedural silence. "Iqbal's portrayal of Shekhar, an Ambedkarite activist and leader of the Ambedkar Students' Union on a national law university campus, is well thought out and an embodiment of Kanshiram's 'bhagidari politics' and Bhim Army chief Chandrashekhar's politics of radical Dalit assertion against the right-wing caste Hindutva juggernaut. The suspension and subsequent social isolation of Shekhar and his comrades on campus is also imagined through Vemula's politics against institutionalised caste discrimination." (*Naskar 2025*). It echoes Ambedkar's enduring critique: without fraternity and dignity, institutions merely reproduce inequality under the guise of democratic order.

Love as a Site of Caste Power

Unlike mainstream Hindi romances that frame love as transcendental and socially redemptive, *Dhadak 2* presents inter-caste love as an asymmetrical and dangerous terrain shaped by entrenched caste hierarchies. The relationship between Neelesh and Vidhi foregrounds what Ambedkar identified as the centrality of endogamy in sustaining the caste system. Ambedkar argued unequivocally that the real remedy for breaking caste is intercaste-marriage yet he also warned that endogamy remains the "essence of the caste system," violently enforced when challenged (Ambedkar, 1936/2014). In the film love does not function as a liberatory force; instead, it becomes a site where caste power reasserts itself—most brutally against the Dalit partner.

A striking scene in which Neelesh is publicly humiliated at a family function culminates in an act of extreme degradation, revealing how caste violence is mobilized to restore what is euphemistically described as 'honour'. This moment exemplifies how caste authority is defended through ritualized degradation rather than spontaneous rage. Kancha Ilaiah Shepherd's critique of Brahminical patriarchy is instructive here: he argues that caste power asserts itself most aggressively when intimacy threatens its boundaries, particularly through relationships that challenge endogamy and lineage purity (Ilaiah Shepherd, 1996). Vidhi's family's response thus exposes honour not as a moral value but as a coded language for caste purity and social control.

At the same time, the film complicates this dynamic by granting Vidhi a degree of narrative agency. As Subhajit Naskar notes in his review, "What stands out in the film is director's conscious attempt at empowerment and giving agency to Vidhi. She constantly challenges Brahminical patriarchy at home, at family gatherings and in the law university campus." (2025) It reflects a cautious movement toward what Sharmila Rege describes as critical allyship where savarna subjects confront caste privilege rather than merely sympathizing with Dalit suffering (Rege, 2013). However, despite this partial subversion, the burden of consequence remains disproportionately on Neelesh. This imbalance reinforces a key Dalit Studies argument: while inter-caste relationships may symbolically challenge hierarchy, the material and corporeal costs are overwhelmingly borne by Dalits, exposing the limits of romantic transgression within an unequal social order.

Silence, Humiliation, and the Dalit Body

One of most politically potent narrative strategies is its sustained use of silence. Neelesh's reticence is not framed as weakness or submission but as a survival mechanism shaped by historical and ongoing caste terror. This representation resonates with Gopal Guru's assertion that Dalit silence is frequently misread as passivity, whereas it is more accurately understood as a response to normalized violence and social vulnerability (Guru, 2009). Silence, in this context, becomes both a protective strategy and a tragic marker of constrained agency.

Scenes of public humiliation—where Neelesh is smeared with sludge, physically assaulted, or symbolically erased through the deliberate omission of his surname—foreground the Dalit body as a site upon which caste power is violently inscribed (*Roy, 2025*). These acts function not merely as individual assaults but as performative gestures meant to reaffirm hierarchy and discipline deviation. Ambedkar's emphasis on dignity becomes crucial here. For Ambedkar, the denial of dignity precedes and legitimizes the denial of life itself, rendering violence against Dalits socially permissible (Ambedkar, 1947/2016).

The film's bleak visual aesthetic—marked by shadows, confined spaces, and prolonged moments of quiet—reinforces the argument that caste violence is not episodic but embedded in everyday social interactions. By refusing melodramatic catharsis, the film aligns itself with Ambedkarite ethics that privilege structural critique over emotional resolution. In doing so, the film compels viewers to confront caste not as a relic of the past but as a living system that continues to regulate bodies, relationships, and silences in contemporary India.

Ambedkarite Iconography and the Politics of Representation

One of the most debated aspects of *Dhadak 2* is its repeated visual invocation of Ambedkarite iconography—portraits of B. R. Ambedkar and Jyotirao Phule, the colour blue, and slogans such as "Jai Bhim." Supporters of the film read these elements as a significant assertion of Ambedkarite consciousness within mainstream Hindi cinema, noting that the narrative is framed from its opening moments by visual cues that unmistakably signal Dalit political presence. (Naskar 2025) In a cinematic tradition that has historically erased caste or replaced it with class metaphors, this visibility itself marks a departure. However, critical responses caution against the risk of reducing Dalit politics to symbolic affirmation without a corresponding transfer of narrative agency. Several reviewers observe that while Ambedkarite symbols are visually prominent, the film remains constrained by the conventions of savarna-mediated storytelling, where political consciousness is often gestured toward rather than fully articulated. "At best, it is the Indian version of a white-saviour movie. It can be called a Brahmanical patriarchal saviour film." (Nisha,2025) This tension foregrounds a key debate within Dalit cultural studies: the difference between representation and self-representation.

Kancha Ilaiah Shepherd argues that Dalit politics loses its radical edge when reduced to "cultural markers detached from material struggle," emphasizing that lived experience—not symbolic inclusion—forms the core of emancipatory Dalit narratives (Ilaiah Shepherd, 1996). From this perspective, Ambedkarite iconography risks becoming ornamental if it does not reshape the narrative's ethical and political centre. The film negotiates this risk unevenly. While the presence of Ambedkar and Phule signals ideological alignment, the film falls short of fully articulating an Ambedkarite counter-epistemology that challenges Brahminical common sense at its roots. At the same time, dismissing these visual strategies as mere tokenism would overlook their interventionist potential within the Hindi film industry. The repetition of blue imagery and Ambedkarite slogans functions as a refusal to assimilate Dalit identity into universalized narratives of suffering, insisting instead on political specificity. This ambivalence reflects what Sharmila Rege describes as the transitional phase of Dalit representation in popular culture, where visibility often precedes structural transformation (Rege, 2013). While *Dhadak 2* may not fully escape the limits of savarna authorship, its insistence on naming caste, invoking Ambedkar, and foregrounding Dalit humiliation as systemic rather than accidental marks a significant rupture in Hindi cinema's representational history. The film thus occupies an uneasy but important position—caught between symbolic assertion and substantive critique—mirroring the broader struggle of Dalit politics to claim space within dominant cultural forms without being absorbed or neutralized.

Censorship, Dilution, and the Politics of Fear

The Central Board of Film Certification's (CBFC) intervention in *Dhadak 2*—particularly its insistence on altering caste-specific dialogues and muting caste slurs—underscores the persistent discomfort surrounding explicit caste discourse in India's public sphere. The replacement of the line "3,000 years of backlog will not be cleared in just 70 years" with the softened formulation "age-old discrimination will not be cleared in just 70 years" (The Wire, 2025) exemplifies what Ambedkar warned against: the systematic depoliticization of historical injustice through abstraction and euphemism (Ambedkar, 1936/2014). By removing temporal specificity and historical accountability, censorship transforms caste from a structural system into a vague moral problem.

This act of dilution is not politically neutral. As Ambedkar repeatedly emphasized, naming caste is a radical act because it exposes the historical continuity of oppression rather than treating inequality as an accidental or recent deviation. The CBFC's anxiety over caste-specific terminology reveals what Gopal Guru describes as the dominant society's fear of "ethical confrontation," wherein the privileged resist narratives that demand moral and political responsibility (Guru, 2009). In this sense, censorship functions as a technology of power that preserves social comfort at the expense of historical truth.

Moreover, the muting of caste slurs such as “chamar” and “bhangi” while replacing them with generic insults effectively erases the linguistic violence that sustains caste hierarchy (The Wire, 2025). As Sharmila Rege argues, language is not merely descriptive but constitutive of caste power; sanitizing speech risks normalizing discrimination by rendering its mechanisms invisible (Rege, 2013). The removal of caste names thus protects dominant sensibilities while denying Dalit audiences the recognition of their lived realities. The politics of censorship also exposes a broader cultural fear: that anti-caste narratives might disrupt the carefully curated image of a post-caste, harmonious nation. Kancha Ilaiah Shepherd contends that Brahminical ideology maintains its dominance not only through overt control but through “selective silences” that regulate what can be publicly articulated (Ilaiah Shepherd, 1996). The CBFC’s interventions exemplify this logic, allowing the film’s release only after its most politically charged elements are defanged.

Paradoxically, this very act of censorship amplifies the political significance of *Dhadak 2*. The cuts signal that caste remains a volatile subject capable of unsettling dominant narratives of unity and progress. As Wire notes, the film’s struggle with certification exposes how even mainstream, moderated representations of Dalit suffering are perceived as threatening (The Wire. 2025). In this context, censorship becomes evidence of the enduring power of caste rather than its decline. Ultimately, the CBFC’s interventions reaffirm Ambedkar’s insight that social reform in India is repeatedly stalled by the reluctance to confront caste directly. By forcing *Dhadak 2* to speak in softened metaphors rather than historical specificity, censorship reinforces the very structures of silence and denial that the film seeks to critique. The politics of fear governing cultural regulation thus mirrors the broader social order—one that tolerates inequality so long as it remains unnamed, unhistoricized, and politically defanged.

Conclusion

The film ultimately reveals that caste in contemporary India is neither residual nor symbolic, but a living structure that continues to regulate intimacy, institutions, and representation. Situated within the current moment of Dalit politics—marked by intensified violence, shrinking dissent, and the appropriation of Ambedkarite imagery without its radical ethics—the film acquires particular urgency. Its uneasy negotiation between visibility and constraint mirrors the broader condition of Dalit representation today: increasingly present in public culture, yet persistently vulnerable to dilution, censorship, and savarna mediation. From an Ambedkarite perspective, the film’s significance lies not in offering narrative resolution but in exposing the limits of liberal inclusion and romantic transcendence. By foregrounding humiliation, silence, and unequal consequence, it affirms Ambedkar’s insistence that social democracy remains unrealized so long as dignity is denied in everyday life. In doing so, the film reminds us that representation without structural transformation risks becoming symbolic containment rather than political challenge. As Dalit politics continues to contest both material injustice and cultural erasure, *Dhadak 2* stands as a contested yet consequential cultural reflection—one that forces mainstream cinema to confront caste not as a moral aberration but as a foundational social order. Its intervention, however partial, underscores an enduring Ambedkarite truth: the struggle is not merely for visibility, but for the annihilation of caste itself.

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EXISTENCE, UNIQUENESS, AND STABILITY OF SOLUTIONS FOR NONLINEAR ψ-CAPUTO FRACTIONAL DIFFERENTIAL EQUATIONS

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ABSTRACT

The primary objective of this study is to derive existence results and stability criteria for a class of fractional-order differential equations by employing fixed point theorems. The existence results are established using Schauder's fixed point theorem and the Banach contraction principle, which provide a solid theoretical foundation for analyzing such equations. Special emphasis is placed on the application of Krasnoselskii's fixed point theorem to determine stability criteria for a specific class of fractional-order differential equations, offering a novel approach to addressing stability concerns in this context. To illustrate the practical relevance of the theoretical findings, an example is provided, demonstrating the effectiveness and applicability of the derived stability result in real-world scenarios.

Key-words: Fractional-order differential equations, Existence results, Stability criteria, Fixed point theorems, Krasnoselskii's theorem.

MACHINING INTEGRITY AND MECHANICAL PERFORMANCE OF NOVEL KEVLAR-PUMICE SANDWICH POLYMER COMPOSITE

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ABSTRACT

The evolution of high-performance materials has increasingly turned toward sandwich structures that offer superior strength-to-weight ratios for critical industrial applications. This presentation details the development and multi-faceted evaluation of a novel Kevlar-reinforced sandwich polymer composite featuring a core filled with volcanic pumice particles. Pumice, a naturally porous and lightweight volcanic rock, was selected to enhance structural bonding while reducing the overall density of the composite system.

The research first explores the fabrication process using open molding and subsequently focuses on the complex machining challenges encountered in industrial settings. Abrasive Water Jet Machining (AWJM) trials were conducted following a Taguchi L9 orthogonal array to evaluate the impact of variables such as hydraulic pressure, standoff distance, and abrasive flow rate on common machining defects. By integrating multi-objective Grey Relational Analysis (GRA) with advanced machine learning techniques, including Linear Regression and Shapley Additive Explanations (SHAP), the study identified optimal parameters to mitigate kerf taper, delamination, and surface roughness. Results demonstrate that a 10% pumice composition significantly contributes to scaling down these damages, achieving notable reductions in delamination and surface roughness by up to 40.71%.

Furthermore, the structural integrity of the material was assessed through three-point flexure tests, revealing that the inclusion of pumice significantly bolsters both the flexural modulus and strength. Composites with 10 wt% pumice showed a 31% increase in strength compared to those with lower loadings, primarily due to well-bonded particles that inhibit core failure and delay the onset of delamination. Numerical simulations via Finite Element Analysis (FEA) using ANSYS further validated these experimental observations, capturing peak stress concentrations at the interface between components with a high degree of accuracy. Microstructural investigations through scanning electron microscopy (SEM) and Atomic Force Microscopy (AFM) confirmed that the coarse surface of the pumice particles fosters strong interfacial bonding between the core and the resin-impregnated Kevlar face sheets.

In conclusion, this hybrid material provides a robust solution for the aerospace, automotive, and construction industries. The integration of bio-inspired statistical modelling and experimental validation confirms that Kevlar-pumice sandwich panels offer a highly efficient, lightweight alternative for structural and impact-resistant applications.

Keywords: Kevlar fibre, pumice particles, sandwich composites, abrasive water jet machining; flexural performance.

STUDY OF INSULATION SCENARIOS USING AN ECOLOGICAL MATERIAL AS A SUSTAINABLE SOLUTION FOR COMFORTABLE AND EFFICIENT BUILDINGS: THE CASE OF MOROCCAN BUILDINGS

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Abstract: Various factors, such as population growth and urbanization, have contributed to a considerable increase in energy consumption and greenhouse gas (GHG) emissions linked to the building sector. The Moroccan government's efforts in this area are reflected in a national energy strategy whose objective is to integrate renewable energies into the energy mix to the tune of 52% and to save 15% of final energy by 2030. Buildings are one of the most energy-intensive sectors, accounting for 33% of final energy consumption and around 12% of greenhouse gas emissions. To achieve this, it is essential to take steps to design and construct buildings with envelopes that are more energy-efficient, more sustainable and more respectful of the environment. To this end, a thermal study in the form of a series of numerical simulations was carried out using TRNSYS software. The study aimed to improve thermal comfort levels and energy requirements by incorporating hemp concrete as a bio-sourced insulator in the wall layer of a typical Moroccan residential building. Different insulation scenarios were studied to make a choice that would ensure optimum thermal comfort in the building with low energy demand.
Keywords: Thermal study, TRNSYS software, bio-sourced insulator, building, thermal comfort, energy demand.

AN AB-İNİTİO STUDY OF PHYSİCAL PROPERTİES OF BEXH$_3$ (X = PD, AG, AND CD) PEROVSKİTES HYDRİDES FOR HYDROGEN STORAGE APPLİCATİONS

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Abstract: Novel perovskite hydride materials have emerged as promising candidates for hydrogen storage applications. In this study, density functional theory (DFT) was used to investigate the effects of substituting transition metals (X = Pd, Ag, and Cd) in BeXH$_3$ perovskite materials on their physicochemical properties and hydrogen storage performance. Thermodynamic stability was confirmed by negative formation energies (-0.872, -0.492, and -0.456 eV/atom for BePdH$_3$, BeAgH$_3$, and BeCdH$_3$, respectively), indicating the potential for experimental synthesis. Mechanical stability assessments revealed that BeAgH$_3$ and BeCdH$_3$ satisfy Born's stability criteria, whereas BePdH$_3$ exhibited mechanical instability. Electronic structure analyses, including the band structure and density of states, indicated metallic behavior for the studied compounds. Additionally, thermodynamic characteristics, such as entropy, Debye temperature, specific heat capacity at constant volume, and thermal expansion coefficients, were evaluated using the quasi-harmonic Debye model over a temperature range of 0–1000 K and pressure range of 0–20 GPa. The Debye temperature determines a gradual decrease with increasing temperature, while the heat capacity approaches the Dulong-Petit limit at high temperatures, consistent with stable solid behavior. The ab initio molecular dynamic results indicate that BePdH$_3$, BeAgH$_3$, and BeCdH$_3$ exhibit significant kinetic stability at 300 K. Furthermore, phonon dispersion calculations confirmed the dynamical stability of BeAgH$_3$, while BePdH$_3$ and BeCdH$_3$ exhibited imaginary frequencies. Hydrogen storage capabilities were further assessed, revealing reasonable gravimetric hydrogen capacities (2.49, 2.46, and 2.37 wt% for BePdH$_3$, BeAgH$_3$, and BeCdH$_3$, respectively), volumetric hydrogen storage capacities (126.06, 107.59, and 90.74 g H2/L for BePdH$_3$, BeAgH$_3$, and BeCdH$_3$, respectively), and moderate hydrogen desorption temperatures (643.92, 363.03, and 336.68 K for BePdH$_3$, BeAgH$_3$, and BeCdH$_3$, respectively).

Keywords: Hydrogen storage; Hydride perovskites; Desorption temperature; Thermodynamic properties.

CLIMATE-RESPONSIVE SELECTION OF THERMAL INSULATION MATERIALS FOR ENERGY-EFFICIENT TERTIARY BUILDINGS IN MEKNES

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Abstract. Reducing energy consumption in buildings largely depends on the ability of the envelope to regulate heat transfers throughout the year. Proper thermal insulation helps limit heat losses during winter periods and reduces excessive heat gains in summer, regardless of the use of mechanical heating or cooling systems. An appropriate choice of insulation solutions can therefore lead to significant energy savings while enabling a more efficient use of air-conditioning systems. This issue is particularly relevant in Morocco, where the building sector represents one of the highest energy-consuming sectors. In a context marked by increasing energy costs and the gradual depletion of fossil energy resources, improving building energy efficiency has become a critical necessity.

In this context, the present work investigates the energy impact of integrating different thermal insulation solutions into the envelope of a tertiary building located in Meknes, Morocco. The analysis demonstrates that the adoption of effective insulation across the main building components results in substantial reductions in both heating and cooling energy demands. The study is based on dynamic energy simulations conducted using TRNSYS software.

Keywords: Energy efficiency, climate zones, residential buildings, thermal analysis, energy performance, simulation software.

ANALYSİS OF STEADY MHD MİXED CONVECTİON WİTH STREAMİNG POTENTİAL İN CU, SNO₂, AND SİO₂ NANOFLUİDS:

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Abstract

This study investigates steady magnetohydrodynamic (MHD) mixed convection flow with streaming potential in a vertical channel filled with three water-based nanofluids—Cu, SnO_2, and SiO_2. The governing nonlinear momentum and energy equations were solved analytically under appropriate boundary conditions to examine the combined effects of electromagnetic, buoyancy, and electrokinetic forces on flow, skin friction, and mass transport. The influence of keyparameters, including the magnetic parameter (M), mixed convection parameter $\left(\frac{Gr}{Re}\right)$ Reynolds number (Re), Debye–Hückel parameter (K), and wall slip parameter (α), was analyzed. Results indicate that increasing M suppresses the fluid velocity in the channel core due to Lorentz forces while slightly enhancing near-wall velocity, whereas higher $\frac{Gr}{Re}$ values promote buoyancy-driven acceleration at the upper wall and induce reverse flow at the lower wall. Velocity increases with Re and K, reflecting stronger inertial and electrokinetic effects. Among the nanofluids, Cu exhibits the highest velocity, skin friction, and mass flow rate, followed by SnO_2 and SiO_2, attributed to its superior thermal and electrical conductivities. Skin friction and mass flow rate increase with M and stabilize at higher $\frac{Gr}{Re}$, while critical $\frac{Gr}{Re}$ values rise with magnetic strength and decrease with wall slip, highlighting the competing effects of magnetic damping and slip-induced flow acceleration. Overall, the results demonstrate that the interplay between magnetic, buoyancy, and electroosmotic forces governs transport behavior, with Cu–water nanofluid providing the most effective enhancement in momentum and heat transfer. These findings offer valuable guidance for the design and optimization of MHD-driven microchannel systems, electrokinetic devices, and thermal management applications.

ADVANCİNG FOOD SAFETY İN ARTİFİCİAL INTELLİGENCE: CURRENT PROGRESS, CHALLENGES, AND FUTURE DİRECTİONS

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Abstract
Food safety deserves the application of higher-level technology to shield customers from dietary illnesses and protect business reputations. The article focuses on artificial intelligence's current situation in the area of food sector, emphasizing the difficulties related to sharing data, encouraging interdisciplinary collaboration, providing training in data science and developing software for professionals in the field, and exploring the various uses of AI within the field of food safety. Machine learning models are discussed, which include a decision tree model that identifies vegetable diseases early on, improving crop superiority and security. The outcomes demonstrate the high rate of precision of the decision tree model. Using a parallel support vector machine model, researchers looked into a risk assessment model for dairy production. Numerous data sources, including analyses of dairy product data and amounts of pertinent components (like protein and sodium), are used to support the study. The accuracy of the algorithms was remarkably high. Moreover, deep learning models are discussed in which researchers looked at using them to handle hyperspectral data to predict shrimp freshness using both visible and near-infrared wavelengths. Based on the acquired deep structures, logistic regression, and a sparse autoencoder model were used to categorize the freshness of the shrimp. The utilization of machine learning as well as deep learning aids to identify patterns in food safety. The suggested algorithms present multiple goals for maximizing the layout and employ a meta-heuristic and the deep neural network method for optimizing the food safety assessment.
Keywords: Food safety, decision tree, sparse autoencoder, Bayesian network, decision tree.

CIRCULAR ECONOMY-BASED CONSTRUCTION OPTIMISATION: TECHNOLOGY, PRACTICE, AND POLICY IN CHINA AND NIGERIA

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ABSTRACT
With an emphasis on laws, technology, and implementation strategies that support resource efficiency, waste reduction, and sustainable material usage, this article analyzes how construction processes in China and Nigeria might be optimized using a circular economy framework. The report highlights China's comprehensive circular construction model, which is backed by a robust regulatory framework, a variety of finance options, and cutting-edge recycling technology. It does this by drawing on policy assessments, case studies, and theme synthesis. Inadequate finance, fragmented laws, low mechanization (less than 10%), and an unofficial recycling network that recovers only 18% of materials are some of the systemic obstacles that Nigeria's building industry must overcome. Critical drivers for circular optimization are identified in the study. It suggests a hybrid model that is suited to Nigeria's situation by combining community awareness efforts, training initiatives to professionalize the unorganized sector, fiscal incentives for private investment, and explicit national circular building regulations.

Keywords: Nigeria, China, Circular Economy, economic diversification, environmental sustainability.

BACILLUS ANTHRACIS; IMPLICATIONS AS A BIOWEAPON

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ABSTRACT
Bacillus anthracis, the etiological agent of anthrax, is a spore forming, Gram positive bacterium with a well documented history of biological weapon. This work focuses on *Bacillus anthracis*, its implications as a bioweapon. Anthrax has a long history as a biological weapon, dating back to ancient times. The unique characteristics of *Bacillus anthracis*, such as its ability to form spores and produce potent toxins, make it an attractive choice for bioterrorism. The deliberate dissemination of anthrax spores has been documented in incidents such as the 2001 anthrax attacks in the United States. These incidents highlighted the potential devastating effects and the need for preparedness and response measures. There are several factors that favor the use of *Bacillus anthracis* as a bioweapon, which are; its high virulence ability to form spores, ease of production and dissemination, and potential for mass casualties. The stability and longevity of spores in the environment further enhance its suitability as a bioweapon. Furthermore, the research examines the various means by which *Bacillus anthracis* can be weaponized. This includes methods of production, dissemination, and delivery, such as through contaminated letters, aerosolized spores, or covert release in populated areas. Understanding these mechanisms is crucial for developing effective countermeasures and response strategies. Also this review examines the potential impacts of using *Bacillus anthracis* as a bioweapon, including its transmission routes, clinical manifestations, detection and diagnosis, and public health implications.conclusively, the findings have significant implications for global health security,bioterrorism,preparedness,and response strategies.

Key words
Bacillus anthracis, etiological agent,bioweapon, bioterrorism,public health,

EVALUATİON OF THE *IN VİTRO* ANTİOXİDANT AND ANTİDİABETİC ACTİVİTİES OF QUİNOA (*CHENOPODİUM QUİNOA* WİLLD.) SEED EXTRACTS AND THE QUANTİFİCATİON OF THEİR BİOACTİVE COMPOUNDS

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Abstract
Oxidative stress plays a major role in diabetic physiopathology; hence, the interest of using natural antioxidants as therapeutic tools exists. Quinoa (*Chenopodium quinoa* Willd.), native to South America and belonging to the family Chenopodiaceae, is a seed crop that exhibits broad genetic diversity, enabling it to adapt to various tough environments, including highlands, salinity, drought, and frost.
This study aimed to assess the *in vitro* antioxidant activity and the inhibitory effects of quinoa seed extracts on key enzymes associated with hyperglycemia. Additionally, it sought to quantify the bioactive compounds present in these extracts.
Antioxidant activity was performed using 2,2′-diphenyl-1-picrylhydrazyl (DPPH) and ferric reducing antioxidant power (FRAP) methods. The α-glucosidase and α-amylase inhibitory activities were investigated using an *in vitro* model.
The hydroethanolic extract of quinoa exhibited the highest antioxidant activity in both DPPH and FRAP methods. This extract also demonstrated the strongest inhibitory effect against α-glucosidase. However, the aqueous extract showed the highest inhibitory effect against α-amylase. Furthermore, the results indicated high levels of phenolic content. The findings suggest that this plant could be a significant source of medically important natural compounds.
Keywords: Chenopodium quinoa Willd.; Antioxidant Activity; Antidiabetic Activity; Bioactive Compounds

MATHEMATICAL MODELLING ON WASTE WATER MANAGEMENT OF AN OXIDATION POND

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Abstract:

This study presents a mathematical model for wastewater treatment process (WWTP) of an oxidation pond. The model permits investigating the effects of a biological based product called mPHO on the degradation of contaminants as well as increase the amount of dissolved oxygen (DO) in the pond. At this aim, an ordinary differential equation with coupled equations has been developed to study the correlation between the number of bacteria (phototrophic and Coliform), Biochemical oxygen demand (BOD), and dissolved oxygen (DO) existing in the pond. The mathematical model is employed to simulate the behaviour of the system where the numerical results demonstrate that the proposed model gives a good approximation of the interaction processes that occur naturally between biological and chemical substances involved in the pond. Runge Kutta Fourth order method is employed to demonstrate the natural occurrence of BOD and DO in waste water management process.

Keywords: Water, Waste, Oxygen, respiratory, bacteria.

ANALYZING THE ROLE OF PERCEIVED ORGANIZATIONAL JUSTICE IN STRENGTHENING ORGANIZATIONAL COMMITMENT AMONG EMPLOYEES OF SMALL AND MEDIUM-SIZED ENTERPRISES IN IRAN

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Abstract
In small enterprises, organizational commitment holds substantial significance, since these businesses tend to depend more on the loyalty, responsibility, and motivation of employees due to constraints in human and financial resources, unlike larger organizations. Employees who exhibit strong commitment contribute significantly to productivity by demonstrating increased effort, enhanced flexibility, and a reduced desire to leave the organization. This commitment also fosters cooperation among staff, diminishes conflicts within the organization, and cultivates workforce stability, all of which are vital for the sustainability, growth, and competitive edge of small enterprises. This study focused on examining how perceived organizational justice influences organizational commitment among employees working in small and medium-sized enterprises (SMEs) in Iran. The research employed a descriptive–correlational design and was applied in purpose. The target population included all employees within Iranian SMEs, with a sample of 189 individuals chosen through simple random sampling from an accessible sampling frame. Data was gathered by utilizing the Organizational Justice Questionnaire created by Cohen-Charash and Spector (2001) and the Organizational Commitment Questionnaire formulated by Allen and Meyer (1991). The reliability of these questionnaires was confirmed with satisfactory Cronbach's alpha coefficients. The Kolmogorov–Smirnov test was used to assess and confirm the normality of the data. Results from multiple regression analysis revealed a positive and statistically significant correlation between organizational justice and organizational commitment at the 0.05 significance level ($r = 0.687$ for interactional justice, $r = 0.604$ for informational justice, $r = 0.312$ for procedural justice, and $r = 0.315$ for distributive justice). Notably, interactional justice yielded the highest impact ($\beta = 0.593$), while distributive justice produced the lowest effect ($\beta = -0.186$). These results imply that bolstering organizational justice—especially interactional justice—has the potential to improve organizational commitment among SME employees, aligning with the conclusions drawn by Colquitt (2001).

Keywords: Organizational Justice; Organizational Commitment; Small and Medium-Sized Enterprises (SMEs)

ANALYTICAL SOLUTIONS OF THE FUZZY FRACTIONAL DIFFERENTIAL GENERALIZED BAGLEY-TORVIC EQUATION VIA Ψ-CAPUTO GH-DIFFERNTIABILITY

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Abstract
The fractional generalized Bagley–Torvik equation (FGB-TE) describes the motion of an immersed plate in a Newtonian fluid, incorporating two independent fractional orders to model both viscous and elastic effects [1]. Analytical study of such systems is challenging, particularly under uncertain initial conditions. In this work, we develop an efficient analytical approach to solve the fuzzy fractional generalized Bagley–Torvik equation (FFGB-TE) by combining the fuzzy Laplace transform (FLT) with the concept of fuzzy ψ-Caputo generalized Hukuhara (gH) differentiability [2,4]. The method produces closed-form fuzzy solutions for both homogeneous and non-homogeneous cases, expressed in terms of the Mittag–Leffler function [3]. Key theoretical results are rigorously derived, and illustrative examples demonstrate the effectiveness and applicability of the proposed approach for modeling fuzzy fractional dynamical systems. This study extends the analytical treatment of fuzzy fractional differential equations and provides a practical tool for complex viscoelastic modeling.

Keywords: Fuzzy fractional differential equations,Caputo generalized Hukuhara differentiability,Analytical fuzzy solution.

PREDİCTİVE MODELLİNG OF SOİL FERTİLİTY USİNG MACHİNE LEARNİNG AND WİRELESS SENSOR NETWORKS

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Abstract
Soil fertility assessment is a critical determinant of agricultural productivity and food security, particularly in developing economies where conventional laboratory-based soil analysis is costly, time-consuming, and spatially limited. This study presents an integrated framework for predictive modelling of soil fertility using Machine Learning (ML) algorithms and Wireless Sensor Networks (WSNs). Empirical data were collected from 120 agricultural plots using in-situ sensor nodes measuring soil pH, moisture content, temperature, electrical conductivity, and macronutrient proxies over two growing seasons. Four machine learning models Multiple Linear Regression (MLR), Support Vector Machine (SVM), Random Forest (RF), and Artificial Neural Network (ANN) were trained to predict a composite Soil Fertility Index (SFI). Model performance was evaluated using Root Mean Square Error (RMSE), Mean Absolute Error (MAE), and coefficient of determination (R^2). Results indicate that the Random Forest model achieved the highest predictive accuracy ($R^2 = 0.93$), followed by ANN ($R^2 = 0.89$). The findings demonstrate the viability of combining WSNs and ML for real-time, scalable, and cost-effective soil fertility prediction, with significant implications for precision agriculture and sustainable land management.
Keywords: Soil fertility, machine learning, wireless sensor networks, precision agriculture and predictive modelling

1. Introduction

1.1 Background of the Study

Soil fertility remains a foundational element of agricultural sustainability, exerting a direct influence on crop yield, nutrient use efficiency, and long-term ecosystem resilience. Fertile soils ensure the availability of essential macro- and micronutrients, support healthy root development, regulate water retention, and sustain beneficial microbial activity. Consequently, accurate assessment and effective management of soil fertility are central to achieving food security, enhancing farm profitability, and mitigating land degradation, particularly under conditions of increasing climatic variability (Bünemann et al., 2022; FAO, 2023).

Conventional soil fertility evaluation relies predominantly on laboratory-based chemical analysis, which is widely regarded as the benchmark for determining soil nutrient status and physicochemical properties. Although these methods provide high analytical accuracy, they are associated with several limitations, including high operational costs, delayed turnaround times, and dependence on specialized infrastructure and skilled personnel (Jones et al., 2021; Zhang et al., 2023). These constraints often result in infrequent soil testing and delayed agronomic interventions, reducing the effectiveness of fertility management strategies. Furthermore,

laboratory-based assessments typically involve sparse sampling, which inadequately captures the spatial variability of soil properties within and across agricultural fields (Minasny et al., 2022).

These challenges are particularly pronounced in smallholder farming systems prevalent in sub-Saharan Africa and other developing regions, where limited financial capacity, poor access to soil testing facilities, and weak agricultural extension services constrain routine soil fertility assessment (Sheahan & Barrett, 2022; Vanlauwe et al., 2024). Consequently, fertilizer application decisions are frequently based on generalized recommendations or experiential judgment, leading to nutrient imbalances, low fertilizer use efficiency, declining soil health, and adverse environmental impacts such as nutrient runoff and soil acidification (Omotayo et al., 2023).

The emergence of Wireless Sensor Networks (WSNs) has created new opportunities to overcome these limitations by enabling continuous, in-situ monitoring of soil parameters. WSNs consist of spatially distributed sensor nodes capable of measuring key soil attributes, including moisture content, temperature, pH, and electrical conductivity, at high temporal resolution. Recent studies have demonstrated that WSN-based soil monitoring systems can provide reliable, real-time data while significantly reducing the cost and labor associated with traditional soil sampling methods (Rao et al., 2022; Kim et al., 2024). Advances in low-power sensor design, edge computing, and long-range communication protocols such as LoRaWAN have further enhanced the suitability of WSNs for deployment in remote and resource-constrained agricultural environments (Jawad et al., 2023).

In parallel, advances in machine learning have substantially improved the capacity to analyze large-scale, multivariate datasets generated by sensor-based agricultural monitoring systems. Machine learning algorithms are particularly effective at modelling complex, nonlinear interactions among soil properties, environmental variables, and fertility outcomes—relationships that are often inadequately represented using conventional statistical approaches (Liakos et al., 2023; Tripathi et al., 2024). Supervised learning techniques, including Random Forests, Support Vector Machines, and Artificial Neural Networks, have demonstrated strong predictive performance in soil property estimation, nutrient mapping, and crop yield prediction tasks (Basso et al., 2022; Yang et al., 2025).

Integrating Wireless Sensor Networks with machine learning represents a paradigm shift in soil fertility management, enabling a transition from reactive, laboratory-dependent assessment to proactive and predictive decision-making. Such integration supports near real-time estimation of soil fertility status, facilitates site-specific fertilizer recommendations, and enhances nutrient use efficiency while minimizing environmental risks (Khanal et al., 2023). By reducing dependence on costly laboratory analyses and improving the timeliness and spatial resolution of fertility information, this data-driven approach holds significant promise for advancing precision agriculture and sustainable land management, particularly in developing economies (FAO, 2023; Vanlauwe et al., 2024).

Against this background, the present study proposes and empirically validates a predictive modelling framework that integrates wireless sensor network data with machine learning techniques for soil fertility assessment under real field conditions. The study aims to contribute empirical evidence on the effectiveness of sensor-driven machine learning models in capturing soil fertility dynamics and to provide practical insights for the deployment of intelligent soil monitoring systems in support of sustainable agricultural production.

1.2 Problem Statement

Despite advances in smart agriculture, many soil fertility prediction models remain either data-intensive or dependent on laboratory-derived inputs. Furthermore, existing models often lack empirical validation under real field conditions using sensor-generated data. This gap limits their scalability and practical adoption by farmers and agricultural extension services.

1.3 Aim and Objectives

The aim of this study is to develop and empirically validate a machine learning-based predictive model for soil fertility using data acquired through wireless sensor networks.

The specific objectives are to:

i. Design a WSN-based soil monitoring system.
ii. Develop a composite Soil Fertility Index (SFI).
iii. Train and compare multiple machine learning models.
iv. Evaluate model performance using standard statistical metrics.
v. Analyze the implications of predictive soil fertility modelling for precision agriculture.

1.4 Significance of the Study

This research contributes to digital agriculture by providing a scalable, data-driven framework for soil fertility prediction. It supports informed decision-making on fertilizer application, reduces environmental degradation, and enhances crop productivity.

2. Materials and Methods

2.1 Study Area and Experimental Design

The study was conducted across 120 cultivated agricultural plots distributed within a semi-humid agroecological zone characterized by moderate rainfall, seasonal temperature variability, and mixed cropping systems. This agroecological setting is representative of many food-producing regions in developing economies, where soil fertility constraints significantly affect crop productivity. The selection of the study area was guided by its heterogeneous soil characteristics and active smallholder farming activities, which provided a realistic environment for evaluating sensor-based fertility prediction models (Vanlauwe et al., 2024).

Each experimental plot measured 20 m × 20 m, a scale chosen to balance spatial resolution with practical deployment constraints. Plots were laid out using a randomized block design to minimize spatial bias and ensure statistical robustness. A single wireless sensor node was installed at the center of each plot at a standardized soil depth of 15 cm, corresponding to the primary crop root zone. Data collection was conducted continuously over two growing seasons to capture both temporal variability and seasonal soil fertility dynamics, consistent with best practices in sensor-based agricultural experimentation (Minasny et al., 2022).

2.2 Wireless Sensor Network Architecture

A Wireless Sensor Network (WSN) was designed and deployed to enable continuous, in-situ monitoring of key soil parameters influencing fertility status. Each sensor node consisted of the following components:

1. **Soil moisture sensor (capacitive):** Used to measure volumetric water content, providing an indirect indicator of nutrient mobility and plant water availability.
2. **Soil temperature sensor (DS18B20):** Selected for its accuracy and stability under field conditions, enabling monitoring of temperature-dependent biological and chemical soil processes.
3. **Electrochemical pH sensor:** Used to assess soil acidity or alkalinity, a critical determinant of nutrient availability and microbial activity.
4. **Electrical conductivity (EC) sensor:** Employed as a proxy for soluble salt concentration and nutrient availability in the soil solution.
5. **Microcontroller (ESP32):** Responsible for sensor data acquisition, preprocessing, and power management.
6. **LoRa communication module:** Enabled low-power, long-range data transmission to a central gateway.

Sensor nodes were powered using rechargeable batteries supported by solar charging modules to ensure uninterrupted operation. Data were sampled and transmitted at 30-minute intervals to a central gateway, which aggregated the data and forwarded them to a cloud-based database for storage and analysis. The choice of LoRa communication ensured low energy consumption and

reliable data transfer over long distances, making the system suitable for deployment in remote agricultural environments (Jawad et al., 2023; Kim et al., 2024).

2.3 Soil Fertility Index (SFI) Development

To provide a unified measure of soil fertility, a composite Soil Fertility Index (SFI) was developed by integrating multiple sensor-derived soil parameters. Raw sensor readings for pH, electrical conductivity, soil moisture, and temperature were first normalized using min–max scaling to eliminate unit inconsistencies and ensure comparability across variables.

Weighted scores were then assigned to each parameter based on agronomic relevance and correlation strength with laboratory-measured soil nutrients. Electrical conductivity and soil moisture were assigned higher weights due to their strong association with nutrient availability and transport processes, while pH and temperature were assigned moderate weights reflecting their regulatory roles in soil biochemical reactions. Nutrient proxies derived from EC and moisture trends were incorporated to approximate macronutrient status.

The resulting SFI was computed as a weighted linear combination of the normalized variables. To ensure validity, SFI values were cross-validated against laboratory soil test results obtained from composite soil samples collected periodically from selected plots. This validation process confirmed that the SFI provided a reliable representation of actual soil fertility conditions, consistent with approaches reported in recent digital soil assessment studies (Bünemann et al., 2022; Tripathi et al., 2024).

2.4 Machine Learning Models

Four machine learning models were implemented to predict the Soil Fertility Index based on sensor-generated input variables:

Multiple Linear Regression (MLR): Served as a baseline model to establish a linear relationship between soil parameters and SFI. MLR provided a reference point for evaluating the benefits of nonlinear modelling approaches.

Support Vector Machine (SVM): Implemented using a radial basis function (RBF) kernel to capture nonlinear relationships between soil variables. Hyperparameters were optimized using grid search to enhance generalization performance.

Random Forest (RF): An ensemble learning model consisting of 200 decision trees constructed using bootstrap aggregation. Random Forest was selected for its robustness to noise, ability to handle nonlinear interactions, and built-in feature importance estimation (Khanal et al., 2023).

Artificial Neural Network (ANN): A three-layer feedforward neural network comprising an input layer, one hidden layer, and an output layer. The ANN was trained using backpropagation with a rectified linear unit (ReLU) activation function and adaptive learning rate optimization.

These models were chosen to provide a comprehensive comparison between linear, kernel-based, ensemble, and deep learning approaches commonly applied in precision agriculture research (Liakos et al., 2023).

2.5 Model Evaluation Metrics

Model performance was evaluated using standard regression accuracy metrics widely adopted in machine learning and agricultural modelling studies:

2.5.1 Root Mean Square Error (RMSE): Used to quantify the magnitude of prediction errors, with greater sensitivity to large deviations.

2.5.2 Mean Absolute Error (MAE): Provided a measure of average prediction error magnitude, offering interpretability in the original scale of the SFI.

2.5.3 Coefficient of Determination (R^2): Assessed the proportion of variance in the observed SFI explained by the predictive model.

The dataset was partitioned using a 70:30 train–test split to ensure independent model evaluation. Additionally, 10-fold cross-validation was applied during training to reduce overfitting and improve model generalizability. This evaluation framework aligns with current best practices in empirical machine learning research for agricultural applications (Yang et al., 2025)

3. Results and Discussion

Table 1: Descriptive Statistics of Sensor-Measured Soil Parameters

Parameter	Mean	Std. Dev	Min	Max
pH	6.42	0.58	5.1	7.8
Moisture (%)	21.6	5.3	10.2	34.5
Temperature (°C)	27.4	2.1	22.9	31.8
EC (dS/m)	0.39	0.11	0.15	0.68

Table 1 shows that the soil conditions reflect moderate fertility levels suitable for cereal and legume cultivation. Variability in moisture and EC indicates spatial heterogeneity, reinforcing the need for predictive modelling.

Table 2 : Correlation Matrix Between Soil Parameters and SFI

Parameter	pH	Moisture	Temp	EC	SFI
pH	1.00				
Moisture	0.41	1.00			
Temperature	−0.36	−0.28	1.00		
EC	0.52	0.46	−0.19	1.00	
SFI	0.61	0.67	−0.42	0.73	1.00

Table 2 shows that the Electrical conductivity and moisture has the strongest correlations with SFI, indicating their dominant influence on fertility prediction.

Table 3: Model Performance Comparison

Model	RMSE	MAE	R^2
MLR	0.087	0.071	0.74
SVM	0.061	0.048	0.86
ANN	0.054	0.042	0.89
RF	**0.041**	**0.033**	**0.93**

Table 3 shows that the Random Forest model outperformed others due to its ability to capture nonlinear interactions and reduce overfitting through ensemble learning.

Table 4: Feature Importance Ranking (Random Forest Model)

Rank	Feature	Importance Score
1	EC	0.31
2	Moisture	0.27
3	pH	0.21
4	Temperature	0.14
5	Time Index	0.07

Table 4 shows that the Electrical conductivity emerged as the most influential predictor, aligning with its role as a proxy for nutrient availability.

Table 5: Prediction Accuracy by Fertility Class

Fertility Class	Accuracy (%)
Low	91.2
Medium	94.6
High	92.8

Table 5 indicate High classification accuracy across fertility classes confirms the robustness of the proposed framework for real-world deployment.

4. Results Summary and Key Findings

i. WSNs provided reliable, continuous soil data with minimal data loss (<2%).
ii. Machine learning significantly outperformed linear modelling approaches.
iii. Random Forest achieved the highest predictive accuracy.
iv. Soil moisture and EC were dominant fertility indicators.
v. The system supports near real-time fertility decision-making.

5. Conclusion

This study has demonstrated that the integration of Wireless Sensor Networks (WSNs) with machine learning constitutes a powerful, scalable, and data-driven approach for predictive soil fertility assessment. By leveraging continuous, in-situ sensor measurements and advanced learning algorithms, the proposed framework effectively captures the complex, nonlinear interactions among soil physicochemical parameters that govern fertility dynamics. The empirical results obtained from field-deployed sensor networks across multiple agricultural plots provide strong evidence of the practical viability and robustness of the approach under real farming conditions.

Comparative model evaluation confirmed that ensemble-based learning methods, particularly the Random Forest model, consistently outperformed linear and kernel-based alternatives in predicting the Soil Fertility Index. The superior performance of Random Forest can be attributed to its ability to model nonlinear feature interactions, reduce overfitting through bootstrap aggregation, and maintain robustness in the presence of noisy and heterogeneous sensor data. These characteristics are especially important in agricultural environments, where soil properties exhibit high spatial and temporal variability.

A key contribution of this work lies in its potential to significantly reduce dependence on conventional laboratory-based soil testing. While laboratory analysis remains indispensable for calibration and validation, the proposed system enables near real-time fertility estimation, thereby minimizing delays in agronomic decision-making. This capability supports timely and site-specific fertilizer management, improves nutrient use efficiency, and contributes to environmentally sustainable farming practices by reducing excessive or poorly targeted input application.

Furthermore, the integration of WSNs and machine learning directly supports the principles of precision agriculture by enabling continuous monitoring, spatially explicit fertility assessment, and data-driven interventions. Such capabilities are particularly valuable in resource-constrained and smallholder farming systems, where access to laboratory facilities and extension services is limited. The scalability and low-power nature of the proposed architecture make it well suited for deployment in diverse agricultural contexts, including remote and developing regions.

Despite these promising outcomes, several avenues for future research remain. Future studies should integrate remote sensing data from satellite and unmanned aerial platforms to complement in-situ sensor measurements and enhance spatial coverage. Additionally, expanding model validation across diverse agroecological zones, soil types, and cropping systems would improve generalizability and robustness. Incorporating advanced deep learning architectures and adaptive model updating mechanisms may further enhance predictive accuracy under changing climatic and management conditions. Collectively, these extensions will strengthen the role of intelligent

sensing and machine learning systems in advancing sustainable soil fertility management and resilient agricultural production.

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SYNTHESİS AND İNDUSTRİAL APPLİCATİONS OF BİONANOMATERİALS: AN UPDATE

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Abstract
Recent trend towards bio-based economy poses great promise to renewable materials like biopolymers as an alternative to petroleum resources. Similarly, reinforcement of biopolymers with nanostructured materials is gaining additional attraction from the researchers in academia and industries, because of the exponential improvement in physical, mechanical, and thermal properties with smaller amounts of nanofillers incorporation. Furthermore, this incorporation can be combined with functionalization routes that may enable new fundamental differences in the properties, biodegradability, biocompatibility, and applications of bionanocomposites compared to pristine ones. This article is intended to review the recent research on bionanocomposites and then compile their most noticeable and novel applications in various industries.
Keywords: Biopolymers; Nanofillers; Biomedical applications, Food packaging, Environmental, Textile industry

THE CURRENT TREND OF TUBERCULOSİS İN THE 21ST CENTURY: A MİNİ REVİEW STUDY

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Background: Tuberculosis remains a critical global health challenge, accounting for approximately 10.6 million new cases and 1.3 million deaths annually. The persistent burden concentrates in low- and middle-income countries where socioeconomic inequalities, inadequate health infrastructure, and drug-resistant strains undermine control efforts. Despite effective treatments, significant knowledge gaps exist regarding contemporary epidemiological patterns, emerging drug resistance, diagnostic innovations, and systemic barriers, particularly in high-burden settings like Nigeria where only 35% of estimated cases are detected.
Objective: This study critically examines tuberculosis trends in the 21st century, assessing global and regional prevalence patterns, examining socioeconomic and biological determinants, analyzing drug-resistant tuberculosis implications, and evaluating current diagnostic and control strategies.
Methods: A systematic literature review was conducted, searching major health databases for publications from 2000 onward. Data were extracted using standardized forms and synthesized through thematic narrative analysis, with quality assessment conducted using design-appropriate criteria.
Results: Global tuberculosis incidence declined slowly at 1.5% annually, below the 4-5% reduction required for End TB Strategy targets. Eight high-burden countries account for two-thirds of cases. COVID-19 reversed progress, increasing tuberculosis deaths for the first time in over a decade. Tuberculosis persistence is driven by poverty, malnutrition, overcrowding, HIV co-infection, diabetes, delayed care-seeking, and weak health systems. Approximately 410,000 people developed multidrug/rifampicin-resistant tuberculosis in 2022; only 40% received treatment. While GeneXpert MTB/RIF improved detection by 10-20%, implementation remains uneven. An estimated 3-4 million cases annually remain undiagnosed.
Conclusion: Eliminating tuberculosis requires comprehensive, patient-centered, multi-sectoral approaches integrating biomedical advances with social protection, strengthening health services, addressing social determinants, and ensuring sustained political commitment with adequate financing.
Keywords: Tuberculosis, Drug-Resistant Tuberculosis, Global Health, Epidemiology, Diagnostic Innovations, Health Systems

PERAN PAJAK PENGHASILAN DALAM SISITEM PERPAJAKAN MODERN

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ABSTRACT
This study begins with the significance of income tax as a primary source of state revenue to support development financing at the national level. However, the effectiveness of income tax revenue collection still faces various challenges, including variations in taxpayer compliance, regulatory complexity, and changes in the global economy. This study aims to: (1) Explore the role of income tax in the contemporary tax system, and (2) Identify elements that influence the optimization of income tax revenue. The method used in this research is a literature review with a descriptive-analytical approach to review taxation theory, recent regulations, and income tax implementation practices in various parts of the world. Research findings indicate that income tax plays a crucial role in creating fiscal stability, more equitable income distribution, and increasing social justice within the contemporary tax system. Furthermore, advances in digital technology and data integration have been shown to improve the effectiveness of tax administration and taxpayer compliance. This study recommends simplifying regulations, strengthening oversight systems utilizing technology, and increasing tax literacy among the public to maximize the contribution of income tax to national development.
Keywords: income tax, contemporary tax system, tax compliance, tax administration

CLIMATE CHANGE AND ITS EFFECTS ON PHYTOCHEMICAL COMPOSITION OF TROPICAL PLANTS: A REVIEW

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Abstract
Climate change represents one of the most significant global challenges affecting plant biodiversity, productivity, and chemical composition. Tropical plants, which constitute a major reservoir of medicinally and nutritionally important phytochemicals, are particularly vulnerable to alterations in temperature regimes, precipitation patterns, atmospheric carbon dioxide concentrations, and the increasing frequency and intensity of extreme weather events. These climates driven changes disrupt plant physiological processes, redox balance, and stress signaling pathways, resulting in metabolic reprogramming and marked variations in secondary metabolite biosynthesis and accumulation. Consequently, the quantity, diversity, and stability of key phytochemicals may be enhanced or diminished depending on species, stress intensity, and duration. This review critically examines the influence of major climate change related factors on the phytochemical composition of tropical plants, with particular emphasis on phenolics, flavonoids, alkaloids, terpenoids, and other bioactive constituents. The underlying biochemical, physiological, and molecular mechanisms governing climate induced phytochemical variation are discussed, supported by evidence from tropical medicinal and food plants. The review further highlights the implications of these changes for natural product research, quality control of herbal medicines, food and nutritional security, and pharmaceutical development. Finally, future research directions are proposed, emphasizing the need for integrative omics approaches, climate resilient cultivation strategies, and sustainable management of tropical plant resources in the context of ongoing global climate change.

Keywords: Climate change, Phytochemicals, Tropical plants, Secondary metabolites, Abiotic stress, Medicinal plants

IMPACT OF ENVIRONMENTAL STRESS ON SECONDARY METABOLITE PRODUCTION: A REVIEW

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Abstract
Secondary metabolites are bioactive compounds synthesized by plants as integral components of their adaptive, protective, and defense mechanisms against environmental challenges. Various environmental stresses, including drought, salinity, extreme temperatures, ultraviolet radiation, nutrient limitation, and biotic pressures such as pathogens and herbivores, exert significant influence on both the qualitative and quantitative profiles of these metabolites. Stress conditions often trigger complex physiological, biochemical, and molecular responses that lead to metabolic reprogramming and enhanced synthesis of specific classes of secondary metabolites. Understanding how different stress factors regulate secondary metabolism is essential for optimizing phytochemical yield, improving the therapeutic quality of medicinal plants, and supporting natural product based drug discovery. This review critically examines the major categories of environmental stress and their effects on secondary metabolite biosynthesis, highlighting key regulatory pathways, stress signaling mechanisms, and gene expression changes involved in metabolite accumulation. Particular emphasis is placed on phenolics, flavonoids, alkaloids, terpenoids, and other stress responsive compounds due to their ecological and pharmacological relevance. The review further discusses experimental evidence from diverse medicinal plants, illustrating stress induced variations in phytochemical content. In addition, the implications for pharmaceutical, nutraceutical, and herbal industries are explored, alongside future perspectives that include controlled stress elicitation, metabolic engineering, and biotechnological strategies aimed at enhancing the sustainable production of valuable plant secondary metabolites.

Keywords: Environmental stress, Secondary metabolites, Phytochemicals, Abiotic stress, Medicinal plants, Plant defense

PHYSİCS-INFORMED NEURAL NETWORK–ENABLED DESİGN AND OPTİMİZATİON OF BORATE BİOACTİVE GLASSES

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Abstract
Bioactive glasses with borate composition have mobilized great interest in the field of biomaterials for regenerative applications owing to their fast dissolution rates, higher bioactivity, and ability to control the release of therapeutic ions. Nevertheless, the search for an optimal chemical composition and degradation properties, together with the required durability, remains an extremely complex, multi-variable problem. The present study emphasizes the synergy between Artificial Intelligence (AI) and Physics-Informed Neural Networks (PINNs), aimed at fast-tracking the design and subsequent performance analysis of borate bioactive glasses. Unlike traditional data analytics approaches, Physics-Informed Neural Networks incorporate the relevant physical and chemical constraints related to the kinetics of glass dissolution, mass transport, and reaction diffusion into the AI design framework itself. Supervised learning and related PINN models are utilized for the prediction of significant properties such as the rate of dissolution, pH alteration, hydroxyapatite index, and ion release as functions of the structural parameters of the borate-networking glasses. The proposed two-fold approach to modelling can be effectively applied for generalizing predictions with fewer experimental validations and can be employed for the robust inverse design and optimization of borate bioactive glasses for specific applications in regenerative and related biomedical fields.
Keywords: Biomaterials, Borate Glasses, Data driven material design, PINN.

THE ROLE OF PROBİOTİC SUPPLEMENTATİON İN ALCOHOL CRAVİNG: BEHAVİORAL AND NEUROCHEMİCAL CORRELATES

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Alcohol Use Disorder (AUD) is characterized by persistent craving and compulsive consumption, underpinned by neuroinflammation, oxidative stress, and dysregulation of reward pathways. Emerging evidence implicates the gut-brain axis as a key modulator of these processes, with gut dysbiosis exacerbating behavioral and neurochemical correlates of addiction. The present study was designed to investigate the therapeutic potential of targeted probiotic supplementation in modulating alcohol-seeking behavior and its underlying neurobiological substrates. Using a pre-clinical rodent model of AUD, subjects were administered a specific multi-strain probiotic formulation alongside chronic intermittent ethanol exposure. Behavioral assays were employed to quantify alcohol preference. Parallel biochemical analyses assessed systemic and central anti-inflammatory markers and antioxidant capacity. Levels of serotonin, dopamine and metabolites were estimation in caudate and nucleus accumbens via HPLC-EC. Probiotic administration significantly reduced alcohol preference and attenuated conditioned place preference for ethanol-paired contexts compared to controls. These behavioral improvements correlated with robust anti-inflammatory and antioxidant effects, as evidenced by reduced pro-inflammatory cytokines and enhanced oxidative stress defense in both plasma and brain tissue. The results highlight the gut-brain axis as a viable target for novel nutritional interventions in AUD and provide a mechanistic rationale for the adjunct use of probiotics in managing alcohol dependence.

Keywords: Probiotic, Alcohol Use Disorder, Craving, Gut-Brain Axis, Conditioned Place Preference, Neuroinflammation, Oxidative Stress, Dopamine

BIOPHARMACEUTICALS: RECENT ADVANCEMENTS AND EMERGING CHALLENGES

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ABSTRACT
Pharmaceuticals made from biological sources are known as biopharmaceuticals, and they are now a vital part of contemporary healthcare. Recent developments in biotechnology, such as gene and cell therapies, recombinant DNA technologies, monoclonal antibodies, and innovative vaccination platforms, have greatly enhanced the management of hereditary, chronic, and fatal illnesses. The effectiveness, safety, and specificity of these treatments have been further improved by advancements in bioprocessing methods and drug delivery systems. But despite these amazing advancements, biopharmaceuticals still have to deal with a number of new problems, including complicated production procedures, high production costs, stability problems, immunogenicity, and strict regulations. To guarantee greater accessibility, affordability, and long-term therapeutic success, these issues must be resolved. The current developments in biopharmaceuticals are highlighted in this abstract, along with the main obstacles that must be addressed to ensure their continuous expansion and therapeutic impact.
Keywords: Monoclonal antibodies, Drug delivery system, Recombinant DNA technology, Immunogenicity, General therapy

SARCOPENİA AND COGNİTİVE IMPAİRMENT: MECHANİSMS OF THE "MUSCLE-BRAİN AXİS" AND THERAPEUTİC PERSPECTİVES

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Abstract
Sarcopenia and cognitive impairment frequently co-occur in older adults, forming a mutually reinforcing, negative feedback loop mediated by the so-called "muscle-brain axis." This comorbidity significantly increases the risk of falls, fractures, disability, and progression to Alzheimer's disease, resulting in a marked decline in quality of life and an elevated public health burden. Key underlying mechanisms include structural and functional deterioration of neuromuscular junctions, chronic inflammation, metabolic disturbances, oxidative stress, proteostasis disruption, endocrine and secretome dysregulation, and gut microbiota dysbiosis. Recent research highlights the role of the "microbiota-gut-brain-muscle axis," opening new non-invasive intervention avenues, such as targeted prebiotics and probiotics, dietary pattern modifications, and experimental fecal microbiota transplantation. The aim of this presentation is to elucidate the system-level mechanistic interconnections, present the shared pathophysiological foundations of sarcopenia and cognitive decline, and provide an overview of emerging integrative, multi-target therapeutic strategies, thereby supporting the development of early diagnostic tools, risk stratification approaches, and personalized interventions.

Keywords:
Sarcopenia, cognitive impairment, muscle-brain axis, microbiota-gut-brain-muscle axis, inflammation, oxidative stress, proteostasis, personalized therapy

Funding:
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DESIGN AND FABRICATION OF COMPRESSED NATURAL GAS (CNG) POWERED GROUNDNUT SHELLING MACHINE

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Abstract
This project focuses on the design, fabrication, and performance evaluation of a CNG-powered groundnut shelling machine for small- and medium-scale farmers. The machine addresses the drudgery of manual shelling and the high operating cost and environmental concerns associated with petrol-driven shellers. A 3.5 hp compressed natural gas (CNG) internal combustion engine serves as the prime mover, driving a shelling mechanism based on combined impact and rubbing actions using a spiked cylindrical drum and concave assembly. Performance evaluation revealed enhanced shelling efficiency, increased throughput, and reduced kernel damage relative to manual methods. The use of CNG ensured cleaner combustion, lower fuel cost, and suitability for off-grid rural operations. Locally sourced materials were employed to enhance affordability, durability, and ease of maintenance.
Keywords: Groundnut shelling machine, CNG engine, agricultural mechanization, shelling efficiency, post-harvest processing.

SECOND-LAW ANALYSİS OF MAGNETO-BİOCONVECTİVE MARANGONİ MAXWELL NANOFLUİD FLOW OVER A POROUS ROTATİNG DİSK

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Abstract
Rotating-disk systems involving complex nanofluids have important applications in thermal management devices, chemical processing, bioengineering systems, cooling of rotating machinery, and energy conversion technologies where minimization of irreversibilities is essential. Inspired by these applications, this study presents a second-law thermodynamic analysis of magneto-bioconvective Marangoni Maxwell nanofluid flow over a porous rotating disk. The flow is driven by surface-tension gradients and disk rotation, while the effects of a transverse magnetic field, porous medium resistance, and bioconvection induced by motile microorganisms are incorporated. Appropriate similarity transformations reduce the governing nonlinear partial differential equations to a coupled system of ordinary differential equations, which are solved numerically. Entropy generation due to heat transfer, fluid friction, magnetic field, and porous medium irreversibilities is quantified, and the Bejan number is evaluated to identify the dominant sources of irreversibility. The results reveal that increasing magnetic and elastic parameters intensifies entropy generation, whereas enhanced bioconvection and Marangoni effects can suppress irreversibilities near the disk surface. The findings provide useful insights for the optimal design of rotating-disk systems using advanced nanofluids.
Keywords: Thermodynamic second-law; Marangoni fluid flow; Maxwell fluid; Bejan number; Entropy generation.

ZİNC İNFLUENCE ON STRUCTURAL, OPTİCAL AND PHOTOLUMİNESCENCE PROPERTİES OF SNO_2 NANOSTRUCTURES SYNTHESİZED VİA SOLUTİON COMBUSTİON TECHNİQUE

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Abstract
In this work, a low-cost solution combustion synthesis approach was used to synthesize Zn-doped SnO_2 nanostructures. X-ray diffraction (XRD) and field emission scanning electron microscopy (FESEM) with energy dispersive spectroscopy (EDS) were used to analyse the structural analysis and morphological characteristics with elemental composition of resultant samples. The tetragonal rutile structure is confirmed by XRD studies, which show that an increase in Zn^{2+} concentration causes the average crystallite size to decrease from 8.6 nm to 7.1 nm. FESEM with energy dispersive X-ray spectroscopy EDS confirms the formation of nanoparticles and composed of the expected elements tin, oxygen and zinc, without any other impurity. UV-visible spectroscopy reveals that, band gap energy values decrease from 3.71 eV to 3.38 eV as Zn concentration increases. The formation of pure phase SnO_2 is also confirmed by Fourier transform infrared spectroscopy (FTIR), which corresponds to O-H, C-H, Sn-OH, and Sn-O-Sn functional groups. The excess of oxygen vacancies within the host structure is confirmed by photoluminescence spectra (PL) of Zn-doped SnO_2 nanostructures, which show a green emission at 524 nm and a near band edge emission or UV emission at 454 nm. Raman spectra also verify the presence of defects such as oxygen vacancies and the reduction of crystallite size. These flaws or defects plays an important role in determining the magnetic properties and enhancement in sensing response of SnO_2 nanostructures.

Keywords: band gap energy, functional groups, oxygen vacancies, green emission

LETHAL AUTONOMOUS WEAPONS SYSTEMS (LAWS) AND STATE SOVEREİGNTY: ETHİCAL AND LEGAL CHALLENGES

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Abstract
Lethal Autonomous Weapons Systems (LAWS), often referred to as "killer robots," represent a transformative development in military technology, enabling machines to independently select and engage targets without meaningful human intervention. This paper examines the profound **ethical and legal challenges** posed by LAWS to traditional notions of **state sovereignty**. Ethically, the delegation of life-and-death decisions to algorithms raises concerns about human dignity, moral accountability, and the dehumanization of warfare, as machines lack the capacity for compassion, contextual judgment, or ethical discernment required under principles such as the Martens Clause. Legally, LAWS complicate compliance with **international humanitarian law** (IHL), including rules of distinction, proportionality, and necessity, while creating accountability gaps that undermine command responsibility and state obligations. From a sovereignty perspective, the proliferation of LAWS risks eroding states' monopoly on the legitimate use of force, potentially facilitating violations of territorial integrity, escalating arms races, and shifting power dynamics toward technologically dominant actors. Drawing on ongoing international debates—including UN General Assembly resolutions, calls from the Secretary-General and ICRC for a legally binding instrument by 2026, and positions from major powers such as the United States' opposition to a ban versus growing support for prohibitions—the paper argues that unregulated LAWS threaten the Westphalian order by blurring lines between human agency and automated violence. It concludes that new international norms, combining prohibitions on unpredictable or anti-personnel systems with regulations ensuring meaningful human control, are essential to preserve ethical standards, legal accountability, and sovereign authority in an era of digital warfare.

Keywords: Lethal Autonomous Weapons Systems, LAWS, Killer robots, Autonomous weapons, State sovereignty, Meaningful human control and international humanitarian law, etc.

MATERNAL CARE RİSK FACTORS DURİNG PRENATAL AND POSTNATAL CONDİTİONS İN PAKİSTAN: CHALLENGES AND STRATEGİES

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Abstract
Background
Maternal mortality is a major concern in various countries across the globe and particularly Pakistan. Access to maternal healthcare services is an essential condition for improving women's health. Pakistan, being one of the low-income countries, also reported a high Maternal Mortality Rate of 186 deaths per 100,000 live births in 2019. Though, a signatory of Agenda 2030, the country still lags behind considerably in achieving Sustainable Development Goals (SDGs).
Objective: **The present study was designed to evaluate the experiences, perceptions and expectations of pre-birth and post-birth women regarding utilization and delivery of maternal healthcare services in Pakistan.**
Methodology: **A quantitative study design was used. Convenient sampling technique was adopted to identify the respondents. Interviews were conducted using structures interview guide. The sample size was: pre-birth women (*n* = 100) and post-birth women (*n* = 100). All interviews were recorded after getting permission from the respondents.**
Results: **The results of the present study concluded that the overall quality of the maternal care services provided in Pakistan was very poor. The age group for the pre-birth respondents was 23–43 years while for post-birth group It was 23–35 years. Majority of mothers 60.8% monthly household income was 20000-40000 and 47.0% mothers education was up to primary. Majority of the mothers 70.3% were delivered baby by caesarian section and 16.1% mothers give birth at home. Majority of the women 65.3% were not involved in the decision-making process, and 34.3 % mothers having less than four ANC visits. 20 % supervisor/attendant during delivery was traditional birth attendants (TBAs /Dai)**
Conclusion: **By making inclusive policies at national level to improve the healthcare facilities that can reduced maternal mortality rate in Pakistan. The Pakistani pregnancy outcomes are much worse. Reasons for these poorer outcomes likely the reproductive age of women, low socioeconomic status, poor education level, birth at home and non skilled staff. There is a need to lunched a emergency service for a pregnant women, so that she can reached hospital at time and reduced maternal mortality. The cost of maternal care was quite high and not affordable for all, therefor, Government should be make polices for priceless treatment for antenatal care, postnatal care of women. As well as need to improve the education system, produced more nurses so that trained staff can be attend pregnancies.**

Keywords: Maternal mortality, Healthcare, Antenatal care, Postnatal care, Pakistan

FIRST-PRINCIPLES INSIGHTS INTO DOUBLE PEROVSKITE HYDRIDES K_2MGCOH_6 AND RB_2MGCOH_6 FOR NEXT-GENERATION HYDROGEN STORAGE

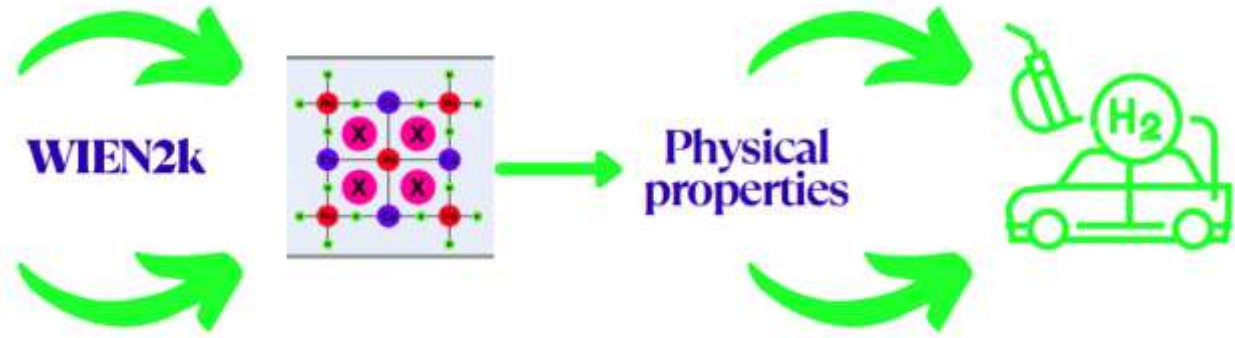
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Abstract

Using first-principles DFT calculations, this study looks at the possible use of two new double perovskite hydrides, K_2MgCoH_6 and Rb_2MgCoH_6, for storing hydrogen in solid form. Phonon dispersion and AIMD simulations confirmed the stability of the structure, making sure it would hold up in normal conditions. We looked at the hydrogen storage capacity and desorption enthalpy. K_2MgCoH_6 performed better and had a lower ΔH, which means it is more reversible. Elastic constants show that the material is mechanically stable, and the fact that the bulk moduli are relatively low suggests that hydrogen can move easily through it. Both materials have indirect wide band gaps, but K_2MgCoH_6 has stronger H-Co interactions. Thermodynamic parameters also show that these compounds can work well in real-world situations. In general, K_2MgCoH_6 is more stable and easier to store than Rb_2MgCoH_6, which makes it a better choice for hydrogen energy applications.

Keywords: DFT · Wien2k · X_2MgCoH_6 (X = K, Rb) · Perovskite Hydrogen Storage

Graphical Abstract



CULTURAL INFLUENCES ON PREGNANCY CARE AMONG RURAL WOMEN İN BANGLADESH: AN APPLİCATİON OF THE HEALTH BELİEF MODEL

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Abstract

Pregnancy extends beyond a purely biomedical event and is deeply embedded within social and cultural constructions. Although the use of biomedical services has increased in rural Bangladesh, decision-making around pregnancy care remains complex and multidimensional. This study addresses a significant gap by examining how rural women's beliefs and lived experiences shape their engagement with care facilities. Guided by the Health Belief Model (HBM), the research critically analyzes women's health-seeking behaviors, perceived risks, and behavioral orientations. A phenomenological qualitative design was employed, using purposive sampling to recruit 20 participants. Data were collected through in-depth interviews and thematically analyzed to identify recurring patterns related to beliefs and care-seeking practices. The findings align with the HBM's three core dimensions- preventive health behavior, sick-role behavior, and utilization of health services. Findings revealed that, in rural contexts, elder women often hold primary decision-making authority, and their socio-cultural norms and prior experiences strongly influence care-seeking patterns, preferred health services, dietary practices, and reliance on traditional healers (*Kabiraj*). The perception of pregnancy as a natural, non-medical process- rooted in longstanding cultural beliefs- contributes to reduced uptake of routine biomedical check-ups.

Key words: Pregnancy, Cultural beliefs, Care-seeking beahviour, Health Belief Model,

THE ROLE OF CHRİSTİAN RELİGİOUS EDUCATİON TEACHERS İN SHAPİNG THE CHARACTER OF JUNİOR HİGH SCHOOL

Students in the Digital Era

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Abstract
The development of digital technology has transformed the landscape of education and the social lives of adolescents, including junior high school students. This literature-based study aims to analyze the role of Christian Religious Education (CRE) teachers in shaping students' character amid the dynamics of digital media. The main issues identified include the weakening of faith value internalization due to exposure to negative content, low ethical digital literacy among students, and the limited capacity of CRE teachers to integrate biblical values into online learning contexts. This research employs a qualitative approach through a review of recent literature to identify effective character formation strategies in the digital era. The findings indicate that effective character building combines teacher role modeling, innovative learning methods (such as project-based and reflective learning), and the integration of biblical values in digital media use. It is concluded that strengthening teacher training, developing value-based digital literacy curricula, and fostering school–home collaboration are strategic steps to support the character development of junior high school students in the digital age.
Keywords: Christian Religious Education, character, junior high school, digital literacy

ASSESSING LAND USE/LAND COVER DYNAMICS AND THEIR EFFECTS ON ECOSYSTEM SERVICE VALUES: A SPATIO-TEMPORAL APPROACH IN MILA, ALGERIA (1994–2024)

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ABSTRACT

Monitoring spatio-temporal changes in land use and land cover (LULC) and assessing their effects on ecosystem service values (ESV) are essential for sustainable development and resource management. Over the past three decades, the Mila region in eastern Algeria, covering approximately 69,052 hectares, has undergone substantial land transformation. The municipality of Mila, located along a minor tributary of the Oued Rhumel and dominated by the Marchau Mountain, represents one of the country's most ecologically and environmentally significant zones.

In this study, four satellite images acquired between 1994 and 2024 were analyzed to map land use and land cover classes and evaluate spatial and temporal changes in ESV. Visual interpretation and supervised classification techniques were applied to derive five main LULC categories: Urban Areas, Active Agricultural Land, Vegetation, Bare Soil, and Water Bodies. These classes were combined with ecosystem service value coefficients from established global databases to estimate temporal changes in ESV across the study period.

The results revealed a notable decrease in vegetation (shrubs and grasslands), accompanied by a significant increase in built-up areas and cultivated lands. Additionally, the extent of water bodies increased, primarily due to the construction of the Beni Haroun Dam. These land dynamics reflect a progressive transformation of the landscape driven by urban expansion, agricultural intensification, and demographic growth.

This study highlights the ecological importance of the Mila region in maintaining landscape functionality and ecosystem stability. It provides a scientific and cartographic reference that supports sustainable land resource management and ecological planning in semi-arid environments. The findings also demonstrate the usefulness of remote sensing and GIS-based approaches in quantifying the spatial and temporal dynamics of ecosystem service values.

Keywords: Land Use-Land cover, Ecosystem service values, Spatio-temporal change, Landscape dynamics, Remote sensing, Mila.

MENTAL HEALTH CHALLENGES OF BADAKHSHAN WOMEN İN REMOTE AREAS

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Abstract:
Women living in the remote regions of Badakhshan face a unique set of mental health challenges shaped by geographical isolation, cultural norms, economic hardship, and limited access to healthcare services. Despite their resilience, many women experience high levels of psychological distress resulting from chronic poverty, social restrictions, gender inequality, and the emotional burden of caregiving within traditional family structures. Barriers such as long distances to medical facilities, lack of trained mental health professionals, and stigma surrounding mental illness further prevent early diagnosis and appropriate treatment. This study explores the interconnected social, cultural, and environmental factors that contribute to mental health vulnerabilities among Badakhshan women, highlighting issues such as postpartum depression, anxiety disorders, trauma from natural disasters, and stress linked to insecurity and displacement. It also examines community coping mechanisms, informal support networks, and the potential role of local women leaders in promoting mental well-being. The findings underscore the need for culturally sensitive mental health interventions, improved rural healthcare infrastructure, and policies that prioritize women's psychological health in mountainous and marginalized regions. Addressing these challenges is essential for enhancing the overall well-being, resilience, and empowerment of women in Badakhshan's remote communities.

SYNERGİZİNG DEEPTECH AND BLOCKCHAİN: UNLOCKİNG THE FUTURE OF DECENTRALİZED INNOVATİON

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Abstract
Blockchain technology and deeptech have evolved as an innovative revolutionary system for secure, decentralized transactions and which can answer intricate glitches to increase the profitability in various domains. However, as its application grows across various industries, ensuring the security of blockchain networks becomes increasingly critical. The security algorithms implemented in the networks of Blockchain perform a fundamental part in ensuring CIA (Confidentiality, Integrity and Availability) of data in decentralized systems. When applied to **DeepTech**, these security mechanisms have far-reaching implications across various trailblazing such as artificial intelligence (AI), biotechnology- genomics, quantum computing-cryptography, and more. This paper provides a wide-ranging literature review on the security apprehensions related with blockchain technology. It explores common attack vectors, examines existing security mechanisms, and highlights ongoing challenges in securing blockchain systems. Furthermore, this paper explores the applications of blockchain security algorithms in Deeptech across several domains.

EFFECTİVENESS OF THE GOVERNMENT INTERNAL CONTROL SYSTEM (SPIP) THROUGH INSPECTORATE SUPERVİSİON İN THE EASTERN LUWU DİSTRİCT GOVERNMENT, INDONESİA

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ABSTRACT

This study aims to analyze the effectiveness of the Government Internal Control System (SPIP) through the supervisory functions carried out by the Inspectorate of East Luwu Regency. SPIP, as mandated by Government Regulation No. 60 of 2008, plays a critical role in ensuring effective, efficient, transparent, and accountable public governance. The study employs W. Jack Duncan's organizational effectiveness theory, which consists of three indicators: goal attainment, integration, and adaptation. A descriptive qualitative approach was used, with data collected through in-depth interviews, documentation, and observation.

The findings indicate that, in terms of goal attainment, the Inspectorate has actively performed its functions related to audit, review, evaluation, and monitoring. However, challenges remain regarding the follow-up of audit findings, particularly at the village level. In the aspect of integration, SPIP supervision has involved multiple stakeholders and fostered coordination among regional government offices, although this coordination has not yet reached optimal levels. In relation to adaptation, both the Inspectorate and regional apparatus units have made meaningful efforts to adjust to supervisory demands and improve the quality of SPIP implementation. Still, capacity building and technical understanding at the implementer level need further strengthening.

The study concludes that the effectiveness of SPIP through Inspectorate supervision in East Luwu Regency is generally adequate but requires improvements in the follow-up of audit findings, enhancement of cross-sectoral collaboration, and continuous capacity development for regional apparatus units. The results of this study are expected to contribute recommendations for strengthening the comprehensive implementation of SPIP.

Keywords: SPIP, effectiveness, supervision, Inspectorate, audit, evaluation, adaptation, integration.

INTRODUCTION

The latest statistics from the Corruption Eradication Commission (KPK) show that throughout 2023, 208 cases of corruption have been handled, with state losses reaching Rp 1.2 trillion. Of these, 45% of cases occurred in local government environments, indicating that internal control systems at the regional level are still weak. This further underscores the importance of strengthening the implementation of SPIP as an instrument for preventing corruption.

According to data from the Ministry of Home Affairs in 2023, out of a total of 542 local governments in Indonesia, only around 55% have reached level 3 (integrated) in terms of APIP capability. More specifically, in Eastern Indonesia, the percentage is even lower, at only 35%. This indicates that there is still a significant gap in the internal oversight capabilities of local governments.

Nationally, out of 542 local governments in Indonesia, 298 (55%) have reached Level 3 (integrated), while the remaining 244 (45%) are still below Level 3. This indicates that nearly half of local governments in Indonesia still need to improve their APIP capabilities. Meanwhile, in Eastern Indonesia, only 35% of local governments have reached Level 3, with a 20% gap between national achievements and those in Eastern Indonesia. This indicates a significant gap in the development of APIP capabilities between western and eastern regions (Wahyuddin 2023).

East Luwu Regency, as one of the autonomous regions in South Sulawesi Province, faces challenges in implementing SPIP. According to the Audit Report (LHP) by the State Audit Agency (BPK) on the Local Government Financial Report (LKPD) of Luwu Timur Regency for the year 2023, despite successfully maintaining an Unqualified Opinion (WTP), there are still several notes regarding weaknesses in the internal control system that require serious attention.

The Inspectorate of East Luwu Regency, as the Internal Government Oversight Agency (APIP), plays a strategic role in overseeing the implementation of the Internal Control System (SPIP). Based on data from the 2023 Performance Report of the Inspectorate of Luwu Timur Regency, supervision was conducted on 45 Regional Government Agencies (OPD) with a total of 156 supervisory activities, including regular audits, performance audits, reviews, evaluations, and monitoring. From these oversight activities, various issues related to financial and asset management were identified, necessitating improvements to the internal control system. The Government Internal Control System in OPDs serves as the driving force of the organization; in other words, without internal control, the likelihood of issues or fraud increases significantly (Kiayi, Canon, and Mattoasi 2023).

This control system will function effectively if all elements involved in the government have the knowledge, ability, and willingness to implement it jointly and sustainably (Aisyah Nur 2023).

The Government Internal Control System must be sustainable from planning, implementation, supervision, to accountability. Since 2011-2023, East Luwu Regency has received an Unqualified Opinion (WTP), which is not unrelated to the role of the Luwu Timur Regency Inspectorate in implementing the Government Internal Control System. However, in reality, there is still a perception that the Inspectorate, as the government's internal auditor, has not yet optimally fulfilled its duties and functions (Nopirina 2023).

In Government Regulation of the Republic of Indonesia Number 60 of 2008, Article 49, the Inspectorate is part of the Internal Government Supervisory Apparatus (APIP), where Government Regulation of the Republic of Indonesia Number 60 of 2008, Article 48, paragraph (1) states that internal government supervision is carried out through: 1) Audit; 2) Review; 3) Evaluation; 4) Monitoring; and 5) Other Oversight Activities. This undoubtedly serves as a benchmark for the success of the Inspectorate's role as an oversight body in the implementation of the Government Internal Oversight System (SPIP).

In corruption prevention, the role of SPIP becomes increasingly important. Data from the KPK Prevention Directorate shows that throughout 2024, there were 128 corruption cases in South Sulawesi that were indicated to have occurred due to weak internal control systems, with potential state losses reaching Rp 91 billion. (https://wamanews.id//).

To achieve effective, efficient, transparent, and accountable management of state finances, Ministers, Agency Heads, Governors, and Mayors/Regents are required to exercise control over the conduct of government activities (Saa'dillah 2023).

In Government Regulation No. 60 of 2008, Chapter I, Article 1, point 1, concerning the Government Internal Control System (SPIP), it is explained that the Government Internal Control System (SPIP) is an integral process in the actions and activities carried out continuously by leaders and all employees to provide adequate assurance that the organization's objectives will be achieved (Muh. Aril surya Ananda, 2019).

SPIP is an internal control system that is implemented comprehensively within the central and regional government. This means that the system must be supported by all elements within the government, from human resources to the tools or systems used (Manialup, Nangoi, and Morasa 2017).

The development of SPIP continues to be carried out by encouraging the implementation of SPIP not only as an obligation but more as a necessity for an organization. The issuance of BPKP Regulation No. 05 of 2021 on the Self-Assessment of the Maturity of the Implementation of the Integrated Government Internal Control System (SPIP) in Ministries/Agencies/Local

Governments is an effort to implement bureaucratic reform in the area of strengthening internal oversight and control within an organizational unit. Based on the results of monitoring by the Internal Government Supervisory Agency (APIP) in 2021, data shows that out of 41 Regional Government Agencies (OPD) in Luwu Timur Regency, only 14 have a risk register related to fraud/corruption prevention. For further details, the data is presented below.

The results of the Baseline Maturity Assessment of Integrated Government Internal Control (SPIP) in East Luwu Regency for the year 2023, conducted by the State Audit Agency (BPKP), as stated in BPKP RI Letter No. S776/PW21/3/2023 dated December 6, 2023, regarding the Results of the Baseline Maturity Assessment of the Implementation of the Integrated SPIP in Luwu Timur Regency, it was noted that Luwu Timur Regency meets the characteristics of SPIP implementation maturity at Level 3 (Defined) with a score of 3.156. As stipulated in the guidelines of BPKP Regulation No. 05 of 2023, level 3 means that the Luwu Timur Regency Government has been able to define its performance well, and its performance achievement strategies are relevant and integrated, while control implementation has been carried out but is not yet effective.

In accordance with legal regulations, the Government Internal Control System (SPIP) serves as a guideline for implementation and a benchmark for assessing the effectiveness of SPIP implementation. Government Regulation of the Republic of Indonesia No. 60 of 2008 on the Government Internal Control System states that the District/Municipal Inspectorate is the Internal Government Oversight Agency directly accountable to the Regent/Mayor. The Inspectorate also plays a role in ensuring that the implementation of SPIP in local governments runs well in accordance with the provisions, as well as conducting regular monitoring.

By viewing the inspectorate's duties as the Government Internal Supervisory Agency (APIP), it is clear that the Government Internal Control System (SPIP) is implemented by each region (Indriani and Siswantoro 2023). The problem that arises in East Luwu Regency is that the instruments supporting this control system are not yet functioning properly and are not integrated, such as socialization related to the Government Internal Control System, training for all officials who are part of the system, and the availability of a budget to support the government's internal control system so that it runs properly (Saputri and Ade 2018).

Another issue is that there is no legal framework to support government officials in conducting self-assessments of the integrated internal control system in the form of a Regent's Decree on the Establishment of a Task Force for Assessing the Maturity of Integrated SPIP Implementation. As a result, in 2022, the East Luwu Regency Government was unable to enter data and conduct self-assessments on the integrated SPIP application website.

RESEARCH METHODOLOGY

This study uses qualitative research. The choice of qualitative research is based on the need to gain a deep and comprehensive understanding of the implementation of SPIP through supervision by the Inspectorate, where the phenomenon being studied requires natural exploration and in-depth interpretation of various perspectives from informants.

Information is obtained from interviews or direct observation in the field on the issues being studied. The data collection techniques used in this research employ the triangulation method as follows: Interviews, Observations, Documentation. The data analysis process is as follows: Data Collection, Data Reduction, Data Display, Drawing Conclusions, and Verification.

RESULTS AND DISCUSSION

According to W. Jack Duncan (1981), goal attainment is an objective measure of an organization's effectiveness, focusing on pre-formulated end results. An organization is considered effective if it can realize its targets, vision, mission, and strategic objectives in a tangible and measurable manner.

Based on the research findings, it can be concluded that the oversight conducted by the Inspectorate of Luwu Timur Regency has made a significant contribution to achieving the primary objectives of the Government Internal Control System (SPIP). This is evident from the achievement of the SPIP Maturity Index, which reached a value of 3.120 in 2023, although it has not yet reached the set target of 3.3380 or only 93.47% of the target. Nevertheless, this figure shows an increase compared to the previous year, which only reached 3.031, resulting in an increase of 0.089 points.

The success in achieving SPIP objectives is closely tied to the active role of the Inspectorate as an internal oversight body that not only functions as a supervisor but also as a mentor and partner for Regional Government Agencies (OPD). As stated by the Inspector of Luwu Timur District, oversight is not merely about finding faults but about driving continuous improvement in the local bureaucratic system. This approach has proven effective, as there have been positive changes from OPDs that no longer view audit findings as mere administrative documents but rather as materials for system improvement.

The effectiveness of oversight is also reflected in the high rate of follow-up on recommendations, reaching 89.63% in 2023. Out of a total of 1,669 recommendations issued, 1,496 recommendations have been properly followed up by LGAs and their affiliated villages. This figure demonstrates the strong commitment of all stakeholders to improving the internal control system. Additionally, the target for reducing the value of findings based on the Audit Report (LHP) was also achieved with a realization of 119.51%, far exceeding the set target of 80%.

The results of the study also revealed that the Inspectorate's supervision has succeeded in raising awareness among OPD leaders of the importance of internal control. This is in line with the opinion of the Head of the Planning and Finance Subdivision of the Regional Secretariat, who stated that the Inspectorate's contribution has been significant in achieving the objectives of the SPIP. Through regular audit, review, evaluation, and monitoring activities, the Inspectorate is able to identify weaknesses in governance and provide constructive recommendations for improvement.

The shift in paradigm from a compliance-based approach to a risk-based approach also demonstrates the success of the Inspectorate's oversight. OPDs no longer view SPIP as merely a regulatory obligation but have adopted it as an applicable and adaptive managerial system. This is evident from the testimony of one OPD, which stated that the Inspectorate's assistance has helped them better understand the importance of internal control and gradually begin to improve their documentation, reporting, and risk mapping.

Despite showing positive results, the implementation of SPIP through the Inspectorate's oversight still faces several challenges. One of the main challenges is the presence of significant financial findings, amounting to Rp5,159,795,782.33 in 2023. Although this figure shows a decrease compared to the previous year, the existence of these financial findings indicates that the internal control systems in some OPDs still need to be strengthened.The follow-up rate for financial findings also varies across supervision regions. Irban II achieved the best results with a follow-up rate of 99.92%, while Irban I and III remained at 75.38%, and Irban IV reached 81.80%. This disparity indicates that the commitment and capacity of OPDs to follow up on findings are still uneven, necessitating more intensive strengthening in certain regions.

The research results show that the Inspectorate plays a very strategic role in the implementation of the Integrated SPIP, which includes SPIP, Implementation of Activity Control Evaluation (IEPK), Institutional Risk Management (MRI), and APIP Capability. The Inspectorate acts as a key player because it performs vital consulting and assurance functions in all four components.

In its consulting function, the Inspectorate provides guidance and assistance to OPDs that do not yet understand the concept of risk management or other aspects of SPIP. Meanwhile, in its assurance function, the Inspectorate conducts periodic evaluations of SPIP implementation and risk management in each OPD. The combination of these two functions enables the Inspectorate

to not only supervise but also build the capacity of OPDs in implementing internal control systems.

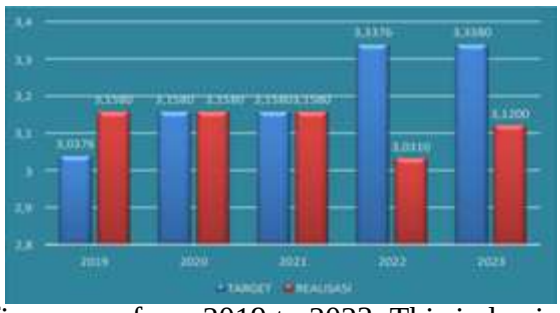
The effective implementation of SPIP through the Inspectorate's oversight has had a positive impact on improving the accountability and transparency of regional financial management. This is evident from the improved quality of financial reports and the reduction in potential irregularities. Efforts to recover state losses amounting to IDR 6,491,065,132.16 in 2023 also demonstrate a strong commitment to safeguarding state assets.

Improved accountability is also reflected in the increasingly better reporting and documentation systems across all government agencies. The guidance provided by the Inspectorate has helped government agencies in preparing more organized and systematic documents, thereby facilitating the audit and evaluation processes. This ultimately contributes to the creation of better governance that is responsive to the needs of the community.

Comparison Between Performance Realization & Performance Targets for 5 Consecutive Years (2019-2023)

Indeks Maturitas SPIP
Target Terhadap Realisasi selama 5 (lima) Tahun
(2019-2023)

INDIKATOR	SATUAN	TAHUN	TARGET	REALISASI	CAPAIAN
Capaian Indeks Maturitas SPIP	Nilai	2019	3,0376	3,1580	103,96
		2020	3,1580	3,1580	100,00
		2021	3,1580	3,1580	100,00
		2022	3,3376	3,0310	90,81
		2023	3,3380	3,120	93,47



Maturity Index (SPIP) in East Luwu Regency over five years, from 2019 to 2023. This index is used to measure the extent to which the internal control system in the local government environment has been running effectively and in accordance with standards.

In 2019, the target value for the SPIP index was 3.0376, and the achieved value was 3.1580. This means the target was exceeded by 103.96%. In 2020 and 2021, the target and achievement were the same, at 3.1580, resulting in a 100% achievement rate—the target was met exactly. In 2022, the target increased to 3.3376, but the achieved value was only 3.0310, resulting in a 90.81% achievement rate—meaning the target was not met. In 2023, the target was even higher at 3.3380, but the actual achievement was only 3.1200, resulting in an achievement rate of 93.47%, which means it was still below the target.

In the first three years (2019–2021), the SPIP index achievement was very good and even exceeded the target. However, in the last two years (2022–2023), there was a decline in achievement, although the value was still above 3 (the “developing” category).

This indicates that local governments need to improve SPIP performance to achieve higher targets in the coming years.

Several research findings explain that audit, review, evaluation, and monitoring are important elements in the indicators of achievement of the Government Internal Control System (SPIP). These four aspects are the main tools for assessing the extent to which local government organizations are able to achieve their objectives effectively and efficiently.

Through audit activities, the Inspectorate can identify weaknesses in work processes, budget utilization, and compliance with regulations. Reviews provide insights into performance and reporting systems, while evaluations are used to assess whether a program or policy is aligned with its objectives. Monitoring is conducted continuously to ensure that follow-up recommendations are implemented and system improvements continue. In other words, the existence of audits, reviews, evaluations, and monitoring is not only a form of supervision but also a tangible indicator of an organization's success in achieving the objectives formulated in the SPIP system.

An audit is the process of identifying issues, analyzing, and evaluating evidence in the performance of the tasks and functions of government agencies, consisting of performance audits and audits with specific objectives. The Inspectorate of Luwu Timur Regency has conducted both performance audits and audits with specific objectives on OPDs within the scope of Luwu Timur Regency.

As stated in Government Regulation of the Republic of Indonesia Number 60 of 2008, Article 50, paragraph (3), audits with specific objectives include audits that are not included in performance audits. The specific-purpose audits conducted by the Inspectorate of Luwu Timur Regency include: compliance audits, investigative audits, personnel audits, comprehensive audits of financial and asset management, special audits in response to public complaints, and audits of state financial calculations at the request of Law Enforcement Agencies (LEAs). Regarding the competence of auditors and P2UPD personnel in conducting audits, most have undergone relevant education and training (diklat), except for training on the calculation of state losses. Audit results are then communicated to the audited entity (obrik) in the form of preliminary findings through presentations or exposés of preliminary findings.

The audit conducted by the Inspectorate also took into account the risk register for OBRIK activities, tested the internal control system, and provided advice and input to OBRIK regarding areas requiring development related to SPIP.

However, the risk map prepared by the OPD is largely incomplete, appears to have been hastily put together, and sometimes fails to highlight risks that should be included in the risk map prepared by the OPD. In conducting this audit, the Inspectorate was hindered by the slow submission of documents by the OPD, which disrupted the smooth conduct of the audit and resulted in the Inspectorate being unable to fully fulfill its role.

Based on the audit conducted by the Inspectorate of Luwu Timur Regency, it can be concluded that through the performance audit, it is hoped that the performance of OPDs will be improved and there will be enhancements in the risk management process for strategic/priority programs of the Regional Leadership, with the objective of assessing compliance with applicable regulations, evaluating from the aspects of Economy, Efficiency, and Effectiveness (3E). Meanwhile, through the implementation of audits with specific objectives, such as audits of state financial calculations, the Inspectorate detects any misuse or fraud, examines documents, data, and transactions related to the calculation of state losses, evaluates whether the calculations were carried out correctly, using appropriate methods, and in compliance with applicable regulations.

A review, as explained in Government Regulation No. 60 of 2008 on the Government Internal Control System, Article 48(b), is a re-examination of evidence related to an activity to ensure that the activity has been carried out in accordance with established regulations, standards, plans, or norms.

Reviews conducted by the Inspectorate of Luwu Timur Regency include: review of the local government financial report (LKPD), review of the Work Plan and Budget, review of the Standard Cost Analysis (ASB), review of the Estimated Price (HPS), and review of the Regional Work Plan (RKPD). In conducting the review of the Local Government Financial Report (LKPD) of Luwu Timur District, the Inspectorate adheres to the 2018 Ministry of Home Affairs Regulation on the Implementation of LKPD Reviews based on the accrual basis. Article 87, Paragraph 10, Subparagraph (3) states that the review is conducted through activities including: tracing figures, requesting explanations, and analytical procedures. These activities serve as a sufficient basis for the Inspectorate to provide limited assurance on the local government financial statements that no material modifications are required to the financial statements to ensure they are presented in accordance with an adequate Internal Control System (ICS) and Government Accounting Standards.

The results of the review of the local government financial statements are stated in the form of a Reviewed Statement (PTD). This statement serves as the basis for consideration by external

parties of the BPK to subsequently conduct an audit of the Local Government Financial Statements (LKPD) of Luwu Timur Regency. If, during the review process, it is found that there are activities that do not comply with applicable regulations, clarification is sought from the relevant parties.

The review does not provide a basis for expressing an opinion, as it does not involve testing the accuracy of the substance of the documents but rather their compliance with the accounting standards as stipulated in Government Regulation No. 71 of 2010 on Government Accounting Standards, which replaces Government Regulation No. 24 of 2005 on Government Accounting Standards (SAP). 88 The implementation of the review of the Local Government Financial Statements (LKPD) of Luwu Timur Regency for the 2023 fiscal year is still far from the expected quality.

There are still significant corrections made by the BPK on the analytical procedure testing figures. One of the challenges faced during the review is the lack of updated knowledge among auditors, as the Inspectorate still uses the old analytical testing procedures when conducting analytical procedure testing on the 2023 Luwu Timur Regency LKPD, rather than adopting the latest analytical testing procedures. Therefore, it is necessary to conduct up-to-date training related to reviews to update the knowledge of auditors, as the challenge faced is that the Inspectorate is required to produce quality reviews to assist in realizing a clean, transparent, and accountable government.

Based on the implementation of the LKPD review by the East Luwu Regency Inspectorate, it was concluded that in the review process, the Inspectorate acted as a quality assurance body in order to ensure the reliability of the information presented in the East Luwu Regency LKPD, and it is hoped that the Inspectorate will become an early warning system that can reduce the findings of audits by the BPK.

Evaluation is a series of activities that compare the results or achievements of an activity with established standards, plans, or norms, and determine the factors that influence the success or failure of an activity in achieving its objectives. Evaluation indicators are the factors that influence the success or failure of an activity in achieving its objectives. Evaluation aims to assess the level of success in managing activities, through an assessment of management and implementation outcomes, as well as the challenges faced. The results of this assessment will then serve as the basis for evaluating the performance of future programs and activities. Therefore, it is hoped that the staff at the Inspectorate of Luwu Timur District will be equipped with the necessary skills to conduct such evaluation activities.

This performance evaluation is conducted quarterly, where the Luwu Timur Regency Inspectorate identifies factors that may hinder the achievement of objectives. Identification is carried out in accordance with technical guidelines for performance evaluation. Evaluation results are presented as recommendations and feedback to the agency in the form of an evaluation report.

In the evaluation process conducted by the Luwu Timur Regency Inspectorate, a common challenge is the delay in obtaining data from the relevant agencies. Additionally, there is a need to enhance competencies related to evaluation procedures. Evaluation activities are crucial because they enable proper program planning and risk management, which are key factors influencing government performance outcomes.

Based on the evaluation activities carried out by the Luwu Timur Regency Inspectorate, it is concluded that the evaluation activities assist OPDs in identifying factors that may influence the success or failure of an activity in achieving its objectives and provide recommendations and feedback as early as possible to minimize potential obstacles in the implementation of such activities.

Monitoring is the process of assessing the progress of a program or activity in achieving its established objectives. Monitoring indicators are the progress of a program/activity in achieving

its established objectives. One of the tasks of the Internal Audit Agency (APIP) is to provide guidance and support to government agencies, from the program planning process to the implementation of monitoring for the activity.

Monitoring is the process of assessing the progress of a program or activity in achieving its predetermined objectives. Monitoring indicators are the progress of a program/activity in achieving its predetermined objectives. One of the tasks of APIP is to provide guidance and assistance to OPDs, from the program planning process to the monitoring of activities.

Monitoring activities are the process of assessing the quality of the internal control system's performance. This oversight helps management in determining system improvements. The implementation of SPIP elements must be continuously monitored for continuous improvement. Monitoring is oversight by management and other designated employees in the performance of their duties as an assessment of the quality and effectiveness of the internal control system.

The process involved in monitoring and evaluation is simply the process of project/activity work so that it can find out “what is actually happening” between implementation (process) and the stated objectives. If deviations are found during the investigation or monitoring, immediate corrective measures are taken so that the gaps can be addressed immediately, or at least minimize the losses that arise.

The Inspectorate of Luwu Timur Regency has conducted monitoring of project implementation and monitoring of findings from inspections by the Regency Inspectorate, Provincial Inspectorate, and BPK that have not been followed up by the relevant agencies. Through continuous monitoring, agencies are encouraged to expedite the follow-up process on findings that have not yet been addressed. During the monitoring of follow-up actions on the audit findings of the South Sulawesi Provincial BPK Office conducted in December 2022 in Makassar, it was reported that the findings from the BPK Audit Report for the 2021 Fiscal Year that have been addressed by the Luwu Timur District Government have reached 90 percent, placing Luwu Timur in second place in terms of the speed of follow-up actions on audit findings by the BPK Regional Office of South Sulawesi Province. Data on the progress of follow-up actions on audit findings by the Inspectorate, as reported by the audited entities (audited entities) as of March 8, 2023, shows that out of a total of Rp 607,783,095 in audit findings by the Inspectorate, Rp 328,646,530 has been addressed, leaving Rp 328,646,530 still pending. This is where the Inspectorate needs to continuously monitor to ensure that all audit findings are followed up by the audited entities.

Monitoring activities of the internal control system aim to ensure that internal controls are functioning as expected and improved as needed; however, there are still challenges in the monitoring process. For example, in monitoring follow-up actions, a common challenge is that agencies often delay or fail to act promptly on audit findings. In monitoring project implementation, challenges that frequently hinder project progress include the unavailability of materials on-site, insufficient labor, and occasionally weather conditions that impede supervision activities.

Based on the results of monitoring conducted by the East Luwu Regency Inspectorate, it was concluded that the Inspectorate played a role in assisting management in determining improvements to the internal control system of OPDs within the East Luwu Regency government, from planning to the implementation of monitoring activities and following up on the implementation of recommendations that have been provided, ensuring that improvement measures are taken and implemented properly, and that identified weaknesses or risks are addressed appropriately.

The research findings indicate that organizational integration in the implementation of the Government Internal Control System (SPIP) in Luwu Timur Regency has seen significant progress, although it is still in the process of refinement. This finding aligns with Duncan's (1981) concept of integration, which emphasizes the importance of socialization, consensus-building,

and inter-organizational communication. The statement by the Functional Supervisor of P2UPD Madya that "integration in the implementation of SPIP is still a work in progress, but it is already much better than before" indicates a paradigm shift in the working relationship between the Inspectorate and Regional Government Agencies (OPD). This transformation is reflected in the change in mindset of OPDs, which have shifted from being passive objects of supervision to active subjects involved in internal control, demonstrating the collective internalization of SPIP values across all local government units.

The integration development strategy implemented by the Inspectorate of Luwu Timur Regency employs a multidimensional approach encompassing structural, communicative, and educational aspects. The establishment of joint forums, the implementation of continuous socialization, and direct assistance in the preparation of SPIP documents are manifestations of systematic efforts to create synergy between work units.

This approach does not only focus on the transfer of technical knowledge but also on building collective awareness of the importance of internal control as a shared responsibility. The implementation of two-way communication that values mutual respect, as stated by the Head of the Planning and Finance Section of the Health Department, reflects the evolution of working relationships from hierarchical-directive to collaborative-participatory, ultimately strengthening organizational cohesion in achieving SPIP objectives.

The involvement of the Regional Secretary as the highest coordinator of regional apparatus provides legitimacy and implementation power for SPIP integration efforts in East Luwu Regency. The statement by the Head of Planning and Finance of the Regional Secretariat emphasizing that "internal control is a shared responsibility, not the burden of one party" reflects the commitment of regional leaders in creating an organizational culture conducive to SPIP implementation.

Efforts to incorporate SPIP as part of the regional strategic agenda and the establishment of a cross-agency forum indicate that integration is not only being built at the operational level but also at the strategic and policy levels. This top-down approach provides the structural impetus needed to accelerate the integration process while ensuring the sustainability of the program through strong political and administrative support.

Research findings indicate that adaptation in the implementation of the Government Internal Control System (SPIP) at the Inspectorate of Luwu Timur Regency has been comprehensively implemented through various adjustment mechanisms in response to regulatory changes and external environmental dynamics. The concept of adaptation according to Duncan (1981), defined as an organization's ability to adjust to its environment, is manifested in practice through a responsive procurement and staffing process in line with changes in central government policy.

The Inspectorate demonstrates a high level of adaptability by actively following every change in rules or policies from the central government, particularly those related to the supervision and implementation of SPIP, through participation in technical guidance (bimtek) and the implementation of circular letters from the State Audit Agency (BPKP) as the primary guidelines for their operations.

The operational adaptation mechanisms implemented by the Inspectorate of Luwu Timur Regency reflect a systematic and structured approach in responding to regulatory changes. When policy changes occur, the organization not only makes internal adjustments to Standard Operating Procedures (SOPs) but also implements a comprehensive socialization process for all Regional Government Agencies (OPDs) to ensure consistent understanding and implementation.

This aligns with the theoretical framework emphasizing the importance of adaptation as an indicator of an organization's effectiveness in addressing rapid and complex external environmental changes. This adaptation process is not passive but proactive and responsive, demonstrating the organization's ability not only to follow changes but also to anticipate and prepare for future dynamics.

Innovation in the implementation of SPIP adaptation is evident in the development of more detailed risk mapping, including the identification and mitigation of digital risks such as data and application misuse. The Inspectorate has implemented a more comprehensive risk management approach by encouraging each OPD to independently compile a risk register, reflecting efforts to build a risk-aware culture within the local government environment. Additionally, the development of the digital application "Periksaki" as a communication and consultation platform between the Inspectorate and OPDs demonstrates significant technological adaptation capabilities. This application not only enhances the efficiency of the consultation process but also provides an automated documentation system that facilitates a more structured and accountable oversight process.

The transformation of the audit approach undertaken by the Inspectorate demonstrates a significant evolution in the implementation of SPIP. The shift in focus from administrative audits to risk-based audits and data integrity reflects the organization's ability to adapt its oversight methodologies to the complexities of modern governance. This approach not only assesses procedural compliance but also integrates risk assessment and information reliability into the decision-making process. This shows that adaptation in SPIP is not limited to regulatory adjustments but also involves improving the capacity of a more comprehensive and prevention-oriented oversight methodology.

CONCLUSION

The effectiveness of SPIP through the supervision of the Inspectorate in the East Luwu Regency Government is considered quite effective, particularly in terms of achieving objectives. This is demonstrated by the Inspectorate's commitment to carrying out its functions of auditing, reviewing, evaluating, and monitoring the implementation of internal controls in OPDs. The gradual implementation of SPIP has led to improvements in regional financial management that are more accountable and transparent. Integration in the implementation of SPIP is reflected in the coordination and collaboration between the Inspectorate and OPDs. The Inspectorate not only acts as a supervisor but also as an active mentor, providing guidance, consultation, and supervision to unify understanding and the implementation of structured internal controls across all levels of local government. The adaptation aspect demonstrates the Inspectorate's high level of responsiveness to regulatory changes and technological developments. This is evidenced by the adjustment of SOPs, the use of the "Periksaki" application, and active participation in SPIP technical guidance and risk management. The Inspectorate also encourages OPDs to compile risk registers and implement risk management independently. However, the effectiveness of SPIP implementation still faces a number of obstacles, such as the suboptimal capabilities of APIP, budget constraints, not all OPDs having risk registers related to fraud, and not fully utilizing risk information as a basis for decision-making. In addition, supporting institutions such as the SPIP Task Force still need to be strengthened through more stringent regulations.

ADVICE

Based on the research results and conclusions obtained, the author provides the following recommendations: To strengthen adaptive capacity through digitalization and technological innovation, it is recommended to further develop these digital innovations, including the integration of surveillance systems with real-time databases and SPIP monitoring dashboards across OPDs. Digital literacy training for all OPDs should also be expanded to ensure that technological adaptation is not partial.

Developing and Implementing Structured and Measurable Risk Policies is recommended so that the Luwu Timur Regency Government can establish regional risk policies that include technical guidelines, standard formats, and standardized risk assessment systems. Establishing sector-based risk indicators will also help improve the quality and accuracy of internal controls. Proposing Strengthening of Regional Regulations on Integrated SPIP. The local government is

advised to immediately draft a Regent Regulation or Decree on the formation of an SPIP Task Force involving the Inspectorate, Bappelitbangda, and other key OPDs so that the implementation of SPIP assessment becomes systemic and legitimate. Enhancing Mentoring and Assistance Through a Sustainable Mentoring Scheme A more comprehensive and sustainable mentoring approach is needed for OPDs, not just limited to occasional training or supervision. Coaching models can be developed through coaching clinics, risk clinics, and open consultation forums conducted at least quarterly. This is important to ensure that the adaptation process to policy changes, technology, and new risks proceeds consistently and is supported by a strong understanding from each local government agency.

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ON SLİDİNG WİNDOW STATİSTİCAL CONVERGENCE OF GENERALİZED FRACTİONAL DİFFERENCE SEQUENCES İN INTUİTİONİSTİC FUZZY NORMED SPACES

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Abstract
Today in the field of mathematics Fuzzy theory has become an extensive area of research. In 1965, L. A Zadeh introduced the concept of fuzzy sets as a generalization of crisp sets. Later in 2102, Atanassov introduced the concept of a more generalized sets which he named as Intuitionistic fuzzy sets. The basic idea was to introduce a dual notion of the membership function of fuzzy set namely non–membership function.
In this paper, we focus on the notion of sliding window statistical convergence of generalized fractional difference sequences by introducing the $\Delta_{\{\varrho,\vartheta\}}^{\{a,b,c\}}(\mu)$ −convergence, which extends classical notions of convergence of fractional difference sequences to accommodate the unique characteristics of intuitionistic fuzzy metrics. We aim to bridge the gap between traditional convergence concepts and their statistical counterparts by establishing a framework for analyzing sequence convergence under this new definition. Our exploration examines the relationships between various types of convergence, including the effects of scalar multiplication and sequence addition, while addressing the uniqueness of limits in the context of sliding window statistical convergence and the conditions governing these relationships.
Keywords: Intuitionistic fuzzy normed space, Sliding window method; Statistical convergence, Lacunary statistical convergence, generalized fractional difference operator, σ–finite measure.

CLIMATE DYNAMICS AND TERRITORIAL VULNERABILITIES IN NORTHEASTERN ALGERIA

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Abstract:
Algeria's northeastern region is extremely sensitive to changes in the climate. Climate records from the 1980, demonstrate significant rainfall variability along with a notable rise in maximum temperatures (+1.5 to +2°C) and a fall in minimum temperatures of up to −1.5°C. The dangers of drought, desertification, and flash flooding are increased by these changes. Extreme events are becoming more frequent and severe, according to climate indices like SPI, SPEI, and RDI. This trend is predicted to get worse as the century comes to a close. This evaluation emphasizes the necessity of bolstering territorial adaptation plans, especially with regard to the sustainable management of water resources.

Keywords: Territorial adaptation; Climate change; Northeastern Algeria; Climate risks; Drought.

BAYESİAN APPROACHES TO FLEXİBLE HAZARD MODELİNG FOR SURVİVAL DATA WİTH TİME-VARYİNG COVARİATES İN STAN

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Abstract
The present study develops a Bayesian framework for survival analysis with time-varying covariates, incorporating flexible hazard structures to capture complex temporal patterns in event-time data. Several baseline hazard formulations—including Weibull, exponential, Gompertz, B-splines, and M-splines—are modeled alongside the extended Cox model. All models are implemented in Stan using Hamiltonian Monte Carlo for efficient posterior estimation. Model performance is evaluated using leave-one-out and widely applicable information criteria, complemented by posterior predictive checks to assess model adequacy. Results demonstrate that spline-based hazard models effectively accommodate non-proportional hazards and provide greater flexibility in describing dynamic risk patterns. The discussion emphasizes the value of Bayesian model comparison in selecting hazard specifications that balance flexibility, interpretability, and predictive accuracy for time-varying survival data.
Keywords: Extended Cox model, Time varying covariate, HMC, Stan

"IN SITU PREPARATION OF 3D FLOWER LIKE BIOBR/$BI_{24}O_{31}BR_{10}$ COMPOSITE BY ANNEALING HYDROTHERMAL METHOD FOR THE CIPROFLOXACIN DEGRADATION UNDER SIMULATED SUNLIGHT IRRADIATION"

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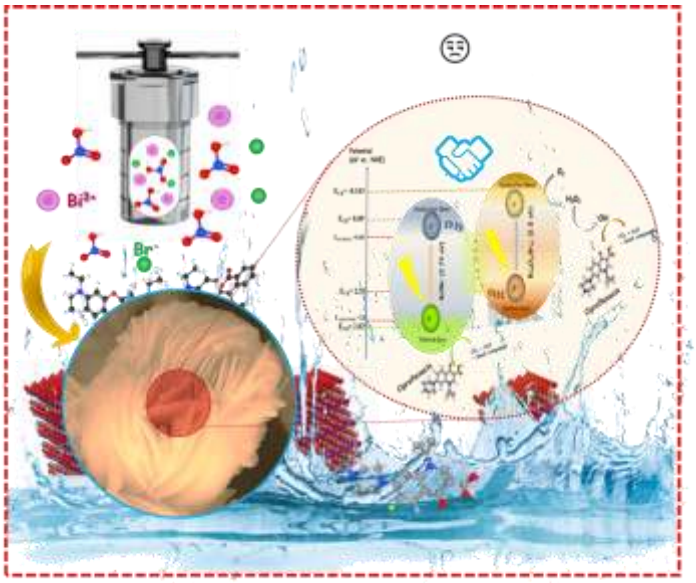
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Abstract

In this work, a hierarchical photocatalyst, BiOBr/$Bi_{24}O_{31}Br_{10}$, was synthesized via a simple two-step hydrothermal and annealing process. The BiOBr/$Bi_{24}O_{31}Br_{10}$ microstructure exhibited significantly enhanced photocatalytic performance compared to pure BiOBr and $Bi_{24}O_{31}Br_{10}$. Under simulated solar irradiation, it achieved 94% degradation of ciprofloxacin (CIP) in 60 minutes, with a reaction rate 5.5 times higher than that of pure $Bi_{24}O_{31}Br_{10}$. Rhodamine B (RhB) was also thoroughly degraded in 20 min. This improvement was attributed to several synergistic effects: the increased BET surface area provided more active sites; the enhanced adsorption capacity toward CIP facilitated its efficient degradation; and the broadened sunlight absorption range promoted the generation of charge carriers with an extended lifetime of 5.70 ns, surpassing that of the individual components. Additionally, the influence of operating parameters such as initial pH, photocatalyst dosage, initial pollutant concentration, and light intensity was systematically investigated.

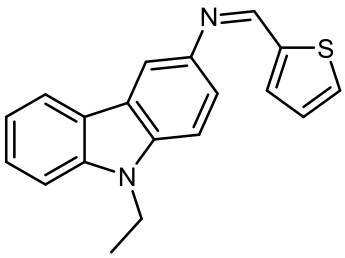
Keywords: Hydrothermal synthesis; BiOBr/$Bi_{24}O_{31}Br_{10}$ composite; DFT calculations; photocatalysis; ciprofloxacin photodegradation;

Graphical abstract



A THİOPHENE-MODİFİED CARBAZOLE MONOMER: SYNTHESİS, ELECTROCHEMİCAL BEHAVİOR, AND CONJUGATED POLYMER FORMATİON

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The Schiff-base derivative **TIC**, produced through the condensation of 3-amino-9-ethylcarbazole with thiophene-2-carbaldehyde, was successfully synthesized and its structure verified by NMR spectroscopy and elemental analysis. Its electrochemical behavior was explored using cyclic voltammetry, after which the monomer was efficiently electropolymerized in a Bu_4NBF_4/CH_2Cl_2 medium, forming a stable conjugated polymer film on the electrode surface. The incorporation of thiophene, a widely used heterocycle known for its strong π-conjugation, high electron density, and excellent charge-transport properties, enhances the ability of TIC to generate electroactive polymer chains. Paired with the carbazole moiety, recognized for its oxidative stability and effective hole-transport capability, TIC provides a favorable platform for creating conductive and durable polymeric materials. The resulting electropolymerized film exhibits characteristics typical of conjugated systems, emphasizing its potential in optoelectronic applications such as organic light-emitting diodes, photovoltaic cells, and field-effect transistors. Overall, TIC demonstrates the versatility of thiophene–carbazole architectures as promising candidates for advanced organic electronic materials.

Keywords: Schiff-base monomer, Electropolymerization, Conjugated polymer, Organic optoelectronics and Conducting polymer.

AN APPLICATION OF MIXED-INTEGER LINEAR PROGRAMMING TO MINIMIZE THE COST OF UNIVERSITY STUDENTS REQUIRED BASIC NUTRITIONAL REQUIREMENTS

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Abstract: This study analyzes the effectiveness of linear programming (LP) methods in minimizing costs within budgets for student nutrition planning and small-scale agribusiness food formulation. In both cases, decision-making within limited resources while maintaining nutritional value is a challenge, where conventional empirical methods are not optimized. In the education-related field, a mathematical model is proposed for residential students, which helps meet nutritional needs at the lowest cost through daily food selection. According to the results, it is possible to implement a balanced diet plan for only 80 taka per day. In the agriculture-based field, since 70% of the production cost of small-scale farm food formulation is related to food, an optimization model is developed using local ingredients. It incorporates information on nutritional value, market prices, and industry practices. The model significantly reduces costs compared to conventional methods and provides insights into realistic decision-making through sensitivity analysis. The two models presented together show that LP-based optimization methods can play a significant role in cost-efficiency and effective use of resources.
Keywords: Nutrition planning; Linear programming (LP) methods; The agriculture-based field; Small-scale farm food formulation; LP-based optimization.

EMPOWERİNG WOMEN İN THE DİGİTAL AGE: OPPORTUNİTİES, CHALLENGES, AND GLOBAL PARTNERSHİPS

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Abstract
The rapid expansion of digital technologies is reshaping societies, economies, and governance systems worldwide, creating unprecedented opportunities for women's empowerment. From access to information, education, and entrepreneurship to participation in global digital markets, the digital transformation has the potential to reduce long-standing gender inequalities. Yet, significant challenges persist, including unequal access to digital tools, gender biases in emerging technologies, online safety risks, and systemic barriers to digital literacy and leadership. This conference theme explores the multidimensional landscape of women's empowerment in the digital age, examining how inclusive policies, technological innovation, and cross-sector partnerships can bridge the gender digital divide. By bringing together global stakeholders—including governments, academia, industry leaders, civil society, and international organizations—the conference aims to highlight best practices, foster collaborative strategies, and promote sustainable digital ecosystems that support women's full participation and leadership. Through these dialogues, the event seeks to advance a shared global vision where digital progress translates into equitable opportunities for all women.

ADMINISTRATIVE OFFICERS AS DRIVERS OF ORGANIZATIONAL DEVELOPMENT: AN ANALYSIS OF THEIR STRATEGIC ROLES IN THE PUBLIC SECTOR

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Abstract
Administrative officers play an indispensable role in the operation, stability, and growth of public sector organizations cannot be over emphasized. Their responsibilities extend beyond routine clerical functions to encompass strategic duties such as planning, coordination, communication management, records administration, and policy implementation. Despite these crucial roles, there is limited scholarly focus on how administrative officers drive organizational development and contribute to public sector performance.
This study therefore examines administrative officers as strategic actors in organizational development, highlighting their influence on workflow efficiency, decision-making, service delivery, and institutional reforms. The study adopts a descriptive survey design, targeting administrative personnel in selected ministries, departments, and agencies. Data collected through structured questionnaires were analyzed using descriptive and inferential statistics. Findings reveal that administrative officers significantly enhance organizational development through effective communication channels, accurate documentation, interdepartmental coordination, and procedural guidance. However, challenges such as inadequate training, poor ICT infrastructure, bureaucratic rigidity, and unclear job boundaries limit their full potential.
The study recommends ongoing professional development, investment in digital administrative systems, improved organizational policies, and enhanced motivation mechanisms to strengthen administrative efficiency in the public sector.
Key words: Organizational policies, ICT, Strategic actors, work flow efficiency, decision making, service delivery, institutional reform.

"DESİGN AND DİSCOVERY OF POTENT 1,2,4-TRİAZOLE DERİVATİVES AGAİNST HEPG2 CANCER CELLS"

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Abstract
Triazole-based acetamides serve as important scaffolds for various pharmacologically active drugs. In the present work, structural hybrids of 1,2,4-triazole and acetamides were furnished by chemically modifying 2-(4-isobutylphenyl) propanoic acid (1). Target compounds 7a–f were produced in considerable yields (70–76%) by coupling the triazole of compound 1 with different electrophiles under different reaction conditions. These triazole-coupled acetamide derivatives were verified by physiochemical and spectroscopic (HRMS, FTIR, ^{13}CNMR, and ^{1}HNMR,) methods. The anti-liver carcinoma effects of all of the derivatives against a HepG2 cell line were investigated. Compound 7f, with two methyl moieties at the ortho-position, exhibited the highest anti-proliferative activity among all of the compounds with an IC50 value of 16.782 g/mL. 7f, the most effective anti-cancer molecule, also had a very low toxicity of 1.190.02%. Molecular docking demonstrates that all of the compounds, especially 7f, have exhibited excellent binding affinities of 176.749 kcal/mol and 170.066 kcal/mol to c-kit tyrosine kinase and protein kinase B, respectively. Compound 7f is recognized as the most suitable drug pharmacophore for the treatment of hepatocellular carcinoma.

Key words
2-(4-isobutylphenyl) propanoic acid; hepatocellular carcinoma; anti-cancer; 1,2,4-triazole; molecular docking; acetamides

THE IMPACT OF INCOME TAX RATES ON PUBLIC WELFARE AND THE BUSINESS WORLD

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Abstract
This study analyzes the impact of the Income Tax (PPh) increase policy on public welfare and business stability. The government needs to strengthen fiscal capacity to fund development and reduce inequality. However, the increase in PPh can reduce public purchasing power and hinder investment. The increase in PPh must be managed well to avoid inflationary pressures and challenges in allocating funds for the Social Safety Net (JPS) program. This research aims to identify the impact of PPh on household purchasing power and business profits, analyze the effectiveness of PPh revenue allocation to the JPS program, and evaluate its impact on investment decisions and economic stability. The method used is a qualitative descriptive study using literature, collecting data from academic journals and central bank reports. The study found that the effectiveness of the JPS depends on accurate data and audit systems. Without complementary policies, the increase in PPh risks reducing foreign investment and small business growth. In conclusion, PPh can improve welfare if accompanied by strong transparency and accountability.
Keywords: Impact, PPh, Society and Business

GREEN SYNTHESİS OF ZİNC OXİDE NANOPARTİCLES AND THEİR IN VİTRO BİOLOGİCAL ACTİVİTİES

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Abstract

Zinc oxide nanoparticles (ZnO NPs) were synthesized via an eco-friendly green synthesis route using *Artocarpus heterophyllus* (jackfruit) leaf extract as a bioreducing and stabilizing agent. The formation of ZnO NPs was confirmed by UV–Visible spectroscopy, exhibiting a characteristic absorption peak at 289-385 nm. Fourier-transform infrared (FTIR) spectroscopy indicated the presence of functional groups from phytochemicals involved in the reduction and capping process. The X-ray diffraction (XRD) pattern displayed well-defined peaks characteristic of the hexagonal wurtzite phase, confirming the high crystallinity of the synthesized nanoparticles. Scanning electron microscopy (SEM) showed aggregated particles with rough surfaces, and dynamic light scattering (DLS) analysis determined an average hydrodynamic particle size of 70.5 nm. Zeta potential measurement revealed a value of −16.4 mV, suggesting moderate colloidal stability. Energy dispersive X-ray spectroscopy (EDX) confirmed the elemental composition of zinc and oxygen, with no detectable impurities. In vitro biological evaluations demonstrated notable antioxidant activity as evidenced by the DPPH assay. The nanoparticles also exhibited significant anti-inflammatory potential by effectively inhibiting protein denaturation. Antidiabetic activity was confirmed through α-amylase inhibition and enhanced glucose uptake in yeast cell assays. Furthermore, the synthesized ZnO NPs showed effective antibacterial activity against *Escherichia coli* and *Enterococcus faecalis*. Overall, the study confirms that *A. heterophyllus* leaf extract-mediated ZnO NPs possess desirable physicochemical characteristics and exhibit multifunctional bioactivities, highlighting their potential utility in biomedical and pharmaceutical applications.

Key words: Zinc oxide nanoparticles, *Artocarpus heterophyllus*, phytochemical studies, Characterization, in vitro biological studies

MATHEMATİCAL MODELLİNG OF CONTRACEPTİVE USE AND BEHAVİORAL DYNAMİCS İN POPULATİON GROWTH CONTROL

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Abstract
This study develops a compartmental mathematical model to evaluate the impact of family planning interventions on population growth and reproductive health outcomes. The model divides the population into six compartments Susceptible, Informed, Sexually Corrupted, Contraceptive Users, Non-Users, and the General Population and describes transitions driven by awareness, behavioral change, sexual activity, and contraceptive adoption. Analytical results confirm the positivity and stability of the model solutions, while the disease-free equilibrium and basic reproduction number are derived using the next-generation matrix approach. The findings reveal that improved awareness and increased contraceptive uptake significantly reduce the number of individuals engaging in high-risk sexual behavior, leading to a decline in unintended pregnancies and a stabilization of population growth. Numerical simulations demonstrate that the basic reproduction number decreases as contraceptive utilization rises, highlighting the effectiveness of targeted interventions and reproductive health education. Overall, this study underscores the value of mathematical modelling as a decision support tool for policymakers, enabling evidence-based planning and evaluation of family planning programs aimed at enhancing public health and sustainable population management.

MULTİ-OMİCS PROFİLİNG UNVEİLS UBE2C, MCM2, AURKA, AND TP53 AS CORE REGULATORY HUBS OF INTERCONNECTED ONCOGENİC NETWORKS İN WOMEN'S BREAST, OVARİAN, AND ENDOMETRİAL CANCERS

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Abstract:
Breast (BRCA), ovarian (OV), and uterine corpus endometrial cancers (UCEC) exhibit well-documented epidemiological associations, yet the molecular underpinnings of their interconnected risks remain poorly defined. Leveraging multi-omics integration, this study identifies conserved pan-cancer common hub genes driving these malignancies and explores their clinical and therapeutic relevance. Transcriptomic analysis of microarray datasets (GSE18520 [ovarian cancer], GSE10797 [breast cancer], GSE7305 [UCEC]) revealed 38 common conserved differentially expressed genes (DEGs; $|\log_2 FC| > 1$, $p < 0.01$) across all three cancers. Protein-protein interaction (PPI) network analysis prioritized four central hub genes UBE2C, MCM2, AURKA, and TP53 exhibiting consistent upregulation in tumor tissues ($p< 0.01$) and significant correlations with poor overall survival (log-rank $p < 0.05$). Methylation profiling uncovered cancer-specific epigenetic dysregulation, with UBE2C hypermethylated in breast and ovarian cancers but hypomethylated in UCEC, while TP53 showed pan-cancer hypermethylation. Immune infiltration analysis revealed a correlation between common hub gene expressions and CD8+ T cell levels (ρ = -0.32 to -0.47, < 0.05), suggesting immune-evasive mechanisms. Functional enrichment linked these genes to cell cycle regulation, mitotic processes, and DNA replication. Drug prediction identified FDA-approved/investigational agents (e.g., Pamiparib, Rucaparib) targeting these hubs, with SwissADME analysis confirming favorable drug-likeness and pharmacokinetic properties.
By bridging epidemiological associations with molecular mechanisms, this study establishes UBE2C, MCM2, AURKA, and TP53 as pan-cancer drivers of gynecologic and breast malignancies, offering novel biomarkers for risk stratification and precision therapeutics. These findings advance translational strategies for patients at elevated risk of secondary cancers and underscore the potential of multi-omics frameworks in unraveling shared oncogenic networks.

TRANSFORMING THE TAXPAYER COMPLIANCE PROGRAM WITH A GAMIFICATION AND DIGITAL REWARD APPROACH TO OPTIMIZE INCOME TAX RECEIPTS

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Abstract
This research analyzes the effectiveness of transforming the Compliant Taxpayer Program through the implementation of gamification and digital rewards in enhancing compliance and optimizing Income Tax (PPh) revenue. The program is designed by incorporating points, badges, leaderboards, and challenges into tax-related activities, such as timely filing of annual tax returns (SPT) and income tax payments. The reward system includes priority services, accelerated refunds, e-vouchers, and "Compliant Taxpayer" status within the Core Tax application. This study employs a literature review and international comparative analysis of similar strategies implemented in several countries. The findings reveal that Taiwan successfully increased tax revenue by 75% through the Uniform Invoice Lottery, Portugal recorded a 36% rise in invoice reporting and a 4% reduction in the tax gap, while Malaysia improved compliance through voucher distribution and lucky draws. Despite its promising potential, challenges remain, such as taxpayers' digital literacy, technological integration within Core Tax, and resistance to adopting new systems. This research recommends that the government integrate gamification- and reward-based strategies to raise tax awareness, expand the income tax base, and optimize state revenue.
Keywords: *Income Tax, Compliant Taxpayer, Gamification, Digital Reward, Tax Revenue*

PERSONALİZED NUTRİTİON USİNG GUT MİCROBİOME PROFİLİNG: A NEW FRONTİER İN OPTİMİZİNG ATHLETİC PERFORMANCE AND RECOVERY

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Abstract:
Recent advances in microbiome science have highlighted the gut as a key regulator of energy metabolism, immune function, and recovery—all of which are critical to athletic performance. This study explores the impact of personalized nutrition plans based on individual gut microbiome profiling on enhancing athletic performance and accelerating post-exercise recovery.
A randomized controlled trial will be conducted involving competitive athletes divided into two groups: one receiving a generic sports diet and the other following a microbiome-informed dietary intervention. Baseline and post-intervention assessments will include endurance capacity (VO_2 max), recovery indicators (heart rate variability, delayed-onset muscle soreness), and inflammatory biomarkers (CRP, IL-6). Gut microbial diversity and composition will be analyzed using next-generation sequencing techniques.
It is hypothesized that the personalized nutrition group will demonstrate superior improvements in performance metrics, faster recovery times, and reduced systemic inflammation. The findings aim to establish the potential of microbiome-guided dietary strategies in precision sports nutrition, offering a transformative approach for individualized athletic optimization.
Keywords: Personalized nutrition, gut microbiome, athletic performance, recovery, sports science, inflammation

THE ROLE OF MANAGEMENT ACCOUNTING IN PROFIT-MAKING ORGANIZATIONSA CASE STUDY OF AHMAN PATEGI UNIVERSITY, KWARA STATE, NIGERIA

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Abstract
This study investigates the role of management accounting in profit-making organizations, focusing on Ahman Pategi University, Kwara State, Nigeria. Although universities primarily focus on academic services, modern private institutions operate under revenue-driven models that require efficient financial management, cost control, planning, and strategic decision-making to remain profitable. The study adopts a qualitative case study design, drawing data from internal documents, interviews with bursary and administrative staff, and observational assessments of financial operations. Findings reveal that management accounting significantly contributes to cost management, budgeting, investment decisions, profit planning, internal controls, and performance measurement. However, challenges such as inadequate automation, inconsistent variance analysis, limited staff capacity, and revenue instability constrain optimal performance. The study recommends improved adoption of digital accounting systems, continuous staff training, stronger performance measurement frameworks, timely budget reviews, and integrated financial planning to enhance profitability and sustainability.

1. Introduction

Profit-making organizations operate with the objective of maximizing financial returns while sustaining operational efficiency. Management accounting provides internal decision-support tools that enhance strategic and operational effectiveness. Ahman Pategi University (APU), although an educational institution, operates as a private organization that relies heavily on tuition fees and internally generated revenues. This study examines the extent to which management accounting contributes to profitability and overall operational efficiency within APU.

2. Literature Review

Management accounting involves the collection, analysis, and presentation of financial and non-financial information for internal managerial decision-making. Key modern techniques include budgeting, variance analysis, CVP analysis, ABC, BSC, and capital budgeting. Private universities increasingly rely on management accounting for sustainability, yet challenges such as inadequate software, unstable revenue, and weak budget discipline persist.

3. Methodology

A qualitative case study approach was adopted. Data was collected through structured interviews, document reviews, and observation. Thematic analysis was used to interpret the data.

4. Findings and Discussion

Key roles of management accounting in APU include budgeting, cost control, internal control, performance evaluation, investment decision support, and use of AIS. Challenges include inadequate automation, insufficient staff capacity, weak variance analysis, and revenue instability.

5. Conclusion and Recommendations

Management accounting significantly enhances profitability and operational efficiency at APU. Recommendations include adopting integrated systems, staff training, strengthening budget controls, automated revenue systems, and KPIs for departments.

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STATISTICAL ANALYSIS OF EXTRACTION THE NATURAL RED DYE MADDER

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Abstract

Alizarin and purpurin are the main colored compounds of madder. The optimization of extraction (Rdt%) of red dye madder has been carried out using Central Composite Design (CCD in the following) taking into account 3 factors (concentration of the acid, concentration of the alkali, and extraction time).The choice of the solvent, acid and alkali was initially determined by a simple screening. The Central composite experimental design and Response Surface Methodology (RSM) were used to determine the best operating conditions for a maximum yield of extraction. Experimental results of the CCD showed that the best operating conditions to obtain the maximum extraction yield (91.8%) were the following: HCl_2.95%, $NaOH_2$.95% and 1, 25 hours extraction time.

Keywords: Rubiatinctorum L, Extraction, Factorial design, Central composite, Design.

THE MENTAL HEALTH OF UNIVERSITY STUDENTS

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Abstract: Mental health refers to a state of well-being in which individuals are aware of their own abilities, can manage the normal stresses of life, work productively and effectively, and are able to contribute to their community. This study examines the mental health status of 250 students at a public university in Vietnam by assessing stress, anxiety, and depression using the Depression Anxiety Stress Scale – DASS-21. Results indicate extremely high levels of psychological distress: 87.6% reported moderate to very severe stress, 94.4% experienced moderate to very severe anxiety, and 85.6% showed moderate to very severe depression. Qualitative responses further suggest that academic pressure and family expectations are major contributors to students' mental health difficulties. These findings highlight the urgent need for targeted mental health support and institutional interventions to reduce psychological burden and promote student well-being.
Keywords: *mental health; university students; DASS-21.*

PRODUCTION AND CHARACTERIZATION OF CARBON NANOTUBES FROM BIOCHAR UNDER MICROWAVE IRRADIATION

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2018-ag-1386
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ABSTRACT

Carbon nanotubes (CNTs) are widely used in a variety of fields to produce a diversity of products, including hydrogen storage systems, and field emitters. In the proposed study, CNTs synthesized via biochar under the microwave irradiation method. In this method, the combination of charcoal and ferrocene are used to synthesize CNTs from the biochar approach. Biochar samples for CNTs synthesis are made from pyrolyzed agro-industrial waste such as rapeseed cake, hazelnut hulls, wheat straw, and oat hulls at different temperatures. The biochar was produced from agro-industrial biomass. During experiments, 100g of biomass was placed in a microwave reactor. The samples were pyrolyzed at 400 °C to 600°C. SEM analysis was used to confirm the morphology of CNTs. SEM micrographs revealed the perfect structure of multiwall carbon nanotubes, while interlayers spacing was changed due to variation of catalysts and measured about 0.34nm. Further, the optical properties were examined by UV-visible spectroscopy. In the UV, one band is clear at 240 nm region due to resonance of nanotubes pi(π) electrons of carbon nanotubes. XRD was used to analyze the glassy structure of prepared CNTs under microwave revealed that the creation and growth of CNTs were mostly influenced by microwave irradiation and the ferrocene catalyst. The structure of CNTs was developed under microwave heating and in the presence of ferrocene catalyst. To research how nitrogen impurities adhere to CNTs, FTIR experiments were conducted in the 400–4000 cm^{-1} range. The sample's FTIR spectra exhibit prominent peaks that correspond to C-H and C=C, respectively.

DEVELOPMENT OF NANOCELLULOSE EXTRACTED FROM AGRİCULTURAL WASTE AS ADDİTİVE İN EPOXY COMPOSİTES

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Abstract
This study was conducted to develop nanocomposites derived from agricultural residue, specifically oil palm trunk, to serve as a nanocellulose additive in epoxy composites. Nanocellulose was isolated through mercerization, bleaching, and acid hydrolysis procedures to produce a material at the nanoscale. This nanocellulose was subsequently incorporated into epoxy via hand lay-up methods at varying concentrations up to 5 wt.%. The influence of these composites on mechanical performance, including tensile strength, modulus of elasticity (MOE), and modulus of rupture (MOR), was examined. The distribution of CNC within the epoxy was notably homogeneous, as demonstrated by SEM analysis, thereby augmenting the mechanical performance through increased tensile strength. The MOR demonstrated a brittleness effect upon the incorporation of nanocellulose at a concentration of 5 wt.%. A decrease in MOE was observed with the addition of 5 wt.% to 10%. In comparison to the epoxy control, the nanocellulose epoxy composites demonstrated enhanced mechanical performance. Nanocellulose is appropriate for incorporation into epoxy to enhance its mechanical properties and can be utilized in various load-bearing applications, such as flooring and wall paneling.
Keywords: agricultural waste; nanocellulose; oil palm; composite; mechanical

TENSOR-BASED MACHİNE LEARNİNG FOR MİXED RADİATİON SEPARATİON

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Abstract
Neutron spectrometry using scintillation detectors has gained widespread adoption in radiation detection and medical science, particularly in radiation diagnosis and radiation therapy. These detectors are highly efficient in detecting neutrons across a broad energy spectrum, cost-effective, and feature a straightforward design that facilitates maintenance and operation. Despite these advantages, a critical challenge remains in accurately distinguishing neutron signals from accompanying gamma radiation, which is essential for precise radiation diagnosis and effective radiation therapy treatment planning. Addressing this challenge, various techniques have been proposed to differentiate neutrons from gamma radiation. This work reviews neutron-gamma discrimination methods using different types of scintillators and compares these methods based on their accuracy and the type of detector used. Additionally, potential recommendations for the research community are provided.

Keywords: Neutron-gamma discrimination, Unsupervised Learning, Pulse Shape discrimination, Scintillation detectors.

INTEGRATIVE APPROACH TO THE CHEMODIVERSITY AND ANTIFUNGAL POWER OF MACROALGAE FROM THE COAST OF EL JADIDA: TOWARDS NEW FUNGICIDAL BIOMOLECULES

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ABSTRACT:

The exploitation of **algae** on a global scale is marginal compared to terrestrial plant production: 10,000 tonnes of microalgae (≅100% cultured; i.e. apart from the microalgae used for wastewater treatment) and 15 million tonnes of macroalgae (including 13.5 Mt cultured), compared to 4 billion tonnes for agricultural production (Person et al., 2011). Microalgae can produce value-added compounds, such as polysaccharides, polyunsaturated fatty acids, carotenoids, phycobiliproteins, vitamins, or sterols. Macroalgae have a wide range of uses. In addition to food uses, these macrophytes are playing an increasingly important role in agriculture (organic fertilizer, livestock feed) and in various industries (pharmaceuticals, cosmetics, etc.).

Regarding **agriculture**, the valorization of algae in this field is a theme that suggests sustainable added value in the use of their biological properties. Indeed, algae are used primarily as fertilizers in coastal regions because their mineral content improves the mineral composition of depleted soils. Algae are particularly rich in the major nutrients nitrogen and potassium as well as the secondary nutrients sulphur, calcium, magnesium, and trace elements. In addition, their richness in colloids increases the water-holding capacity of soils, fixes silts and reduces erosion of arable land. Another important advantage of sustainability is the production of fertilizers that are certified in organic farming. When applied to crops, the nutrients in the algae and their extracts are released slowly, which has the advantage of allowing plants to grow. Brown macroalgae are also used in the formulation of growing media (enriched potting soils) and fertilizers in the form of flours or liquid extracts. After the extraction of the molecules of interest or carbohydrates from the algae, most of the nutrients are still present in the remains of the biomass. Rich in nutrients, this residual biomass presents a potential market for use as **biofertilizers**. Algae even contain **biostimulant** compounds that have the ability to alter physiology in order to promote germination, growth, development and therefore plant vigor and productivity. These natural bioactive compounds have activities that stimulate biological processes even at ground level. In the field of phytosanitary treatments, algae can be used as a **bioprotective** agent against plant diseases by acting as elicitors (stimulators of the plants' natural defences). They are therefore 'phyto-vaccines' applied to plants to increase their natural defence, which makes it possible to reduce the frequency and importance of curative phytosanitary treatments using chemicals. Polysaccharides (e.g. fucoidans, laminaranes and polymanuronic acid oligoalginates) possess this type of activity. Metabolic activators based on algal extracts are also able to increase the response of plants to environmental stresses through their bioactive elements. Polyphenols are thus present in algae extracts and are biologically active antioxidants.

KEYWORDS: Agriculture, Biotechnology, Algae, bio-fertilization, biostimulation, bioprotection.

A FİRST KAP ASSESSMENT AND MİCROBİOLOGİCAL PROFİLİNG OF STREET FOOD İN MARRAKECH, MOROCCO

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Abstract
Background: Despite its significance as a vital sector in urban Morocco, concerns regarding the safety of street food persist, posing significant public health risks due to the growing number of food poisoning outbreaks. This study presents the first comprehensive assessment of food safety knowledge, attitudes, and practices (KAP) among street food handlers in Marrakech, combined with a bacteriological evaluation of their food contact surfaces.
Methods: A cross-sectional study was conducted among 200 street food handlers in Jamaa El Fna square using face-to-face interviews with a structured questionnaire. The survey assessed socio-demographic characteristics and KAP levels. Simultaneously, 115 swab samples were collected from food contact surfaces (hands, cutting boards, knives, preparation tables) for bacteriological analysis, including Total Aerobic Viable Count (TAVC), *Escherichia coli*, *Staphylococcus aureus*, and *Salmonella spp*.
Results: The study revealed a low overall food safety knowledge score (39.2%), contrasted with generally positive attitudes (72.1%) and moderate self-reported practices (62.7%). Critical knowledge gaps were identified in time-temperature control (only 35% aware of the danger zone) and cross-contamination prevention (32-35% used separate utensils). Microbiological analysis confirmed substantial contamination, with mean aerobic counts of 4.03 $\log_{10}$ CFU/cm². Pathogens were widely detected: *E. coli* (68%), *S. aureus* (45%), and *Salmonella spp.* (25%). A strong positive correlation was found between knowledge and attitudes ($r=0.907$, $p<0.001$), but weaker correlations existed between knowledge-practices ($r=0.291$) and attitudes-practices ($r=0.327$). Training experience, education level, and work experience significantly influenced KAP scores ($p<0.05$).
Conclusion: Although the vendors displayed a positive attitude, they demonstrated inadequate knowledge and practices regarding food safety, resulting in high levels of microbial contamination. These findings highlight an urgent need for well targeted food safety training programs and improved hygiene infrastructure to reduce foodborne disease risks and protect consumer health in Morocco's street food sector.
Keywords: Food Safety, Street Food, KAP, Microbial Contamination, Food Handlers, Public Health

INCLUSİON İN HİGHER EDUCATİON THROUGH SİGN LANGUAGE INTERPRETERS: CHALLENGES AND OPPORTUNİTİES

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Abstract
Diversity and inclusion serve as valuable assets that foster belonging, equity, and justice for all individuals. However, several barriers hinder the inclusion of students with hearing impairments (SWHI). These include inadequate institutional policies and practices, limited accessibility, insufficient awareness of Deaf culture and sign language, and a shortage of trained and qualified interpreters . The role of a sign-language interpreter is inherently dynamic and adaptable rather than fixed and prescriptive, highlighting the need for interpreters to respond effectively to diverse situations to achieve communication goals across various educational contexts.
The present study aims to identify the challenges that restrict hearing-impaired students' full participation in higher education and to explore how sign-language interpreters can support them in overcoming these obstacles. The study population comprised all sign-language interpreters employed in higher education institutions across District Lahore. Data were collected through semi-structured interviews with five interpreters working in both public and private universities. The findings reveal multiple challenges faced by interpreters when supporting students with hearing impairments or communication difficulties. These include considerable resistance from colleagues and students, as well as a lack of broader administrative support. The study further underscores the importance of interpreters' knowledge, dedication, and professional commitment, along with the necessity for institutional backing, appropriate resources, and effective methodologies to ensure their success.
Keywords: Sign-language, Higher education, Inclusive learning, Interpreters, Learning impairment, challenges, opportunities

ASSESSMENT OF PLANKTON ASSEMBLAGE AND WATER QUALİTY OF RİVER JEGA

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Abstract
This study evaluated the plankton assemblage and water quality characteristics of River Jega, Kebbi State, Nigeria, over a three-month period (June–August 2023). Water samples were collected from three stations representing upstream (A), midstream with intense human activities (B), and downstream (C). Physicochemical parameters including temperature, pH, turbidity, dissolved oxygen (DO), and total hardness were analyzed using standard methods, while plankton samples were collected with a plankton net and identified microscopically.

Results indicated that pH values ranged between 6.46 and 8.53, falling within WHO recommended limits for freshwater. Dissolved oxygen ranged from 6.25–6.91 mg/L, sufficient to support aquatic life. Temperature remained stable (29–31°C), while turbidity showed slight variation (9–12 cm). Total hardness was generally low, with the highest values recorded at downstream station C.
A total of 10 phytoplankton species (five classes) and 6 zooplankton species (five classes) were identified. Among phytoplankton, Euglenophyceae and Cyanophyceae were the most dominant (30% each), with *Euglena viridis*, *Nostoc commune*, and *Spirulina spp.* showing high abundance. Zooplankton composition was dominated by Monogononta (33.33%), with *Acartia tunsa*, *Cyclops strenuus*, and *Keratella spp.* occurring frequently. Community distribution patterns reflected the influence of anthropogenic activities at Station B and relatively better water conditions at Station C.
The findings indicate that River Jega supports moderately diverse plankton communities and maintains water quality parameters largely within acceptable ecological ranges, although evidence of stress was observed in stations exposed to human disturbance. Continuous monitoring, pollution control, and improved watershed management are recommended to maintain ecological integrity and support sustainable aquatic biodiversity in the river.
Keywords
Plankton assemblage, Water quality, River Jega, Zooplankton, Phytoplankton, Freshwater ecology

TEMPERATURE DEPENDENT TENSİLE STRENGTH ADDİTİVE MİXED WARM MİX ASPHALT

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Abstract:
Temperature fluctuations and the weight and impact of vehicles cause tensile cracking in Bituminous roadways leading to short pavement life. The use of Warm Mix Asphalt (WMA) with additives, as an anti-stripping and workability enhancing additive, is a way to support sustainable technology by lowering the production temperatures of asphalt while improving tensile strength & moisture resistance. This study evaluates how critically important tensile strength is to all Bituminous Mixes since cracking is a significant factor in durability issues for pavements. Using Indirect Tensile Strength (ITS) Tests allows for accurate and reproducible results for assessing cracking levels under different exterior environmental conditions. Specifically, this research evaluates how varying finer materials & the mixing temperatures affect the tensile properties of Warm Mix Asphalt produced with an additive; the chemical additive Zycotherm makes it possible to produce Warm Mix Asphalt at a lower mixing temperature & has improved workability and anti-stripping ability. Specimens of Warm Mix Asphalt were prepared using the Marshall Mix Design method to determine the appropriate bitumen content for optimal stability, flow & void space. Mixes were tested for standard properties such as Marshall Stability, Flow Value, Air Voids, and Voids in Mineral Aggregate on the prepared specimens when the optimum content was achieved to ensure all of the properties met pavement specifications. The ITS Test (indirect tensile strength testing) was conducted on cylinder-type specimens at designated temperature intervals of 5 degrees Celsius for simulating field conditions, using the controlled temperature settings. Cement as a filler consistently resulted in higher ITS, showing 20-30% improvement compared to other finer materials at all temperature levels. This is due to cement's increased stiffness, better binder adhesion, and pozzolanic reactivity. These results highlight cement's advantages for WMA applications in high-traffic pavements. They also support sustainable practices by reducing energy use and improving durability.

Keywords: Warm Mix Asphalt, ITS, TSR, Zycotherm, Filler.

SPECTRAL AND KELLER BOX ANALYSİS OF MHD CASSON FLUİD FLOW WİTH TEMPERATURE-DEPENDENT TRANSPORT PROPERTİES AND VİSCOUS DİSSİPATİON OVER A PERMEABLE STRETCHİNG SURFACE EMBEDDED İN POROUS MEDİA

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Abstract:

The present paper investigates the steady, laminar boundary layer flow and heat transfer of a magnetohydrodynamic (MHD) Casson fluid over a nonlinearly stretched permeable sheet. The impact of both injection and suction cases are examined with variable viscosity and thermal conductivity under the influence of porosity, viscous dissipation and heat absorption/generation. Utilizing the similarity transformation, the governing partial differential equations (PDEs) are transformed into a self-similar system of nonlinear ordinary differential equations (ODEs). These equations are solved by robust and efficient techniques viz. Keller box method (KBM) and shifted Chebyshev collocation method (SCCM). The analysis reveals that, physical parameters have a significant impact on the fluid flow. An increasing value of injection leads to accelerated fluid flow, whereas a suction process results in flow deceleration. Furthermore, the attained results are compared successfully with previously published results.

Key words: MHD Casson fluid; two-dimensional boundary layer flow; variable properties; suction/injection effects; Keller box method; Chebyshev spectral method.

THE INFLUENCE OF CULTURE AND RELİGİON ON CHİLDHOOD IMMUNİZATİON USAGE: A SYSTEMATİC REVİEW

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Background:
One of the most effective public health initiatives remains childhood immunizations, despite the prevalence of vaccine reluctance worldwide. Among low-income and middle-income societies, parental decisions about vaccinations are extremely impacted by culture, religious beliefs, and customs.
Aims and Objectives:
This systematic review aims to assess existing studies on how cultural and religious beliefs influence the usage of childhood vaccination.
Methods:
This is a systematic review conducted according to the PRISMA guidelines. PubMed, Web of Science, Scopus, CINAHL, EBSCO, and African Journals Online were thoroughly searched for studies published from 2000 to 2025. Sixty studies met the inclusion criteria. Two reviewers independently extracted data and assessed quality using the Newcastle-Ottawa Scale for the evaluation of the study quality and risk of bias.
Findings / Outcomes:
Dependence on traditional health beliefs, worries regarding the components of vaccines, and social norms that either discouraged or supported immunization were the major influences identified. Decisions made by parents were controlled by misinformation spread through close-knit community members and religious leaders, and elders. The dynamics among gender, particularly the restricted ability of mothers to make decisions, also contributed to refusals or delays in the uptake of vaccination. On the other hand, communities that had a high level of trust in healthcare professionals and communicated in a way that was culturally appropriate accepted the vaccines.
Conclusion:
To improve the usage of vaccination, hesitation in diverse populations should be addressed through the development of culturally sensitive interventions and health communication/education.
Implication(s) for Practice:
The implication for practice is to improve the intake of vaccines through culturally sensitive approaches. Healthcare providers should incorporate cultural competence into practice. Trust, gender-related barriers, and collaboration with traditional healers should be promoted during community health education.
Keywords: childhood immunization, pediatrics, vaccine hesitancy, cultural beliefs, religious beliefs

ENHANCİNG HOUSİNG QUALİTY İN TRADİTİONAL URBAN CORES: INSİGHTS FROM ADO-EKİTİ, NİGERİA

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Abstract
Traditional urban cores in many Nigerian cities are experiencing housing deterioration resulting from ageing structures, inadequate infrastructure, and weak planning controls. This study examines housing quality challenges in Ado-Ekiti's traditional core area, drawing on field observations and secondary data. Findings show that overcrowding, inadequate sanitation, structural defects, poor urban renewal, and limited access to utilities remain the dominant issues. The study argues for integrated policy reforms, community-based upgrading, and context-appropriate housing improvements that respect cultural heritage while enhancing livability. Recommendations include targeted infrastructure renewal, improved regulatory enforcement, and local stakeholder collaboration.

3D NUMERİCAL ASSESSMENT OF HEAT EXTRACTİON ENHANCEMENT İN PVT COLLECTORS USİNG NANOFLUİD-COOLED CHANNELS

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Abstract
Hybrid photovoltaic/thermal (PVT) systems offer an effective route to improve solar-energy utilization by coupling electrical generation with enhanced thermal management. This study conducts a three-dimensional CFD analysis of a nanofluid-cooled PVT collector equipped with engineered channels to strengthen convective heat extraction. The effects of flow rate, solar irradiance, ambient conditions, wind influence, and nanoparticle concentration on the thermal, electrical, energetic, and exergetic responses are systematically examined. The findings demonstrate that optimized channel geometry promotes superior heat removal, stabilizes PV temperature, and improves overall energy conversion. Exergy evaluation further shows that higher irradiation levels and increased nanoparticle loading elevate the quality of the recovered energy. These results underline the potential of nanofluid-assisted channel cooling for advancing high-performance PVT technologies and guiding the design of next-generation solar collectors.

Keywords: PVT modules; Energy efficiency; Solar collectors; Nanofluids.

ENVİRONMENTAL ISOTOPİC AND CHEMİCAL ASSESSMENT NEAR THE ROOPPUR NUCLEAR POWER PLANT

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This study aims to establish an environmental baseline around the Rooppur Nuclear Power Plant (RNPP) by assessing the physicochemical, heavy metal and radiological characteristics of groundwater and soil samples. Groundwater was analyzed for pH, EC, major ions, and heavy metals, while soil samples were evaluated for pH, salinity, elemental composition, and natural radionuclides. Radiological measurements included ^{226}Ra, ^{232}Th, ^{40}K, and ^{137}Cs using standard gamma-spectrometric techniques. Groundwater exhibited slightly acidic to near-neutral pH (6.53–6.98) and moderate electrical conductivity, with a Ca–Mg–HCO_3 hydrochemical signature dominated by carbonate and silicate weathering. Elevated concentrations of Fe, Pb, and Cd were detected in several wells, resulting in increased Water Quality Index (WQI) and Heavy Metal Pollution Index (HPI) values, indicating localized geogenic or anthropogenic metal input. All radionuclides in groundwater were below detection limits, confirming an absence of radiological influence from RNPP operations. Soil samples showed weakly acidic pH and low salinity, and the activities of ^{226}Ra, ^{232}Th, and ^{40}K were slightly above global averages yet consistent with natural lithological variability. Heavy metal concentrations in soil were within normal crustal ranges, and cadmium was not detected, indicating minimal industrial influence. Overall, the region surrounding RNPP remains radiologically safe, with no evidence of nuclear-related contamination; however, localized heavy-metal enrichment in groundwater suggests the necessity for continued environmental surveillance.

Keywords: Groundwater quality; Heavy metal contamination; Radiological assessment; Environmental monitoring; Hydrogeochemistry; Rooppur Nuclear Power Plant

THERMO-OPTIC TUNING OF POLYMER FIBER SENSORS: INVESTIGATING THE IMPACT OF SUB-T_g, NEAR-T_g, AND POST-T_g HEAT TREATMENTS ON BAND GAP AND REFLECTION INTENSITY

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ABSTRACT

Polymer Optical fiber (POFs) offer exceptional durability for sensing, yet their fabrication has historically required chemical etching that damages the fiber surface. To solve this, our work utilizes a thermal-only method to tailor Polymethyl Methacrylate (PMMA) fibers, eliminating chemical exposure entirely. We explore a multi-stage heat treatment strategy targeting three specific thermodynamic states relative to the glass transition temperature (T_g): the relaxation phase (Sub-T_g), the transition phase (Near-T_g), and the viscous flow phase (Post-T_g).

By combining standard reflection spectroscopy with Tauc plot analysis—applied via the Kubelka-Munk transformation—we mapped how heat alters both the physical geometry and the electronic landscape of the material. Our data reveals a distinct behavior across regimes: lower temperatures (80°C) primarily relax internal manufacturing stresses, resulting in a highly stable optical signal. Heating the fibers above Tg (130°C), however, forces significant structural disorder. This appears as a distinct 'red shift' in the optical band gap alongside higher Urbach energy. This induced disorder is advantageous: it produced a 25% increase in refractive index sensitivity over the control group. Beyond its role in geometry, heat treatment proves to be an effective mechanism for 'thermo-optic tuning,' offering a sustainable alternative for developing sensitive intrinsic sensors.

Keywords: Polymer Optical Fiber, Tauc Plot, Kubelka-Munk, Thermal Annealing, Optical Sensors.

DESIGN AND DEVELOPMENT OF NOVEL APPROACH FOR FILE SHARING FOR SECURITY USING BLOCKCHAIN TECHNOLOGY : LITERATURE REVIEW

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Abstract: File sharing is a fundamental aspect of data management, and it is essential for collaboration, communication, and data exchange. However, file sharing systems are susceptible to security threats and data breaches, which can compromise data confidentiality, integrity, and availability. A novel approach for file sharing using blockchain technology is required which would ensures secure and decentralized file sharing. The novel approach for file sharing would use a hybrid consensus mechanism, combining proof-of-work and proof-of-stake algorithms, to ensure network security and prevent malicious attacks.

It would use multi-layer encryption to enhance file security, where files are encrypted at the user level and the blockchain level. The proposed Novel approach would also incorporates smart contract technology for file access control, where users can set permissions for file sharing and access. The proposed approach was developed and tested using a prototype implementation, and the results show that the system is secure, efficient, and scalable. The system also provides a high level of data privacy and security, making it suitable for various applications, including healthcare, finance, and government.

Keywords: Novel Approach, File sharing; Security; Blockchain, Technology

EMBRACING ARTFICIAL INTELLIGENCE AND DIGITAL CONNECTIVITY FOR MANAGING ODL AND TEACHING LEARNING RESOURCES IN NIGERIAN UNIVERSITIES

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ABSTRACT
Teachers can influence the lives of tomorrows leaders and have the ability to cultivate in their pupils love for learning. The importance of secondary education in educational system cannot be overemphasized. Apart from serving as the link between primary and tertiary education the main purpose of this paper is to examine how teachers play their role as the custodian of guidance and counselling towards ensuring Nigeria's transformation to a greater height. Hence, there is need for quality teachers through which education industry can be effectively utilized for transforming Nigeria for the socio-economic growth and national development. In the olden days teachers formed the core of the local leadership. They were in the forefront of the public enlighten and development programmes. Teachers are the main determinants of quality in education, but if they are apathetic, uncommitted, lazy, unmotivated, immoral, anti-social, demoralized and unethical, the whole nation is doomed. It was discovered that, problems characterizing teacher education in Nigeria include lack of training and re-training. Recommendations were made, these include among others adequate funding of the sector at all levels, involvement of all stake holders in repositioning the place of a teacher and teaching like other professions, strict adherence to the minimum requirement for teaching according to the National Policy of Education which is Nigerian Certificate of Education (NCE), revisiting the concluded Cluster Centers training in March last year in all Local Governments of Sokoto State to become permanent as NCE awarding Centers based on contact sessions, and finally, TETFund intervention on staff development should consider incorporating teacher training of both Secondary and Primary School teachers as a priority for the realization of the nation's vision a reality..
Keywords: *Teachers, Transforming, Administrators, Sociologists, Nigeria, Implication.*

INTRODUCTION
Introduction
There is need for quality teachers through which education industry can be effectively utilized for transforming Nigeria for the socio-economic growth and national development. In the olden days teachers formed the core of the local leadership. They were in the forefront of the public enlighten and development programmes. Teachers are the main determinants of quality in education,Open and Distance Learning (ODL) programme has been considered as one of the most important educational innovations in Nigeria is leading the country to a sustainable development. Open and Distance Learning has provided opportunities for those who could not afford to leave their job to attend to full time conventional education. UNESCO (2002) stated 'in efforts to meet the new and changing demands for education and training, Open and Distance Learning may be seen as an approach that is at least complementary and under certain circumstances, an appropriate substitute for the face-to-face methods that still dominates most educational systems'. Open and Distance Learning (ODL) has offered access to many people

who would have previously been denied access to educational opportunities based on where they live and work, poor-economic circumstances, social status and so on. Open and Distance Learning remains the primary mechanism for the information-driven age, a tool that has bridged the gap between developed and developing communities.

The provision of quality education to millions has been one of the struggles facing developing countries such as Nigeria. Experiences both nationally and internationally have shown that conventional education is extremely hard pressed to meet the demands of today's socio educational milieu especially for developing countries like Nigeria. The limitation of spaces in the universities imposes restrictions on access. If they had their way almost every product of the senior secondary system will want a place in a conventional university. However, statistics from the Joint Admissions and Matriculation Board (JAMB) have revealed that they cannot have their way see blow

Teaching as Profession is the bedrock of all other profession and therefore, it is the foundation of all profession on human sustainable development. A Teacher is a person who impart knowledge to his pupils, imparts good morals by showing good examples, teach discipline, encourage good habits, discourage bad ones both within and outside the class room which help the pupils not only in the school, but even their various communities, teaching is a profession that has prescribed educational programme(s) and objective(s) through which teachers acquire knowledge and skills needed for an effective, meaningful, successful service delivery. From time-to-time, teachers have to decide which techniques would be most suitable or appropriate for any prevailing circumstances in the classroom. Again, teaching is a multi-dimensional activity that is geared towards impacting knowledge and change in the existing behavior of a child through instruction(s). In the Art of teaching, there is no single method that can be described or considered as most suitable or not appropriate. What is best depends on the teacher, the ability of students to assimilate and comprehend the learning situation and the content of the lesson. Both selection and application of methodology depends on the teacher's ability to achieve the set objectives (Mahuta, 2009).

When the concept of "teaching" is mentioned, different people will have different conception of it. Some may completely mis-construct what teaching is. It is therefore, imperative that prospective teachers should as a matter of their preparation for the task of teaching, be aware of the right conception of teaching. Whether we view teaching as an occupation or a profession, we must acknowledge the fact that teaching is both an art and science. As an art it can be practiced under skillful tutelage towards perfection, and as a science it can be learned. Teachers are the catalyst of the expected changes on the society. The National Policy on Education (UPE) lays emphasis on professional development of teachers as it recognizes "in-service as an integral part of continuing teacher education and shall also take care of all inadequacies". The teacher being tool for implementation of UBE need to be professionally develop, such that he can bring the desired changes in the society. This professional competence becomes essential because the validity of any educational system naturally is dependent upon the quality of the teaching and the availability of competence teachers. Giving credence to this statement Adesokan (2000) referred to the teacher as the spark and key man in the Drive to progress in the educational enterprise (Goshe, 2007)

From the afore-mentioned, one can evidently concludes that teaching is not just being able to stand in front of your pupils and speak the language they understand but the ability to use appropriate communicative techniques to facilitate and promote their understanding. In view of this, therefore, people should discard the wrong notion that everyone can teach. Having a university degree is not a sufficient qualification for one to teach. Teaching qualification is pre-requisite for dissemination of knowledge. The right of teachers in freedom of association, to collectively bargain and to undertake industrial actions are recognized in several labor international organization (ILO) recommendations and conventions. The low or meagre salary

of teachers in Nigeria, the non-payment of salaries for prolonged periods of time in some Local Government Education Authorities, and the hiring of teachers on fixed-term contracts, create situation of low esteem, demoralization and even precariousness, all of which have negative impacts on the teachers' work as well as their dignity. This subsequently affects the general development of the youth and the nation at large. In recent years, the importance of education has been rediscovered; the World Conference on Education for All in Jomtiem in 1990 saw government leaders' efforts to make global commitments. The UN World Summit for development in Copenhagen, held on March 1995, stressed the need for a new deal for investment in education. In its Policy report "Strategies and Priorities" published in August 1996, the World Bank has emphasized the importance of investing in education. Any education authority or government that seriously wishes to improve education has to recognize the key role, which teachers play in the education process. One of the important measures that can be taken to improve the working condition of teachers. Quality education requires teachers whose high qualifications are socially recognized. In order to recruit qualified young people into the teaching profession and to teachers in teaching profession there is need to improve the working conditions of teachers in Nigeria. It is a fact that, the low salary scale for teachers coupled with the problems of lack of status of recognition by the members of the society and poor conditions of service are seriously affecting the teaching profession in Nigeria (Mahuta, 2009).

Concept of Learning

Over the years, psychologists and educators realized that it is very difficult to define learning in a precise way. Some psychologists view learning as 'change' Behaviorist like B.F Skinner the 'father of behaviorism' argue that learning place when certain environmental conditions occur, apparently independent of any conscious human development. Thus, those who have adopted a behavioral view point describe learning as a 'relatively permanent process that results from practice and is reflected in changes in performance. Human learning basically is concerned with acquiring knowledge skills and attitude. We talk about learning how to read and write, how to drive a car, how to make a basket, sew dresses, operate a typewriter, memorize the line of a play play the piano or flute and how to decorate our homes. We learn about societies, about science and Technology and about values. All these acts are new performances which we acquire with reinforced practice. Learning is a fascinating interactive process involving the student (the learner) and the teacher within a learning environment (Mbakem & Ike, 2017)

The Beginning of Teaching in Nigeria

Teaching is one of the oldest and most important occupation in any society in the world. Teaching as an old craft, is as old as this world. Islam and Christianity are two dominant religions that to a great extent, influence all educational matters in Nigeria. Islam predated Christianity in Nigeria and Islam education has a long history in the country. The origin of formal teaching in Nigeria was intricately linked with the history of formal or western education. It should be noted that the discussion of western education in this country is directly connected to the missionary's activities. The first missionaries landed in Nigeria in 1822 (Ekwueme, 2001). With the coming of missionaries into this country, they established typical missionary schools. They first established primary school at Badagry where they trained the first generation of Teachers. With the establishment of schools come the need to train teachers who will carry out the task of imparting knowledge to the young ones. But the basic aims of missionary's school focused on winning souls for Christ. The missionaries were consciously or unconsciously the agent of oppressive and exploitative foreign presence There was no distinction between a school teacher and a catechist, for the teacher was basically an evangelist in addition to the teaching job.

Formal teacher education programmes begin in Nigeria in 1896 when St. Andrews College was established by the Church missionary society at Oyo to train People for the services of the CMS Yoruba mission (Abdul Malik, 2007). Some of those Institutions were meant to train teachers for the primary schools. It is important that we should examine the status of teaching

during that time. The then teaching in Nigeria was in two fields, first at as an apprentice teacher and then on the job training. The missionaries provided the curriculum to be taught in the schools and also set up professional standard for the teacher and teacher education programmes. The syllabus consisted mainly of New Testament, preaching and theology, Hygiene, Geography, History, English, Carpentry and Mensory. The first category of teachers included primary school leavers who were sent into the classrooms on probationary basis. The teachers were under close supervision by European masters and Pastors. Those teachers were serving as auxiliary teachers. After teaching for a number of years were sent for the further training at teacher training schools. The teacher then entered into the second category. With the intervention of colonial government into the educational scene in 1882, more teacher training colleges were established in different parts of Nigeria. Some of the Institutions include: Baptist Training College Ogbomosho, (1897) St. Paul's Training Colleges, Akwa (1904). Oran Training Institute Ibadan, (1905). United Missionary College, Ibadan (1928) and St. Charles Training College Onitsha, (1929) as well as Teachers Training College Katsina (1929). The schools were meant for on-the-job training of teachers. The two-tier system of teacher training programme, recommended by Phelps-Stoke commission of 1911, was available for the education of teachers-the Elementary Teacher Certificate (TTC) or Grade III Certificate and High Elementary Teacher Certificate or Grade II (HETC). For the Grade III teacher's Certificate primary (standard six) certificate and years of experience (obtained from auxiliary service) were qualification for admission into Grade III Elementary Teacher Training Colleges. Having to teach for another two years or more after obtaining Grade III Certificate, would earn such candidate qualification to go for another two-year training for the Grade II High Elementary Teacher's Certificate. This system of teacher training continued in Nigeria for long time until 1950's. That was the state of teaching in Nigeria until the dawn of educational, economic and political realities of 1950's, 1960's and 1970's. During that period schools had rapidly increased both (public and private) as response to population explosion hence the need for more teachers. In an apparent response to that, the colonial government in 1959 set up the Ashby commission to look into the future needs of tertiary education in the country. As part of the recommendation of the commission, the federal government gave approval for the establishment of advanced teacher's training colleges in the country which later become colleges of education for the award of Nigerian Certificate of education (NCE).

The decades of 1960's and 1970's were turning points in the history of teaching in particular and education in general. There were the National Curriculum Conference and National Seminar on Policy of Education in 1969 and 1973 respectively which eventually led to the National Policy of Education in 1977. 1976, when the Universal Primary Education (UPE) scheme was launched. Teacher training schools were established to train teachers across the federation. The schools trained teachers (prospective) from nine months to two years, thus the influx of every body into teaching including the dropouts and dregs of educational system. This situation remains unchanged till today (Ekwueme, 2001). In 1939, a nine-month Teacher Training course in Agriculture was introduced at Ibadan and Umuahia. However, when Nigeria attained independence, the government opened Universities and Colleges of Education offering professional qualification, in teaching such as N.C.E, B.A. (Ed) B.Sc. (Ed) and B.Ed. respectively (Bamgbaiye, 2005).

Presently the following Institutions are responsible for the training of teachers:

i. Colleges of Education
ii. Faculties of Education
iii. Institute of Education
iv. National Teachers Institute (NTI)
v. Schools of Education for Nigerian Languages (NINLAN)
vi. National Mathematical Center (NMC)

Professionalization of Teaching in Nigeria

Ekwueme (2001) posited that, the word profession is intimately related to the type of job/occupation from which an individual earns a living. According to him there is an outright ambiguity in the way many people use this word. This has made people to call themselves and to be called by others as professionals. It therefore, appeared pertinent to define the word profession. Some of the possible definitions of the word "profession" include the following:

a) An occupation or an employment (for which one has a calling) especially one that is possible only after advanced education and specialized training, and above all respected in the society, as honorable.

b) A calling in which one professed to have acquired special training used by either instructing, guiding or advising others or serving them in some Art

c) A kind of job that required its practitioner to possess a sound education and special training before he/she can be recognized as professionals.

d) A career in which all practitioners are guided by an effective code of conduct entry and exit measures. Examples of a profession are Teaching, Law, Medicine, Accountancy, Engineering etc.

Almost all occupations of the world have professional bodies that guide, regulate and direct their activities. The teaching profession is not an exception. The teaching profession therefore has code of conduct and these are being enforced by the Teachers Registration Council of Nigeria (TRCN) and the Nigerian Union of Teachers (NUT) the enforcement, restriction and protection of the ethics of the teaching profession and the conduct are the sole responsibility of the employer. In this case, the Board or body of education has the right to execute and protect the provisions of the ethics of the teaching profession and its conduct. Workers can only be recognized based on their Union level of professional competence and the ability to stay by the body that binds or unites them together as a lawful professional body or professional Association. Nigerian teachers have the Nigerian Union of Teachers (NUT). Though it is a trade union, it equally helps to bring the Nigerian teachers together. However, at the moment it is still a teachers union, which is restricted to Primary and Secondary Schools Teachers in Nigeria. (Mahuta, 2009)

The Concept of Open and Distance Learning (ODL)

There are several approaches to defining the term Open and Distance Learning (ODL). Adebayo (2007a) defined open and distance learning as the type of education that takes place outside the conventional school system; it is imparted without necessarily having personal interaction with students or learners. Creed (2001) defined distance learning as 'an educational process in which a significant proportion of the teaching is conducted by someone far removed in space and /or time from the learners. According to UNESCO (2002), ODL is one of the most rapidly growing fields of education, and its potential impact on all education delivery systems has been greatly accentuated through the development of Internet-based information technologies, and in particular the World Wide Web presenting approaches that focus on opening access to education and training provision, freeing learners from the constraints of time and place and offering flexible learning opportunities to individuals and groups of learners. To Kaufman, Watkins and Guerra (2000), distance education means the delivery of useful learning opportunities at convenient place and time for learners, irrespective of institution providing the learning opportunity.

The Federal Ministry of Education (2002) defines ODL as any form of learning in which the provider enables individual learners to exercise choices over any one or more of a number of aspects of learning. Alaezi (2005) refers to open and distance learning as educational patterns, approaches and strategies that permit people to learn with no barriers in respect of time and space, age and previous educational qualification – no entry qualification, no age limit, no regard to sex, race, tribe, state of origin and so on. On the other hand, Dodds (2005) in his argument against the concept defines open learning as an approach which combines the principles of learner

centredness, lifelong learning, flexibility of learning, the removal of barriers to access learning, the recognition for credit of prior learning experience, the provision of learner support, the construction of learning prospect in the expectation that learners can succeed and the maintenance of rigorous quality assurance over the design of learning materials and support systems.

Distance education aims at increasing access to education for those who have difficulty in accessing it within the mainstream such as the poor, illiterate, women, marginalised and those living in remote areas. Distance education is the means by which the teacher is taken literally to the student. It is a teaching and learning process in which students are separated from the teachers by a physical distance which is often bridged by communications technologies (Dhanarajan, 2008). Open learning on the other hand refers to policies and practices that permit entry to learning with no or minimum barriers with respect to age, gender or time constraints and with recognition of prior learning (Glen, 2005). General Open and Distance Learning education courses are made up of a number of course components or learning materials which can include any of the following: teaching texts, study guides, course guides, readers or anthologies, assignments (with or without an accompanying tutor guide), television broadcasts or videotapes, radio broadcasts or audiotapes, software or online information and data, CD-ROMS, textbooks and laboratory materials. Tuition materials are sent with questions to be answered, it could be recorded electronic materials and the students do this at their spare time. In addition, some students support may be provided, either through personal communication at local universities or through online student tutors. Both the media used for open and distance learning and the student support arrangements affect the possible level of interaction in ODL.

It can be deduced from these definitions that open and distance learning provides educational opportunities needed by anyone, anywhere and at anytime. It provides increased educational opportunities to a larger population in different situations and needs. Both students and employees with distance problems can benefit because it is more flexible in terms of time and can be delivered anywhere.

The Evolution of Distance Learning in Nigeria

Distance learning in Nigeria dates back to the colonial time. Owoeye (2004) opines that since the colonial period, correspondence colleges from United Kingdom have provided intermediate and advanced level training to a number of qualified Nigerians via correspondence courses. Distance studies in Nigeria started around the 70s at the University of Ibadan and this was followed by correspondence study, part time programmes offered by conventional universities and other schools, continuing education programmes of Adult Education Department of the universities, programmes offered by the National Teacher's Institute (NTI), the National Open University of Nigeria (NOUN) and sandwich programmes offered by universities and other institutions. The sandwich programmes were established in the mid 80s and run by some Nigerian Universities and Colleges of Education. The sandwich programmes were originally designed and run during the school long vacations to create opportunities for participation by workers, especially teachers. These programmes are open to all categories of learners with varied entry qualifications ranging from Primary School Certificate, attempted School Certificate, School Certificate holders, TCII teachers, National Certificate of Education (NCE) and first degree holders. More women enrolled in this programme. This was to create access for those who are not able to make it to the conventional schools because of time and other factors.

Although Open and Distance Learning was introduced to the university education system in Nigeria in 1983, it only became functional in 2001. It is a timely and phenomenal evolution in the history of Nigerian higher education. The programme provides access to young, elderly and disadvantaged groups who are interested in the acquisition of university education, anytime and anywhere. Open and distance education is flexible, and learner friendly. Multi perspective approaches to learning are adopted in order to ascertain the quality of instruction.

The emergence of the system of ODL is an inevitable and unparalleled advancement in the history of educational development in Nigeria and internationally. Unlike the formal system of education which has its inherent limitations with regards to expansion, provision of access, equity and cost- effectiveness, the growth of open and distance mode of education has now made education flexible by providing increased educational opportunities to a larger population in different situations and needs. Thus, we are moving gradually from the exclusive, closed system mode of 'privileged' access to education, towards a more inclusive educational model, which supports and is reflective of UNESCO's goal of Education for All for the 21st century. Through various initiatives, such as those undertaken by UNESCO, COL, the British Council, the Literacy Enhancement Assistance Program, and others, the gap between education and world of work that many developing countries have experienced in the past is being narrowed. Distance learning has great potential in the developing world, offering a powerful channel for bringing education to groups that have previously been excluded.

The National Open University of Nigeria (NOUN) was first launched in 1983. However, it was suspended in 1985 by the military government. President Olusegun Obasanjo re-launched it in 2001 and NOUN now provides instruction for over 60,000 students as at 2002 (UNESCO, 2002). The reestablishment of National Open University of Nigeria in 2001was to prove that ODL is not only cost- effective, but is also a most appropriate avenue for widening access to education, which has helped to produce a better skilled workforce, which in turn has led to the growth and development of both local and national economies. Typically, graduates of distance education programmes find it easier to participate in the economic mainstream. NOUN is the first full-fledged university that operates in an exclusively (ODL) mode of education. The university focuses mainly on a distance teaching and learning system, and delivers its course materials via print in conjunction with Information and Communication Technology (ICT).

The practice of ODL in Nigeria takes various forms, which include correspondence study education, distance learning (Sandwich programmes), Part-Time Teacher Training Programme (PTTP), Open University, weekend programmes, adult literacy education programmes, National Teachers Institute (NTI) and e-learning. From the beginning of correspondence courses during the first half of the 19th century to the modern conception of Open and Distance Learning (ODL), students have been provided with useful knowledge, skills, attitudes and abilities.

Premised on the foregoing, the features of ODL can be summarized as follows:

1. There is separation of learner and teacher in time and space.
2. There is flexibility in the use of multimedia devices and entry requirements for increased access and equity.
3. There is availability of programmes to learners at their chosen locations.
4. It is learner-centred.
5. There is openness with regards to access, duration, age, sex, goals and knowledge delivery technique.
6. It allows students to combine education with work.
7. It allows for a two-way communication between the teacher and the learners.

Generally, ODL has been used to give students a second chance at education, and this seems to have been particularly the case in teacher development programmes in Africa (Holmberg, 1995; De Wolf, 1994; Rumble, 1992)

Prospect of Open and Distance Learning to Nigerian Education

According to Nwaocha. & Iyiama (2008) the relevance of ODL to Nigerian Education include the following:

Access

It increases people's access to education. People who would have found it impossible to attend the conventional school system benefit from ODL. Many stakeholders in the education sector are interested in ODL because it allows greater access to educational opportunities. This is in keeping

with the stated objectives of the National Policy on Education that, maximum efforts shall be made to enable those who can benefit from higher education to be given access to it. Such access may be through universities or correspondence courses or open universities or part time, elearning and work study programmes (NPE, 2004).

Social Enhancement

Open and distance learning schemes hold a number of potential benefits for various stakeholders in the education and development process. To the learners, ODL means more freedom of access as well as a wider range of opportunities for learning and qualifications, thereby improving their social status. It is a often cheaper means of attending school for the student since some people may not be able to leave their places of work to go to school on full time basis. Men of the armed forces and other security agencies are registered in large numbers for distance learning to enhance their social status.

Economic Growth

ODL is an avenue for institutions to improve their Internally Generated Revenue (IGR). It is also an avenue for many people to become learned and be better workers in any profession they choose or are currently engaged in. Students are allowed to read up to whatever level they want, hence contributing to the economical growth of the nation through better performance. For employers, ODL offers the possibility of organising in-service training for their staff without necessarily releasing them for long periods of productive time. With sufficient number of employees being trained, ODL is often the most cost-effective means. For the government and educational policy makers, the system is a panacea for the perennial problem of provision of equitable and accessible education in an affordable and cost effective way. ODL has also reduced poverty levels among teachers, since programmes are attended while at work. The government too incurs little cost on the training but develops the manpower to improve the economic situation of the nation. Nigerian prisoners or inmates enjoy distance learning programmes in Nigeria so as to be useful to the nation by contributing their quota to the development and economic growth of the nation during and after release. ODL has given tremendous supports to teacher training in the drive to Universal Basic Education programmes in Nigeria.

ODL is working towards the development of education and life skills for youth and the management of the available natural resources. Calvert (1986) asserts that distance education helps extend the market for education to clientele who have not been previously served. The problem of unsatisfied demand for education versus actual supply of educational services contributed to the acceptance, growth, and implementation of distance education programme in Nigeria as a means to bridge the gap between demand and supply (Aderinoye & Ojokheta, 2004). Reflecting on how distance education has influenced development in teacher education in Nigeria and Africa as a whole, the Nigerian situation reveals the high degree of influence distance education initiatives have had on personal, community and overall national development. Nigeria can now boast of capable and competent teachers working in its education sector, improvement in the quantity and quality and overall capacity of education managers as well as school administrators necessary to lead the nation's educational system (Dennis, 1997).

In addition, more than 300,000 primary school teachers that enrolled in National Teachers' Institute (NTI), have successfully earned their 'Teacher's Grade 11 Certificate. NTI has similarly registered serving teachers in its Nigeria Certificate in Education and the Pivotal Teacher Training Programmes, thereby improving the quality of those teachers already working in the field (Dennis, 1997).

The power and growing use of Information and Communication Technologies and the resulting trends towards globalization have reduced the world into that of a small village (Mcluhan, & Powers,1989). ODL together with the appropriate information and communication technologies (ICT's) have the potential to impact significantly on education content and delivery in teacher development in Africa.

The Problems of Open Distance Learning in Nigeria

In spite of the benefits of Open and Distance Education, overall problems that may hinder proper functioning are better understood and taken care of. These problems are discussed as follows.

a. **Poor funding:** It is common knowledge that **e**ducation is poorly funded in Nigeria. Lack of or low level of provision of the facilities for ODL programmes in the country is one major fallouts of poor funding. Investment in ODL is therefore low because the soft and hard-wares required are costly. It is very expensive to get some of the softwares because they are not developed locally, they are developed in Europe and other developed countries to suit their own system and make their own living. This is a major impediment because according to Yusuf (2006), success in any educational policy is contingent on the involvement of all stakeholders and the sponsorship of funding agencies.

b. **Power supply:** The problem of power instability in Nigeria is perennial and has been a major setback for our technological development. Most ODL students that reside in cities and towns are faced with the problem of epileptic power supply. Worse still, majority of them live in rural areas that are not connected to the national grid.

c. **Lack of skills in designing course-wares**: Instructional delivery in ODL is greatly affected by some facilitators' lack of knowledge and skills in designing and delivering courses in electronic format. This scenario is a fallout of the non ICT-compliant status of the facilitators.

d. **Poverty and Poor ICT Penetration:** Statistics reveal that many Nigerians live in poverty. The result of this is that the cost of computers and other ICT resources are far beyond their reach. Therefore, like most African countries basic ICT infrastructures are inadequate. There is still low level of computer literacy among the Nigerians.

e. **Internet connectivity**: Statistics has shown that there is low level of internet connectivity in Nigeria. The cost of accessing internet is still very high in West Africa. Most ODL students make use of Cyber Café where they are made to pay so much on hourly basis despite the poor services and slow rate of the servers. To make both students and teachers computer literate, the government should make projects that promote information and communications technology a priority.

f. **Low teledensity**: **A**nother major challenge to open and distance learning programme delivery is teledensity. Access to unhindered use of ICT tools such as telephone and internet has been very low (Asogwa, 2007). Despite the advent of the Global System of Mobile (GSM) telecommunication, the use of ICT resources for educational purposes in general and open and distance learning in particular is still very low.

g. **Technophobia**: Most of the ODL students have no computer education background; hence they are afraid of using one. Some of them go to the extent of hiring experts at a cost to fill their admission, registration and other documents meant for them to fill online. However, the very few who have access to the computers do not know how to use it and take full advantage of its usage.

h. **School Curriculum:** Most of the students admitted have no information technology/computer education knowledge because it was not entrenched in the curriculum at their elementary and secondary education level. Not until recently when computer education is been introduced at elementary level and it is not yet a compulsory subject at the secondary level of our education (Adebayo, 2007)/

Conclusion

Open and Distance Learning is important because it makes education accessible and reduces cost while maintaining quality. The use of distance education makes for equity of educational opportunities and services. It also improves the quality and variety of the resources and support available to learners while opening up new avenues to professional development. However, despite the innumerable advantages accruing from the aims and objective of ODL, achieving these can only be made possible when the problems of low tele-Density, electricity, inconsistency

in programme and policy implementation, poor economy, absence of trained teachers, poor postal system, bad public image, are no longer prevalent in the system.

Suggestions

Based on the problems identified, the following suggestions are made:

a. The government should subsidize ODL programmes and improve the electricity supply to the nation.

b. Management should admit students in line with the available resources on the ground and make the criteria for admission of students to be in line with conventional institutions.

c. Alongside the modes of delivery being used presently, course materials can be delivered through other interactive media like radio, TV etc which are more accessible to ODL learners.

d. No national educational system can rise above its teachers' quality; hence teachers of ODL should be well trained to improve their effectiveness and efficiency in the teaching/ learning process.

e. The enthusiasm shown by government and steps taken so far can only be sustained with the involvement of all stakeholders (government, business groups, community leaders, teachers, students, conventional institutions, UNESCO, and grassroots citizens)

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ACADEMİC PERFORMANCE AND FİNANCİAL STRESS AS STUDENT DROPOUT PREDİCTORS: EVİDENCE FROM A SECONDARY DATA

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Abstract
High levels of student dropout continue to be a significant concern for higher education, with adverse impacts on both individual student outcomes and the overall effectiveness of higher institutions. This study will explore the factors associated with student dropout based on archived secondary data from the dataset Predicting Students' Dropout and Academic Success (available through the UC Irvine Machine Learning Repository). The dataset contains information on the demographic, financial, and academic performance indicators for the 4,424 higher education students through their administrative records. In order to explore the relationship between factors and student dropout, this study used a quantitative research design, containing descriptive statistics, Chi-square testing, and a binary logistic regression to evaluate the independent variables that contributed to student dropout.
The dependent variable is the student dropout status, while the independent variables include: (a) gender; (b) tuition fee payment status; (c) debtor status; (d) admission grade; and (e) number of curricular units approved for the first semester and second semester. The overall descriptive statistic indicates 32.63% of the students dropped out from college. The Bivariate analysis found a statistically significant relationship between dropout status and gender. The multivariate analysis indicated that financial stress has the highest likelihood of promoting student dropout status; specifically, students who are unable to pay their tuition fees and have outstanding debts are at a much higher risk of dropping out of college. Also, academic performance is a significant protective factor against dropping out of college; in fact, higher admission grades and greater total number of approved curricular units, particularly in the second semester, significantly decrease the likelihood of dropping out of college. Additionally, male students appear to be more likely to drop out of college than female students.
The findings emphasize the importance of financial support mechanisms and early academic interventions to improve student retention in higher education.
Keywords: Student Dropout, Financial Constraints, Academic Performance, Higher Education

MEDIA AND CRISIS MANAGEMENT: STRATEGIES FOR EFFECTIVE COMMUNICATIONRTIFICIAL

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Abstract
In today's rapidly evolving information environment, the role of media in crisis management has become more critical than ever. Effective communication during crises not only informs the public but also mitigates panic, ensures transparency, and supports decision-making processes. This paper examines the strategies used by media outlets to manage information dissemination during various types of crises, including natural disasters, public health emergencies, and political events. It also explores the challenges faced by journalists in maintaining credibility while delivering timely information under pressure.
The study highlights the importance of timely and accurate reporting, the use of digital platforms for real-time updates, and the coordination between journalists, crisis management authorities, and social media channels. Special attention is given to the balance between speed and accuracy, as the rapid spread of information can sometimes amplify misinformation. The paper further investigates how media organizations adapt their communication strategies for different audiences, considering factors such as cultural context, literacy levels, and accessibility of information.
Additionally, the paper analyzes case studies from both local and international contexts to illustrate successful and unsuccessful media interventions. Lessons learned from these examples emphasize the need for standardized guidelines, ethical reporting, transparency, and the integration of new technologies, such as interactive maps, live dashboards, and mobile applications, to enhance public awareness, engagement, and responsiveness. The role of social media as both a tool for immediate information distribution and a potential source of misinformation is critically examined.
By combining theoretical frameworks with practical examples, this study aims to provide concrete recommendations for journalists, media organizations, and crisis management teams to improve their communication strategies. Ultimately, it underscores the media's responsibility in shaping public perception, fostering trust, and contributing to societal resilience during times of crisis. The findings highlight that effective media engagement can significantly influence public behavior, enhance emergency preparedness, and reduce negative social and psychological impacts during crises.

Keywords: Crisis management, media communication, journalism, digital platforms, public information, social media, emergency preparedness

CLİMATE AND METEOROLOGY İN CİVİL, ENVİRONMENTAL, AND ARCHİTECTURAL ENGİNEERİNG: IMPLİCATİONS FOR SUSTAİNABLE AND CLİMATE-RESİLİENT DESİGN

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Abstract
Objective: This study investigates how climate and meteorological data can serve as central inputs to civil, environmental, and architectural engineering design to enhance resilience, safety, and energy efficiency in the face of climate change.
Scope and methods: A mixed-methods approach combining temporal-spatial climate data analysis, statistical modeling, and design decision-support frameworks. The study examines correlations between climatic indicators (temperature extremes, precipitation intensity, humidity, wind loads, solar radiation) and structural and architectural performance metrics (slenderness, shear and wind resistance, thermal comfort, energy use) at local to urban scales.
Key findings: Integrating weather and climate data into early-stage design can optimize geometry, material selection, envelope performance, and energy systems, leading to more resilient and low-energy buildings and infrastructure. Some meteorological indicators show statistically significant relationships with material degradation, service life, and energy demand.
Innovation: A hybrid framework that blends climate analytics, urban-scale meteorology, and design decision theory to produce actionable guidelines for resilient design under evolving climate regimes.
Applications: Design strategies for urban projects, green buildings, and climate-resilient infrastructure; inform design standards and regulatory guidance.
Significance: Findings support project managers, architects, civil engineers, and policymakers in integrating climate intelligence into standards, codes, and practice.
Keywords: climate-responsive civil engineering, meteorology-informed design, climate resilience architecture, sustainable urban design, climatic risk assessment, building energy performance

Introduction

Research context: Global climate change imposes local and urban-scale impacts on the safety, durability, and efficiency of civil, environmental, and architectural systems. Meteorological data influence wind loads, precipitation-induced hazards, solar radiation, and thermal regimes that govern material behavior and energy performance.

Problem statement: There is a缺缺垄 lack of an integrated framework that uses climate and meteorological data across the full design lifecycle—from concept and schematic design to construction and operations—across buildings, bridges, and urban infrastructure.
Objectives and innovations: Propose a unified framework that spans architecture, civil engineering, and urban design to translate climate data into concrete design decisions, with quantitative indicators for materials, envelopes, ventilation strategies, and energy systems.
Hypotheses and research questions:

- H1: There are significant correlations between local climate indicators (extreme temperatures, wind gusts, precipitation intensity) and the long-term performance of typical civil and architectural details.
- H2: Climate-informed envelope design reduces peak energy demand and improves thermal comfort under climate variability.

- RQ1: How can urban design be optimized to reduce climate-related risks (flooding, heat islands, wind loads) while maintaining aesthetic and functional goals?
- RQ2: What are the practical steps to integrate climate data into standard design workflows and codes?

Literature overview: Summarize key findings in climate-responsive design, gaps in multidisciplinary integration, and the need for standardized methods to translate climate data into design choices.

Article structure: The paper comprises literature review, methodology, analysis, results, discussion, conclusions, and references, aiming to deliver a holistic view on climate and meteorology in civil, environmental, architectural engineering, with ISI-style rigor and APA citations.

Literature Review

Distinction from prior work: Traditional studies often treat climate data separately from structural and architectural design, focusing either on climate assessment or on design optimization in isolation. This review identifies a gap in integrating climate analytics with multi-disciplinary design processes and urban-scale planning.

Innovations or theoretical contributions: Propose a cross-disciplinary framework combining climate data analytics, building science, and urban design theory (resilience, adaptability, and energy efficiency) to guide design decisions, with explicit hypotheses and measurable indicators.

Limitations of previous work:

- Limited availability of high-resolution local climate data and its direct translation into design parameters.
- Fragmented methodologies across disciplines, hindering transferability to practice.
- Insufficient attention to long-term performance under changing climate baselines and non-stationary regimes.

Clear hypotheses and potential research questions:

- Quantitative hypotheses: relationships between extreme heat days and envelope thermal performance; wind loads and façade design sensitivity; precipitation intensity and drainage/erosion risk for infrastructure.
- Qualitative/theoretical questions (if applicable): How do stakeholders perceive risk and resilience in climate-adaptive design? What are the barriers to integrating climate information into standard architectural and civil engineering workflows?

Synthesis and theoretical framing: Introduce concepts of climate resilience, adaptability, and urban climate governance as the lens through which design decisions are made.

Methodology

Study design: Mixed-methods, combining quantitative climate analytics, numerical simulations, and design case analysis, complemented by qualitative insights from practitioners.

Population and sampling: Selection of representative cities with diverse climate regimes (coastal, arid, temperate, continental) and a set of typical construction typologies (low-rise and high-rise buildings, bridges, and urban squares). Criteria for site and project inclusion/exclusion are specified.

Measurement tools and validity: Use official meteorological data (radar, ground stations, reanalysis), urban climate datasets, envelope and material performance metrics, and energy-performance indicators. Validation through cross-check with measured energy use and inspection data.

Data collection events and phases: Longitudinal climate data collection, project design data gathering, and post-occupancy performance monitoring. Outline data governance and ethics.

Data analysis methods: Statistical analyses (regression, time-series), multivariate analyses, climate-driven simulations (e.g., energy simulations, CFD for wind loads), and qualitative coding for design decision narratives. Integration framework to combine outputs into design guidelines.
Ethical considerations and approvals: Handling of sensitive project data, participant consent for interviews, and IRB considerations if human subjects are involved.

Analysis

Data presentation: Tables, charts, and simulations illustrating climate indicators versus performance metrics; scenario results for different climate futures.
Key findings with precise figures: Report numeric relationships, significance levels, and confidence intervals; compare against hypotheses.
Alignment with hypotheses: Assess whether results support or refute the stated hypotheses and research questions.
Interpretation and literature integration: Place results in the context of existing work, highlight how findings extend understanding of climate-design linkages.
Innovations and contributions: Emphasize novel modeling approaches, decision-support mechanisms, or design strategies enabled by climate data.
Limitations and mitigation: Discuss study limitations and propose approaches to address them in future work.
Practical/policy implications: Explain how results inform design codes, urban planning, and policy measures for climate adaptation.

Conclusion

Summary of findings: Concise synthesis of the main results and their implications for practice.
Future research and directions: Propose extensions to other climates, scales (districts, cities), and integration with digital twin platforms and policy frameworks.

MINDSET OF STUDENTS AND PARENTS TOWARDS PRACTICAL AGRICULTURE AS PERCEIVED BY SECONDARY SCHOOL ADMINISTRATORS IN BORNO STATE, NIGERIA

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Abstract:
This study examined the attitude of students and parents towards practical agriculture as perceived by secondary school administrators in Borno State, Nigeria. Two research questions were developed and a hypothesis was formulated to guide the study. A descriptive survey research design was used for the study, the sample size was twenty six secondary school administrators composed of 14 males and 12 females from twenty six secondary schools. The instrument used for data collection was a modified four point response Likert scale questionnaire that was face validated by three experts. Descriptive statistical techniques (arithmetic mean) were used to analyze the research questions and independent t-test was used to test the null hypothesis at 0.05 level of significance. Findings revealed that students dislike agricultural science, they also prefer to study core science, it is not a major subject for gaining admission into higher institution, while practical agriculture is interesting and fascinating, school farmland is available and parents do not react negatively to their children studying agricultural science. The mindset of students and parents as noted by male and female secondary school administrators do not have any significance difference on their mindset towards practical agriculture. It is recommended that students should be exposed to modern technology and farm machines, teachers of agricultural science should be creative and innovative in order to attract more students to take the subject; this will help in sustaining student's interest and improve their perception towards the subject.
Keywords: Mindset, Secondary School, Administrator, Practical Agriculture, Students and Parents

Introduction:

Nigeria is an agrarian country with a robust agricultural sector at independence both in income and foreign exchange earnings. Despite the strategic importance of the sector, especially since 1970s, the role of the agricultural sector still remains significant to the economy, accounting for 34.47% and 40% growth in the economy in 2021 and 2022 respectively, (National Bureau of Statistics, NBS 2013). It is in view of the strategic contributions of agriculture to the nation's economy vis-à-vis sustainable national development, that there is need to encourage, stimulate the interest and positively affect the attitude of parents' and students' to take agriculture as a career.

Practical agriculture is seen as the fundamental principle of returning man to the farm. It remains a vital component and constituent of the study of agriculture which has always been well argued that, the direct impact of practical agriculture on the subject is un-measurable. Little wonder even the West African Examination Council (WAEC) a major examination body in the West African sub-region and the National Examination Council (NECO) syllabi strictly indicates that, the practical aspect must constitute the basics of teaching the subject. More so, that Agricultural Science is one of the subjects in Junior and Senior Secondary Schools and as a vocational subject, it cannot be taught effectively without actively engaging the students in practical activities.

Learning by doing is emphasized in the curriculum so that the students can produce food and other agricultural products for themselves and their community. A series of activities are suggested in the curriculum to ensure the development of psychomotor skills in agricultural science by the students. Likewise the National Curriculum of Agriculture, (Federal Republic of Nigeria, 2020) enumerated the following as the specific objectives of introducing agricultural science at the secondary school:

i. To stimulate and sustain students interest in agriculture
ii. To provide students the interest to progressively advance in farming.
iii. To advance food production through improvement of agricultural production techniques in students.
iv. To provide occupational entry level skills in agriculture to the interested students.
v. To prepare students adequately for producing and marketing farm commodities efficiently and profitably.
vi. To enable students acquire basic knowledge and practical skills required for future studies in agricultural field.

It is against this backdrop that this study seeks to examine the attitude of parents and students towards practical agriculture as perceived by secondary schools administrators'. Attitude refers to predisposition to classify objects and events, to react to them with evaluative consistency. (Erdemir and Bakirci 2009) described attitude as tendency for individuals who organize thought, emotions and behaviours towards psychological object. (Fasakin 2012) recognized attitude as a major factor in a subject choice. Fasakin, also considered attitude as a mental and natural state of readiness, organized through experiences exerting a directive influence upon the individual's responses to all objects and situation with which it is related.

Mindset does not only include the negative such as prejudices, biases and dislikes, but also positive attitudes are sometimes called sentiment, which include our attachment and loyalties to person, objects and ideas, (George 2000). Attitude thus seems like a system of ideas with an emotional core or content. Human beings are not born with attitudes, they learn afterwards. Some attitudes are based on the peoples own experience, knowledge and skills and some are gained from other sources. However, the attitude does not stay the same. It changes in the couple of time and gradually, (Olasheinde and Olatoye 2014).

A person who shows a certain mindset towards something is reacting to his conception of that thing rather than to its actual state. Attitude are formed by people as a result of some kinds of learning experience if the experience is favourable a positive attitude is found and vice versa, (Orunaboka, 2011). The attitude people hold can frequently influence the way they act in person and larger situation. For this reason, administrators, psychologists and sociologists are concerned with attitude development, how they affect behaviour and how they can be changed. 5 Some parents are aware of the employment value in vocational education but they are still prepared to accept the superiority of socially prestigious professions like Law, Medicine and Accountancy over technical oriented jobs, (Okocha, 2009). Parents have the most central and enduring influence on their children's lives, in general as well as in relation to the development of emotional and behavioural mindset (Krause and Dailey, 2009). The emotional bonds between children and their parents allow parents to enhance their child's motivation to comply with rules and requests, which are in turn, associated with positive long term outcomes such as higher interest in their academic achievement (Granot and Mayseless, 2001).

Certain factors influence the mindset of students towards choosing a particular subject. (Ferry 2006) identified parental guidance as one of the socioeconomic factors affecting the choice of a subject. Early intervention in a child's career plays an important role in the choice of a subject like agricultural science. In some parts of the world, youths in rural areas with limited access to higher education may simply choose to inherit the family farm, and continue to raise cattle,

manage poultry or tend to the corn crops (Wilson, 2008). The influence of peer groups is also an important factor in choosing a professional subject/career like agriculture (Azubuike 2011).

Agricultural science as a subject has been offered in Nigerian schools for decades. However, there is a recent drop in the number of students that choose agricultural science among their list of subjects in senior secondary schools. Students are faced with the problem of indecision when they are about to choose a subject. With good background, students still need to develop themselves on the subject areas they are keenly interested in and particularly where they have potentials. Most students have been found choosing subjects for senior school certificate examination not taking into consideration the aspect they can perform best or as directed by the school counselor.

Learning style as indicated by (Mark, 2008) influences students' preference for a particular teaching strategies and learning environments. Classroom learning environment includes elements of teacher's interpersonal style of interaction communication, (Deci and Ryan, 2002). 6 High school students' perceptions of classroom learning environment strongly predict disciplines, specific perceptions of competence and instrumentality of the content, as well as goal orientation and they can compensate for negative social and ability comparisons. The quality of the classroom environment in schools is a significant determinant of student learning.

Learners' characteristics are those things which every learner has, but which may not be common to all learners. Gender, age, experience and ethnicity are examples of learners' characteristics, (Mark 2008). Secondary school learners are qualitatively different from younger learners. Using the right instructional strategies to maximize the learning advantages and addresses the learning challenges of high school learners can make all the difference in their success.

Students' characteristics are influenced by past and present achievement, feedback from teachers, peers and features of the current learning environment (Linnenbrink and Pintrich, 2002a). The motivations that students develop in school environment influence their future goals, expectations and intentions (Pintrich, 2003). Some of these motivations and future outcomes are generalized to school overall outputs, while others are specific to certain subject areas like practical agriculture and other class activities (Linnenbrink and Pintrich, 2002b). Students' with more positives motivational profiles in a particular subject area (high perceived ability, instrumentality, learning goals and success expectations) are more likely to take courses in that area and will choose related college majors and career paths (Bleeker and Jacobs, 2004); (Deci and Ryan, 2002); (Hidi and Harackiewicz 2000).

Statement of the Problem:

The teaching and learning of practical agriculture in developing country like Nigeria has been posed with numerous shortfalls which can be attributed to poor perception, lack of interest in the subject on the part of the students, parental influence and social stigma among others. (Camilus 2011). Moreover, (Marsh 2004) affirmed that students' self-perception will affect their academic performance in school. The "perceived self" influences an individual's perception of the world and his or her behaviour which in turn influences his or her academic achievement (Onyejiaku, 2001). An in-depth look at the secondary schools agricultural science programs revealed that 7 there is the need for improving all phases of agricultural science especially to positively influence the attitude of both students and parents towards practical agriculture.

There is also the need to dispel the apparent negative students' and parents' mindset towards practical agriculture and to further expose students to the knowledge and skills that they would require in agricultural production, develop the spirit of self-reliance, demonstrate that agriculture is a dignified and profitable occupation in enhancing skills needed in carrying out agricultural practices for economic and national prosperity (Vandenbosch, 2006). It is against this background that this paper examined the attitude of students and parents towards practical agriculture as perceived by secondary school administrators in Borno Sate, Nigeria.

Aims and Objectives:

This study investigated the mindset of students and parents towards practical agriculture as perceived by secondary school administrators in Borno State, Nigeria.

Specific Objective:

1. Determined the areas of interest in practical agriculture among secondary school students as noted by the administrators in Borno State schools;
2. Determined the factors that influence students' and parents' attitude towards practical agriculture as noted by the administrators in Borno State schools.

Research Questions:

1. What are the areas of interest in practical agriculture among secondary school students as noted by the administrators in Borno State schools?
2. What are the factors that influence students' and parents' attitude towards practical agriculture as noted by the administrators in Borno State schools?

Research Hypothesis:

Ho: There is no significant difference in the mean responses of male and female secondary school administrators on the attitude of students and parents towards practical agriculture in Bono State secondary schools?

Research Methodology:

Design of the Study:

The study adopted a descriptive survey research design. In the views of Olaitan, Ali, Eyoh and Sowande (2000), survey research design is the plan, structure and strategy that the investigator wants to adopt in order to obtain solution to research problems and test hypothesis formulated for the study. They further stated that it guides the investigator in the process of collecting, analyzing and interpreting observations. The design 'was therefore, appropriate for the study since it obtained data from male and female school principals through the use of structured questionnaire on the attitude of students and parents towards practical agriculture as perceived by Secondary School Administrators in Borno State, Nigeria.

The Borno State is located in the geographical location of the North East Nigeria. It has a land area of 69,436 square kilometers. It is bounded on the east by Niger Republic, Chad Republic, the west by Yobe State, in the southeast by Adamawa State and the northwest by Gombe State. Borno State have latitudes 10' and 14′ North, longitudes 11'30' to 14'45 East central 11.5' north and 13, 5 east′. The Borno state has natural endowments such as; its rolling hills, isolated highlands and other endearing features make it a delight. The savannah grassland of the South and the East Belt, the richness of the tropical rain forests of the south and an equable climate all combined to make the south part a soil-rich agricultural haven.

The population for the study was made up of all the three (3) geo-political zone, which comprised of one hundred and sixty-three (163) junior secondary schools principals (State Universal Basic Education Board, SUBEB, Maiduguri, 2025) and fifty- seven (57) senior secondary schools principals (Teachers Service Board (TSB) , Maiduguri, Abuja, 2025). The entire population in the three (3) geo-political zones in the state was used for the study to get a better representation of the opinion of the respondents.

The study uses simple random sampling by ballot was applied to give every area council a chance of being selected. This was in line with the recommendation of (Maicibi 2000) that 30% of total population can be used as a sample for a study, so as to have a fair representation of the entire population. The researcher randomly selected and studied three (3) geo-political zones which 3 were Easter Borno, Northern Borno and Southern Borno. Based on this, the researcher involved twenty-six (26) junior and senior secondary school administrators representing each secondary school for this study. A total of thirteen (13) secondary schools were selected from each of the three zones for the study. In all, twenty-six (26) secondary schools were selected for the study out of fifty-two (52) secondary schools in the both councils.

Instrument of Data Collection:

The instrument used for collecting data for the research was a structured questionnaire. Twenty – six (26) copies of the questionnaire were personally administered to the respondents (Secondary School Principals) from the three (3) geo-political zones of the study in the Borno State Nigeria. The Secondary Schools selected were visited and respondents were given a copy of the questionnaire containing the instruction. The questionnaire copies were later retrieved for analysis.

Any item with a mean of 2.5 and above was regarded as required or agreed, while any item with a mean score below 2.5 was regarded as not required or disagreed. The upper limit of 2.5 was chosen because it discriminated better. In calculating the personal characteristics for the 26 respondents, descriptive statistical techniques and simple percentages were used and t-test at 0.05 level of significance was used to test the hypotheses. For each research questions, the responses relating to it were totaled, the total weighted frequencies were used to determine the mean and standard deviation score for each items.

In this part of the survey instrument the participants were asked to indicate their level of satisfaction with each of the 10 items using the modified four Likert Scale ranging from strongly agree to strongly disagree as follows: 4=Strongly Agree, 3=Agree, 2= Disagree, 1= Strongly disagree. In the following sections, the researcher presents the participant responses to those items in relation to the two key research questions.

Results and discussion

Table 1: Distribution of respondents by students areas of interest in practical agriculture (n=26)

S/N Areas of interest in practical agriculture	X	SD	Remarks
1. Students enjoys keeping and feeding farm animals	2.88	1.32	Agree
2. Students enjoys clearing bushes and tilling the soil manually	2.27	1.1	Disagree
3. Students love sowing seeds of crops	2.69	1.10	Agree
4. Students are willing to harvesting their own crops.	2.78	1.28	Agree
5. Students are eager to sell their produce and make income	2.93	1.33	Agree

Cut-off point: 2.5 and above = Agreed, less than 2.5= Disagreed

Source: Field survey, 2025.

The results in table 1 above shows that secondary schools administrators disagreed with item 2 with a mean of 2.27. This implies that students dislike manual clearing of bushes and tilling of soil for growing crops. While the secondary school administrators agreed with item 1 with a mean of 2.88, item 3 with a mean of 2.69, item 4 with a mean of 2.78 and item 5 with a mean of 2.93. This implies that students enjoys keeping and feeding farm animals, sowing seeds of crops, harvesting of crops and selling of their farm produce for income. This is in line with (Bleeker and Jacobs, 2004); (Deci and Ryan, 2002); (Hidi and Harackiewicz 2000) that opined that students with more positives motivational profiles in a particular subject area (high perceived ability, instrumentality, learning goals and success expectations) are more likely to take courses in that area and will choose related college majors and career paths.

Table 2 Factors that influence students' and parents' mindset (n=26)

S/N Influences on student and parent mindset	X	SD	Remarks
1. Parents see Agricultural Science as the subject for from poor economic background	2.11	1.03	Disagree children
2. Parents react negatively to their children studying Science	2.31	1.11	Disagree Agricultural
3. Student practical's in Agriculture Science are and fascinating	2.61	1.23	Agree interesting

4. The School farmland is available for practical agriculture	2.58	1.22	Agree
5. Few students take Agricultural Science as a subject	3.20	1.42	Agree

Cut-off point: 2.5 and above = Agreed, less than 2.5= Disagreed
Source: Field survey, 2025.

The results in table 2 above shows that secondary schools administrators disagreed with item 1 with a mean of 2.11 and item 2 with a mean of 2.31. This implies that parents do not see agricultural science as a subject for children from poor economic background neither do they react negatively to their children studying agricultural science as a subject. While the secondary school administrators agreed with item 3 with a mean of 2.61, item 4 with a mean of 2.58 and item 5 with a mean of 3.20 which indicates that student's practical agriculture is interesting and fascinating, school farmland is available for practical agriculture and few students take agricultural science as a subject. This finding is in line to a study by (Mark 2008) who posited that secondary school learners are qualitatively different from younger learners, using the right instructional strategies to maximize the learning advantages and addresses the learning challenges of high school learners can make all the difference in their success. This also agreed (Krause and Dailey, 2009) that parents have the most central and enduring influence on their children's lives, in general as well as in relation to the development of emotional and behavioural attitudes. (Vandenbosch 2006) observed that there is also the need to dispel the apparent negative students' and parents' attitude towards agriculture and to further expose students to the knowledge and skills that they would require in agricultural production, develop the spirit of self-reliance, demonstrate that agriculture is a dignified and profitable occupation in enhancing skills needed in carrying out agricultural practices for economic and national prosperity.

Research Hypothesis:

Difference between availability of resources by male and female secondary school administrators the null hypothesis for the variables on table 3 was tested at 0.05 level of significance and 24 degree of freedom. The t- calculated for the two variables i.e. male and female secondary school administrators were less than the critical value and this indicated that there is no significant difference in the mean rating of the two variables. Therefore, the null hypothesis was accepted. This suggests that the administrators' sex do not influence the attitudes of students and parents towards practical agriculture.

Table 3: Mean rating of the responses of secondary schools administrators on the attitudes of students and parents towards practical agriculture.

Sex	Frequency	Mean of Sec. School Administrator X	S.D	t-critical	t-cal	Decision
Male	14	0.54	2.69	1.692	0.03	Accept Ho
Female	12	0.46	2.31			

t- cal = 0.03< t critical=1.692, p value = 0.05, df = 24
Source: Field survey, 2025.

Conclusion:

Based on the findings from the study, this conclusion was drawn:

Students dislike agricultural science due to manual clearing of bushes and tilling of soil. But they rather enjoys keeping and feeding farm animals, sowing of seeds of crops, harvesting and marketing of their farm produce. Parents do not see agricultural science as a subject for children from poor economic background neither do they react negatively to their children studying agricultural science. While student's practical agriculture is interesting and fascinating, school

farmland is available for practical agriculture but few students take agricultural science as a subject in secondary schools in Borno State.

Recommendations:

Based on the results of the analysis, the following recommendations were made:

1. Secondary school students should be exposed to modern technology and farm machines in order to motivate them towards acquiring requisite skills needed in practical agriculture, likewise they should take agriculture as a subject and for further studies in higher institution which will make the self-reliant, producing food for national development.

2. Teachers of agricultural science should be creative and innovative in order to attract more students to take the subject; this will help to sustain student's interest and improve their perception towards the subject.

3. One of the policies of government should be geared towards making agricultural science a compulsory vocational subject for gaining admission into higher institution.

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RADİONUCLİDE MOBİLİTY AND TRANSFER DYNAMİCS İN SEMİ-ARİD MOROCCAN AGROECOSYSTEMS

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Abstract
Understanding how radionuclides migrate from soil to edible plant tissues is essential for evaluating radiological exposure through food chains, particularly in regions where agriculture supports local livelihoods. This study examines these transfer processes in the semi-arid farmlands of Meknes, Morocco. Soil and crop samples were collected from multiple cultivated areas, and radionuclide activity concentrations were quantified using High-Purity Germanium gamma spectrometry and alpha spectrometry. The investigation focused on Th-234, Ra-226, Th-228, Ra-228, Pb-210, K-40, Cs-137, and Po-210.
Transfer factors—defined as the ratio of radionuclide activity in plant tissues to that in corresponding soils—were used to assess radionuclide mobility and bioavailability within the soil–plant system. Standardized analytical procedures ensured consistency and allowed comparison with studies conducted under different environmental and agricultural conditions. The results demonstrated significant variations in transfer factors depending on soil properties, plant species, and radionuclide chemical behaviour. The elevated transfer values observed for K-40 highlight its essential nutritional function and greater mobility compared to actinides and other radionuclides.
This study enhances understanding of radionuclide dynamics in semi-arid agroecosystems and underscores the importance of continued radiological monitoring to ensure food safety. The findings provide a reference framework for evaluating potential human health risks associated with contaminated crops and for guiding remediation strategies in vulnerable agricultural regions.

EMBEDDING CIRCULAR ECONOMY PRINCIPLES IN ARCHITECTURAL DESIGN FOR SUSTAINABLE CITIES

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Abstract:
This paper explores how the concepts of circular economy can be incorporated into architectural design as a measure to improve the sustainability of urban areas in this context; that is, the current challenges of resource depletion and waste generation common in the modern-day architectural design practices. The study, conducted on the basis of a detailed examination of qualitative case studies of the available sustainable buildings and quantitative evaluation of resource utilization and waste reduction indicators, shows that effective implementation of the practice of the circular economy can significantly reduce material waste and make the use of resources in cities more efficient. The main conclusions are that the principle of circles is used not only to ensure the minimum impact on the environment, but also to create a healthier urban habitat due to the positive effect on the air quality and the overall well-being of the community. These results go beyond the profession of architecture since they emphasize the importance of sustainable urban settings on overall population health outcomes indicating that environmentally more sustainable architectural endeavors can achieve an improved health of urban populations. Furthermore, the paper puts forward the possible implication to the healthcare industry, including the need to use the concept of sustainable buildings that may offer a paradigm of healthier environments, lower healthcare-related expenditures in connection with environmental pollution, and enhance the comprehensive perspective on community health. Presenting the architectural design in the framework of the circular economy, the current research study helps to continue the existing discussion of sustainable urban development and its applicability to areas of public health, thus stimulating future investigations and implementation of these principles into different sectors.
Keywords: Circular Economy; Sustainable Architecture; Urban Sustainability; Zero-Waste Design; Resilient Urban Development.

ECONOMIC VIABILITY OF VERTICAL FARMING IN URBAN ARCHITECTURE: A SUSTAINABILITY PERSPECTIVE

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Abstract:
This paper explores the economic feasibility of vertical farming in urban architecture, in terms of how it would contribute to food production sustainability, as well as environmental impact reduction. The research design combines both quantitative analysis of the initial investment expenses, operating costs, yields as well as revenue and qualitative analysis of consumer attitudes and policy frameworks that are in place to influence urban farming projects. Highlighted in the findings include that initial expenses are high, but vertical farming can provide competitive yield benefits and operational efficiency, thus it is a viable alternative to an urban setting with space constraints and food supply issues. Moreover, the work emphasizes an increasing tendency of the consumers towards locally sourced food which is important in terms of urban agricultural policy and the ability to maintain a healthier diet. These findings are important to the healthcare sector because they highlight the importance of sustainable urban food systems in overcoming food insecurity, enhancing both nutritional quality and reducing the population health hazards related to environmental degradation. Finally, the study adds to the discussion of urban sustainability, causing policymakers and urban planners to reconsider how urban agriculture can not only increase the efficiency of food production, but also rebuild the community health outcomes, which can make urban environments more sustainable.

Keywords: Vertical Farming; Urban Architecture; Food Security; Agri-Architecture; Sustainability Assessment.

ISLAMIC ECONOMIC PRINCIPLES IN ECO-MOSQUE ARCHITECTURE: A PATH TO SUSTAINABILITY

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Abstract:
This paper explores the introduction of Islamic economic values to eco-mosque buildings to help develop sustainability to meet the urgent intersection of religious practice and environmental care. The study using a mixed-methods approach includes both qualitative data (case studies of currently existing eco-mosques), interviews with architects and community leaders, and the examination of a quantitative data on the environmental effects of these buildings. The results demonstrate that the design of eco-mosques that demonstrates Islamic values helps to decrease carbon footprints and increase community interactions with sustainability programs. Moreover, the structures show how the faith in religious principles can guide the proper management of the resources, thus creating the holistic perspective that would solve the spiritual satisfaction and environmental protection issue. The implications of these results can be conveyed to the healthcare industry as a sustainable environment is associated with better population health results; thus, the introduction of environmentally-friendly construction of mosques may influence a wider change in society towards healthier constructions. Finally, this research has deep implications, proposing that green architecture which incorporates Islamic economic principles not only facilitates environment sustainability but also can serve as an example of establishing health-aware communities, which should trigger a massive reconsideration of how religious environments can be used to the forefront of communal health and environmental robustness.

Keywords: Eco-Mosque Architecture; Islamic Economic Principles; Sustainable Architecture; Religious Buildings; Community-Oriented Design.

THE GREEN WAQF: FINANCING ECO-ARCHITECTURE THROUGH ISLAMIC ENDOWMENTS

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Abstract:
This paper examines the plausibility of Green Waqf as a sustainable financing tool to fund eco-architecture by Islamic communities with a particular emphasis on whether the traditional Islamic endowments can be modified to favorably fund environmentally friendly building practices. The study indicates that current Green Waqf practices have the potential to finance eco-architecture projects, thus showing that Waqf can be used to tackle the current environmental issues. The study comes up with essential insights through qualitative data collected in different case studies and interviews with stakeholders in the fields of Islamic finance and architectural realms, which reveal the significance of implementing sustainability in urban development in these societies. The results of the study show the importance of Green Waqf in the creation of health promoting environment and indicate that investment in eco-architecture is not just in line with Islamic, but also leads to the well being of the people by improving the air quality, lessening energy use, and providing habitable spaces. The present study provides meaningful implications to the health field, as it shows that building environmentally friendly infrastructure can bring significant improvement in health outcomes and community resilience. This study, by providing an example of how conventional Waqf can be redefined to serve as a dynamic environmental sustainability tool, can be added to the larger discussion on the intersection of Islamic finance, architecture and community health, indicating avenues of future initiatives that reimburse cultural values to promote sustainable development.

Keywords: Green Waqf; Eco-Architecture; Sustainable Financing; Environmental Stewardship; Sustainable Urban Development.

THE TRADE-OFF BETWEEN ECONOMIC GROWTH AND ENVIRONMENTAL ARCHITECTURE IN DEVELOPING REGIONS

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Abstract:
This paper examines the compound relationship between economic growth and environmental architecture in the developing world with main emphasis on the frantic conflict between the fast rate of economic growth and the need to follow sustainable environmental practices. The study involves qualitative and quantitative approaches and includes an in-depth examination of economic indicators, environmental impact evaluation, and multiple case-studies of development initiatives in a number of geographic settings. Important findings include the fact that economic growth is a necessary process that improves the standards of living, but it tends to compromise the environmental integrity, which translates to increased pollution and degradation of natural resources. Notably, the research study finds a strong relationship between sustainable architecture and better public health outcomes, which suggests that areas that consider the environmental factor in their developmental policies have improved healthcare profiles, including a lower rate of respiratory diseases and an overall increase in the well-being of the communities. The implications of these results are not limited to the context of urban planning and population health but are vital in policy-making and stakeholders in the healthcare industry, who need to take into consideration the need to ensure that environmental sustainability is part of the economic planning to enhance a holistic development. Finally, the study can be described as part of a more sophisticated perception of the trade-offs inherent in the practice of development, which is why the need to promote the adoption of policies that will encourage economic growth and the preservation of the environmental health are justified, which is also directly connected to the main goal of ensuring that the healthcare systems of emerging economies become more sustainable.

Keywords: Economic Growth; Environmental Architecture; Green Building Design; Socio-Economic Trade-Offs; Sustainability Challenges.

ARCHITECTURE, ENVIRONMENTAL EXTERNALITIES, AND ECONOMIC POLICY FOR SUSTAINABLE CITIES

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Abstract:
This paper explores the complex correlation of architectural practices, environmental externalities and economic policy in urban environments which center around the critical role of sustainable urban development. It fills a gap that is very important on current research because it presents empirical information that links architectural strategies to their environmental effects and financial results by gathering and analyzing case studies, thorough statistical data about urban environmental indicators, and analysis of contemporary economic policies. The results indicate that particular design options and construction materials have a considerable impact on urban thermal trapping, air quality, and resource use, and the evaluation of the economic policies indicates the flaws in the incentivization of eco-friendly architectural innovation. The study highlights the importance of combining architectural decision-making with environmental health factors, which might imply that better architectural work could result in a dramatic increase in urban public health conditions, including the number of respiratory diseases solved and the quality of life. Also, the implications go beyond personal health gains; by educating policy-makers and city planners, the study proposes a synergist action plan that creates an equilibrium between the architectural design solution and the environmental sustainability and economic benefits, which will generate the resiliency in the healthcare systems of the city. The findings highlight why the interdisciplinary work of the architects, environmental scientists, and economists is needed to facilitate one holistic approach to urban development that would lead to the long-term sustainability and the benefits of urban development to the population.

Keywords: Environmental Externalities; Economic Policy; Sustainable Cities; Urban Sustainability Governance; Green Building Design.

MAPPİNG THE CONCEPTUAL STRUCTURE OF EURO ADOPTİON LİTERATURE, A MULTİ-METHOD BİBLİOMETRİC ANALYSİS OF KEY RESEARCH THEMES

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Abstract:
This study look into the academic discourse surrounding Euro adoption, employing a multi-method bibliometric framework to see the field's underlying conceptual structure and the developmental status of its central themes.Drawing on a comprehensive corpus of 1,062 publications from the Web of Science Core Collection, the research utilizes four complementary analyses.By combining a Co-occurrence Network with Thematic Mapping (based on both community detection and Multiple Correspondence Analysis-MCA), we aimed to move beyond mere frequency counts.This layered approach allowed us to distinctly visualize two main research clusters, one exploring the economic and monetary dimensions (e.g., integration, policy), and the other focusing on applied impact and efficiency.The MCA mapping positioned key concepts like Euro, Convergence, and Inflation at the intellectual core of the literature, highlighting their high centrality and maturity. A final, focused thematic map, analyzing a sub-set of 194 records on "inflation AND euro adoption," further reinforced the finding that Monetary Policy and the concept of Shocks are fundamental drivers of research in this area.Ultimately, the findings confirm that the debate on Euro adoption remains firmly linked with traditional macroeconomic concerns, with the issue of Inflation standing out as the single, most consistent theoretical and empirical preoccupation across the analyzed literature.

Keywords: Euro adoption; Bibliometric analysis; Inflation; Monetary policy; Economic convergence; Thematic mapping.

EXPLORİNG THE PSYCHOLOGİCAL IMPLİCATİONS OF HYPER REALİTY ON YOUNG ADULTS İN THE ERA OF SOCİAL MEDİA: A CRİTİCAL ANALYSİS FOR MENTAL HEALTH

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Abstract

The prevalent occurrence of hyper reality, driven by the ubiquitous usage of social media platforms, is especially evident among youth, resulting in a distortion of their perspective of reality. This study examines the influence of social media on the mental health of young adults, specifically on sadness, anxiety, and self-esteem concerns. The research adopts a quantitative methodology, employing surveys and questionnaires for data collection. The research targets students from the University of Agriculture, Faisalabad (UAF), and the University of Punjab, Lahore. A straightforward sampling method was utilized to pick a sample of 205 students aged 18 to 25 years. The Bergen Social Media Addiction Scale (BSMAS) and Social Media Disorder Scale (SMD) were employed to assess mental health, and the gathered data was analyzed using SPSS. The research findings provide significant insights into the demographic attributes of the sample group, encompassing age, gender, marital status, education, family income, family type, and family size. The results illuminate the prevalence of anxiety, despair, insomnia, physical health issues, social difficulties, and social media addiction among the polled respondents. The study examined participants' impressions of social media's effects on their academic achievement, mental health, self-esteem, and interpersonal connections. Additionally, it examined their perceptions of disconnection between social media and real-life experiences, the endorsement of unattainable beauty ideals, and the prevalence of impulses to engage with social media. The research underscores the necessity for formulating ways to mitigate the adverse impacts of social media on mental health, as evidenced by the majority of participants expressing agreement or strong agreement with the significance of such interventions. Moreover, there is substantial agreement among participants that social media corporations have to assume responsibility for fostering healthy social media practices. The study concludes by analyzing participants' preferences for various social media platforms, their usage frequency, and their engagement in diverse social media activities.

Keywords: Hyperreality, Social Media, Young Adults, Mental Health, Psychological Implications

COMPOSITION AND DISTRIBUTION OF AQUATIC INSECTS IN RELATION TO WATER QUALITY OF SARU LAKE, GUMMI LOCAL GOVERNMENT ZAMFARA STATE

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ABSTRACT
This study investigates the composition and seasonal distribution of aquatic insects in relation to environmental factors, evaluates water physicochemical parameters, and assesses heavy metal concentrations in water and sediment across three stations in Saru Lake, Gummi Local Government Area, Zamfara State. Sampling was conducted across the Harmattan, rainy, and dry seasons. Aquatic insects were collected using dip nets, while water quality parameters-such as temperature, pH, dissolved oxygen, and electrical conductivity-were measured using standard meters. Heavy metal concentrations in water and sediment were analyzed through atomic absorption spectrophotometry, and statistical analyses were applied to assess the relationship between insect diversity and environmental parameters. A total of 548 insects were identified, consisting of 27 genera, 27 families, and 12 orders. Insect abundance was significantly higher at Stations II and III (199 and 175, respectively) compared to Station I (174). Dissolved oxygen peaked at Station I during the Harmattan and rainy seasons (8.67±0.15 mg/L), whereas electrical conductivity was highest at Station I in the dry season ($p < 0.05$). Chromium levels in sediment were highest at Station II during the Harmattan season (0.22±0.10 mg/L). Correlation analysis showed that aquatic insect abundance was positively correlated with dissolved oxygen ($r = 0.76$) and pH ($r = 0.62$), but negatively correlated with electrical conductivity ($r = –0.68$) and temperature ($r = –0.53$), indicating that water quality significantly influences insect distribution and diversity. The findings underscore the role of aquatic insect diversity as an indicator of water quality and seasonal variations. This study highlights the need for regular monitoring of physicochemical parameters and heavy metals in Saru Lake. It also recommends enhanced waste management strategies and community awareness programs to mitigate human induced impacts and safeguard the lake's ecological balance.

COMPARATİVE ANALYSİS OF GENETİC DİSORDERS USİNG MACHİNE LEARNİNG ALGORİTHMS

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Abstract
Genetic disorders continue to pose a major challenge in modern healthcare, largely because of their complex biological foundations and the difficulty of achieving early, reliable diagnosis. Predicting such conditions accurately requires analysing multiple clinical and genetic indicators that often display non-linear and high-dimensional behaviour. In this study, titled "Comparative Analysis of Genetic Disorders Using Machine Learning Algorithms," we evaluate the performance of three widely used classification models Random Forest (RF), Support Vector Machine (SVM), and Decision Tree (DT) in identifying five genetic disorders: Thalassemia, Hemophilia, Breast Cancer, Sickle Cell Anemia, and Cystic Fibrosis. To support this analysis, a synthetic and structured dataset was created, incorporating clinically relevant biomarkers such as hemoglobin levels, fetal hemoglobin percentage, BRCA1 gene expression, sweat chloride concentration, and the percentage of sickled red blood cells. The data undergoes preprocessing and is then used to train, validate, and test each model under identical conditions to ensure a fair comparison. Model performance is measured using accuracy, precision, recall, F1-score, cross-validation, and confusion matrices. The results show that Random Forest provides the best overall performance with an accuracy of 94%, followed closely by SVM at 93% and Decision Tree at 91%. These findings highlight the advantage of ensemble learning methods over single-tree models when dealing with complex biomedical datasets. Overall, the study demonstrates the potential of machine learning tools to support early detection of genetic disorders and lays the groundwork for integrating predictive models into clinical decision-support systems.
Keywords: Genetic Disorders, Machine Learning, Random Forest (RF), Support Vector Machine (SVM), Decision Tree (DT)

HOUSEHOLDS' POVERTY INFLUENCE ON YOUTH BEHAVIOUR IN OGUN STATE, NIGERIA

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ABSTRACT

Poverty is an age long, hydra-headed dilemma, affecting the whole world, with no boundaries, as it affects all in various depths and levels. Poverty drags some other problems along with it, such as low standard of living, inequity in education and even negative behaviour. This study investigated households' poverty influence on youth behaviour in Ogun state. Systemic sampling was used to sample 200 respondents for the study. Interview schedules and structured questionnaires were used to obtain data while descriptive and inferential statistics such as Pearson product Moment Correlation (PPMC) were used to analyze the data collected at $p<0.05$ level of significance.

Respondents were mostly male (59.0%), single (82.0%) with mean age of 24.05±5. Few (17.0%) were married and 1.0% were divorced. More than half (50.5%) of respondent's households experienced high levels of poverty. The major cause of poverty in households was lack of employment opportunities ($\bar{X}$= 1.53). More than half (58.5%) of the respondents had positive behaviour. This study revealed that marital status had no significant relationship with youth behaviour (p=0.065). However, sex (p=0.001), religion (p= 0.013), educational attainment (p= 0.000), employment status (p=0.027), position in family (p= 0.039) and primary occupation (p= 0.000) had significant relationship with youth behaviour in the study area.

The study concluded that there is a significant relationship between the household poverty level and the behaviour of youths in the study area. Non-governmental organizations and individuals in the society should create mentorship opportunities and platforms for youth, where they will be educated on career and life paths like ICT (Tech).

Keywords: Youths, household poverty, youth behaviour, Ogun State.

"THE NEW ARCHITECTURE OF DIGITAL INFLUENCE: HOW SOCIAL SEARCH, SHORT-FORM VIDEO, AND FACELESS CONTENT ARE RESHAPING CONSUMER ENGAGEMENT"

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Abstract
The rapid evolution of social media has redefined how consumers discover, evaluate, and engage with digital content. This conceptual paper examines the emerging "architecture of digital influence," shaped by the convergence of three dominant trends: the rise of social platforms as search engines, the sustained effectiveness of short-form video formats, and the growing prevalence of faceless and niche creator content. As younger audiences increasingly turn to platforms like TikTok, Instagram Reels, and YouTube Shorts for search-based information, the boundaries between entertainment, exploration, and decision-making continue to blur. Simultaneously, faceless creators and micro-communities are reshaping the authenticity paradigm, offering relatable, low-barrier content that drives deeper trust and engagement. This paper synthesizes existing literature and industry insights to propose a conceptual framework illustrating how these shifts collectively influence consumer behavior, brand communication strategies, and digital engagement models. The study highlights the implications for marketers, educators, and content strategists, emphasizing the need to adapt to a more search-integrated, creator-led, and community-driven digital ecosystem.**Keywords:** Generation Z, Baby Boomers, language clash, digital communication, intergenerational gap, internet slang, sociolinguistics, cross-generational communication, cultural literacy
Keywords: Digital influence, Social search, Short-form video, TikTok search behavior, Faceless content, Creator economy, User-generated content (UGC), Micro-communities, Digital engagement, Content evolution, Consumer behavior, Niche content, Social media strategy, Interactive media, Digital ecosystems.

STRUCTURE-BASED DRUG REPURPOSİNG TO İNHİBİT THE DNA GYRASE OF *MYCOBACTERİUM TUBERCULOSİS*

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Short Introduction:

Drug repurposing is an alternative avenue for identifying new drugs to treat tuberculosis (TB). Although TB can be cured with anti-tubercular drugs, the emergence of multidrug-resistant and extensively drug-resistant strains of *Mycobacterium tuberculosis* H37Rv (Mtb), as well as the significant death toll globally, necessitate the development of effective drugs to treat TB.

Experiments and Key result findings

In this study, drug repurposing approach was employed to address this drug resistance problem by screening drugbank database to identify novel inhibitors of the Mtb target enzyme, DNA gyrase. The compounds were screened against the ATPase domain of gyrase B subunit (MtbGyrB47), and the docking results showed Echinacoside, Doxorubicin, Epirubicin, and Idarubicin possess high binding affinities against MtbGyrB47. Comprehensive assessment using fluorescence spectroscopy, SPR, and CD titration studies revealed that Echinacoside as a potent binder against MtbGyrB47. Further, ATPase, and DNA supercoiling assays exhibited IC_{50} values of 2.1-4.7 µM for Echinacoside, Doxorubicin, Epirubicin, and Idarubicin. Among these compounds, the least MIC_{90} of 6.3 µM and 12 µM were observed for Epirubicin and Echinacoside, respectively. Hence, our findings indicate that Echinacoside and Epirubicin target mycobacterial DNA gyrase, inhibit its catalytic cycle, and retard mycobacterium growth. Further these compounds exhibits potential scaffolds for optimizing novel anti-mycobacterial agents that can act on drug-resistant strains.

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SYNTHESIS OF ACTIVE $NICL_2$ NANOPARTICLES SUPPORTED ON CHITOSAN AS A REUSABLE CATALYST FOR THE SYNTHESIS OF FUNCTIONALIZED PYRIDINE DERIVATIVES

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Abstract :
An environmentally friendly and efficient one-step process has been developed for the synthesis of 2-amino-4-arylquinoline-3-carbonitrile derivatives. This process is based on a three-component reaction involving anilines, aldehydes, and malononitrile. The use of chitosan-supported $NiCl_2$ as a heterogeneous, recyclable catalyst in aqueous media enabled the production of the corresponding products in high yield. The structure of the synthesized Zn(II)/chitosan nanoparticles was identified by energy-dispersive X-ray spectroscopy (EDX), scanning electron microscopy (SEM), X-ray diffraction (XRD), thermogravimetric analysis (TGA), infrared spectroscopy (FT-IR), and inductively coupled plasma atomic emission spectroscopy (ICP-OES). The catalytic activity of Zn(II)/chitosan in these reactions was tested on a range of aldehydes and amines, demonstrating its reactivity towards various functional groups. The multicomponent reactions exhibited good regioselectivity, and computational studies further investigated this selectivity. Moreover, the catalyst is readily recoverable and reusable over multiple cycles without significant loss of catalytic activity. This method simplifies the synthesis process, reduces handling, and offers an environmentally friendly alternative for the production of these important chemical compounds, thus demonstrating its considerable potential in synthetic organic chemistry.
Keywords: pyridine; oxygen-containing heterocycles; Nickel; chitosan; Recyclable catalyst; green chemistry;

PHOTOCATALYTIC DEGRADATION OF METHYLENE BLUE AND CONGO RED USING A SIO2-AG BASED CATALYST: PREPARATION, CHARACTERIZATION, AND REACTIVITY

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ABSTRACT

The dynamic development of nanotechnology has been particularly observed in the field of materials engineering. Excellent examples are the various nanoparticles, for which current research focuses on their design, fabrication, characterization, and applications. The specific properties and functions of nanoparticles can be controlled by their shape and size at the nanometer scale. Several methods have been proposed for the synthesis of these materials, namely chemical vapor condensation, arc discharge, hydrogen-metal plasma reaction, and vapor phase laser pyrolysis, microemulsion, hydrothermal, sol-gel, etc. Nano-silica (SiO2) has a wide range of products, from manufacturing to science. The preparation of silica nanoparticles from natural sources (clay and sand) is then used as a precursor for the synthesis of zeolitic materials. The obtained NP was characterized using Fourier Transform Infrared Spectroscopy (FTIR) and X-ray Diffraction Spectroscopy (XRD). The expulsion of dyes into the water resource system is a major threat to the environment. Adsorption is a cost-effective and potential method for removing dyes from effluents.

We therefore attempted to study the photocatalytic degradation of dyes (methylene blue and congo red) by nanoparticles (NP) prepared from sand and clay. This is the first study using unique 650 nm nanoparticles for the dye adsorption process. The results showed that the photocatalytic degradation increased with the concentration of NP, contact time, and the dye.

Keywords: Nanoparticles_ photocatalytic degradation _ methylene blue_ congo red.

Why is Bloom's taxonomy important?

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ABSTR ACT:

The authors of the revised Bloom's Taxonomy offer a multi-level answer to this question, adding some clarifications:

1. First, establishing objectives is important in an educational exchange so that both the teacher and the learner understand the purpose of the exchange.

2. Second, organizing objectives helps clarify the goals for both teachers and students.

3. Finally, having an organized set of objectives helps teachers to:
o Plan and deliver appropriate instruction
o “Design tasks and strategies for teaching using Bloom’s Taxonomy”
o “Ensure that instruction and assessment are aligned with objectives.”

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ASTROCYTİC CALCİUM WAVES AS THERAPEUTİC TARGETS: REDEFİNİNG EARLY INTERVENTİON STRATEGİES İN NEURODEGENERATİVE DİSEASES

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ABSTRACT

Background: Neurodegenerative conditions like Alzheimer's and Parkinson's were thought to only affect neuronal pathways; recently, however, the discovery of astrocytic signaling as needed to support homeostasis has emerged. One important communication process is calcium-dependent signaling within glial cells (astrocytes). This form of calcium communication spreads via calcium fluctuations and inter-astrocytic connections and regulates synaptic activity, blood flow to the brain, and neurotransmitter equilibrium. Miscommunication appears to be one of the first signs of impending neurodegeneration prior to more well-known inflammation such as the presence of amyloid plaques, changes in microglial signaling, or degeneration of dopaminergic neurons.
Objective: Thus, could the next new target in treating neurodegeneration be through astrocytic calcium waves? The analysis of calcium signaling through astrocytes as well as neurons represents a new paradigm in how we consider and treat onset of disease and subsequent response as traditionally, investigations without regard for astrocytes was conducted within the confines of neuronal calcium signaling compartments.
Methods: This literature review seeks to compile the most recent findings from in vivo imaging, translational studies with genetically modified animal models and pharmacological studies that test the boundaries of astrocytic calcium involvement. The review assesses the intraparticles of calcium release, ATP-mediated signaling downstreams and entrance of calcium through specialized channels. Qualitative analysis of intracellular calcium waves, exosome release and command of neuronal activity occurs via comparison between wild-type astrocytes and disease-modified models.
Results: Ultimately this assessment reveals that when calcium-dependent signaling is compromised, astrocytes make neurons hyperactive, exocytosis of glutamate is impaired from the vicinity, and adhesion between neural cells is ineffective when measured years before classic neuropathological findings are measured. In the case of Alzheimer's, reduced astrocytic calcium flow corresponds with increased neuronal activity within the cingulate cortex. In the case of Parkinson's, abnormal peaks in astrocytic calcium occur in conjunction with increased cytokine levels and mitochondrial distress.
Conclusion: Early attempts at rescuing normal astrocytic calcium levels via enhancement of STIM1 or pathway mediation of cAMP-calcium have restored microB connectivity between neurons and slowed manifestations of disease.
Keywords : Astrocytes, Calcium Waves, Neurodegeneration, Alzheimer’s Disease, Parkinson’s Disease

DIAGNOSIS AND IMPROVEMENT OF CONCRETE BLOCK PROPERTIES: A CASE STUDY IN TLEMCEN, ALGERIA

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ABSTRACT

This study focuses on the manufacturing and optimization of concrete blocks in the city of Tlemcen (Algeria), aiming to improve their physical and mechanical properties for the construction sector. A survey conducted across about twenty production sites allowed the identification of the equipment, materials, and mix formulations used, as well as the location of the sites and characterization of the products manufactured. A laboratory experimental program was carried out on sampled blocks, revealing a high absorption coefficient, low compressive strength, and significant dimensional variation between shrinkage and swelling. The study also identified the main parameters influencing block performance, including gradation, density, moisture content, and aggregate proportion. Experiments were conducted to evaluate the impact of these factors on compacity, porosity, compressive strength, modulus of elasticity, and dimensional stability. The results show that the optimal selection and combination of aggregates can significantly increase block density and mechanical strength while reducing variability between production batches. Finally, practical recommendations are proposed to improve aggregate homogeneity and the quality of constituent materials, aiming to limit cracking, dimensional instability, and premature deterioration. The study highlights the value of an approach combining experimental testing and empirical analysis to ensure rigorous quality control and enhance the durability of concrete structures

Keywords: Concrete blocks, Physical and mechanical properties; Compressive strength; Aggregate; optimization; Durability.

EXPLORING THE ROLE OF CHATGPT IN COMPUTER SCIENCE EDUCATION: A LITERATURE REVIEW ON ADVANCED EDUCATIONAL TECHNOLOGY

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Abstract

The emergence of generative AI (GenAI) tools, particularly ChatGPT, has transformed computer science (CS) education. ChatGPT has been designed to develop understanding of coding and solve problems more comprehensively since its release at the end of 2022 because it mixes natural language generation with code mechanisms. It also reduces instructors' workloads through automated grading, language translation, and adaptive learning (St. Clair College, 2023). In CS education it increases the level of engagement of the students, the degree of comprehension and simplifies the administrative work. Nevertheless, integration is a very serious challenge. The hazards are code plagiarism and overdependence, which can undermine critical thinking as well as school integrity. Other concerns relate to accuracy of content, algorithm bias, data protection and moderation of content. Automated tests create worries of the evaluator fairness and cause the reconsideration of the testing models. The question of ethics is intensified in situations where the data of students is on the third-party AI platforms where they require increased transparency in policy and protection. Other factors include inability to adopt the same frameworks because of the lack of uniformity in pedagogical frameworks. This study conducted a systematic literature review of peer-reviewed works (2020–2025) examining ChatGPT's role in postgraduate CS education, focusing on its benefits, risks, and adoption trends. Evidence confirms its worth on improving the programming ability, aiding problem-solving as well as easing the load of teaching. Nonetheless, the problem of academic misconduct, loss of skills, partiality, privacy violation, and AI-content recognition inadequacy has not been solved. At the same time, low-volume impact data do not impede adoption, which increases from 5% in 2020 to 92 % in 2025. The study comes to the conclusion that the opportunities presented by ChatGPT need to be balanced with integrity by means of reinforced institutional policies, enhanced AI literacy, and the redefined pedagogical approaches to its ethical and effective integration.

Keywords: ChatGPT, Generative Artificial Intelligence (AI), Natural Language Models, Pedagogy, Computer Science Education.

1.0 INTRODUCTION

The advent of generative artificial intelligence (AI) has brought a new dawn to education with computer science being at the forefront where problem-solving, code creation, and computational thinking are prominent skills. ChatGPT, a chatbot created by OpenAI that is able to think like humans, help with programming, and offer adaptive learning support, is one of the most powerful generative AI-based tools. ChaatGPT and other models are changing the way education is being done as they are opening new possibilities of individualized learning, engagement and scalable instructional support. Meanwhile, their increased implementation poses some fundamental questions concerning pedagogy, assessment, and even ethics and the future of teaching in an AI-led space. It is in this light that the role of ChatGPT and generative AI in computer science education is critically investigated by conducting a



systematic review of literature, in this occurrence. In the past, computer science education has struggled with factors like limited supply of instructors, high attrition in programming classes, and the challenge students face to understand abstract concepts such as alg orithms, recursion and data structures. Conventional forms of pedagogy, despite being in place in the formal setting, fail to meet the needs of such learners as well as offer sustained support beyond the classroom setting. Generative AI, such as ChatGPT, can help solve some of these problems by providing on-demand explanations, code debugging tools and interactive learning experiences that mimic a conversation with an expert tutor. By so doing, they make academic support more democratic and promote self-directed learning, which is particularly important in education under resource constraints. The topicality of this discovery is supported by the fast rate of AI adoption in the world. The past several years, 2020–2025, have seen a rise in scholarly interest in generative AI applications in education, both due to enthusiasm about its potential and worry over its implication. To educators, administrators, and policymakers, the study of the role of ChatGPT in computer science education is not a pure academic task but a pragmatic one. It educates the curriculum design, influences the instructional strategies and shapes ethical frameworks that will govern the use of AI within learning settings. Besides, since higher educational institutions train students to work in an AI-driven environment, there is an urgent need to ensure that they include generative AI as a learning resource, in addition to a topic of critical discussion. Although the transformative potential is present, there are threats associated with the introduction of ChatGPT into computer science education. The objections to over-reliance on AI-driven tools include the fact that students might lose a problem-solving skill because learners can replace actual intellectual effort with the machine-generated answers. Issues of plagiarism, the originality of student work and academic integrity are becoming issues of concern among educators. Moreover, AI-based systems such as ChatGPT have been identified to generate results that are subject to the influence of biases in their training data, provoking concerns on fairness and inclusiveness. This black box quality of generative AI also makes adopting it more complex because students and instructors may not always know the responses are generated in what way, which makes it harder to trust and be more transparent during an educational interaction. The systematic literature review (SLR) serves to cover these controversies by means of synthesizing the current studies on the role of ChatGPT and generative AI in education in computer science. The review is based on the PRISMA (Preferred Reporting Items to Systematic Reviews and Meta-Analyses) model to provide the methodological rigor of the selection, analysis, and synthesis of relevant studies. The current trends and knowledge of the educational applications of generative AI are captured by this study through the analysis of the research published between 2020 and 2025. The main idea is to discuss the ways ChatGPT can be utilized in the learning process, its weaknesses, and the fields, where additional studies are needed. The importance of this review is that it contributed to the academic and practical field. To the scholars, it gives an in depth mapping of knowledge which can be used in the future in the empirical research and theories. It presents evidence-based information that can inform practitioners and policymakers to make decisions concerning curriculum innovation, technology adoption, and ethical governance. And to a larger extent, the review has placed ChatGPT in the wider context of digital transformation in teaching and learning where there should be a balancing force to ensure that the advantages and opportunities are fully realized and the dangers are minimalized. Overall, the advent of ChatGPT and generative AI into computer science education is an indicator of hope and danger. Such technologies are not the peripheral items but the impetus to rethink the methods of delivering, acquiring, and evaluating knowledge. Through a systematic literature review, this study will serve to give a refined insight into what the current body of knowledge entails, what critical gaps in need of attention are, and what avenues might be pursued to integrate generative AI in a manner that is pedagogically sound, ethically responsible, and socially inclusive. In the sections that follow, a close overview of the literature covering the topic will be provided,

followed by the description of the methodological approach in the current study, and the analysis of findings and the implications it has on the future of computer science education.

Research questions. This review addresses the following questions:

1. In what ways are ChatGPT and generative AI used in computer science education?
2. What learning outcomes or instructor/student perceptions are reported in empirical studies?
3. What are the primary risks and limitations (accuracy, authenticity/academic integrity, bias)?
4. What pedagogical and assessment strategies have been proposed or evaluated to mitigate risks and harness benefits?

2.0 LITERATURE REVIEW

The integration of generative artificial intelligence (AI), particularly ChatGPT, into computer science education has become a defining trend in recent years. Scholarly inquiry between 2020 and 2025 reflects both optimism about the pedagogical potential of these tools and caution regarding their risks. This section synthesizes the literature across four central themes: pedagogical affordances of ChatGPT, its impact on learner engagement and outcomes, the challenges and risks of AI integration, and ethical, social, and institutional considerations.

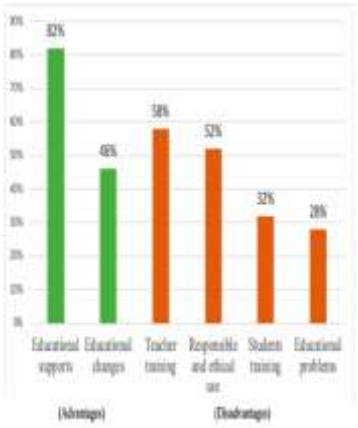
2.1 Pedagogical Affordances of ChatGPT

The pedagogical affordances of ChatGPT can be considered one of the best contributions to computer science education. Generative AI has been demonstrated to provide a powerful and adaptive teaching method in personalised and often unattainable ways that traditional teaching fails to do. As an example, Kiesler and Schiffner (2023) compared GPT-3.5 and GPT-4 to 72 Python prog ramming tasks and achieved success rates of over 94 percent, showing their ability to assist with automatic code generation to near-expert levels. In the same vein, Phung et al. (2023) pitted GPT-4 output against human tutor in major programming situations and found that GPT-4 is roughly as useful as a human tutor in syntax correction and conceptual elaboration. On top of coding, the interactive learning experience of ChatGPT is a result of its dynamic conversational interface. In contrast to textbooks, which are considered one of the most stable resources, the tool is able to modify the explanations by responding to the queries of students and paraphrasing the material in various forms until they can understand it (Bringula, 2024). In their case study about a database administration course, Lopez-Fernandez and Vergaz (2024) stated that students who actively used ChatGPT succeeded in their courses and developed confidence in their problem-solving, in particular, students with good background knowledge. These results indicate that this tool can not only be used to deliver content, but also scaffolds higher-order cognitive abilities, which is consistent with constructivist learning theories in which knowledge is created through interaction and exploration. The other learning strength is the ability of ChatGPT to create new learning content. It has been utilized by educators to make problem sets, quizzes, and even illustrative examples, which are specific to the objectives of a course (Bringua, 2024). This saves the instructor workload and increases the variety of practice sites offered to the students. ChatGPT also minimizes typical bottlenecks that slack progress in programming courses because it offers immediate debugging support and explanations. Such affordances highlight its versatility as a teaching assistant and a means of inquiry to be driven by the students.



2.2 Impact on Learner Engagement and Outcomes

Research points to ChatGPT with a consistent beneficial impact on learning experience, self-esteem, and performance of learners. In large-scale introductory courses in programming, students can be easily overwhelmed and underserved because of high student-instructor ratios. ChatGPT helps to overcome this as a tutor that can be easily accessed. In their eight-week investigation of an introductory Python course, Ma et al. (2024) found that students appreciated the ease and the interactivity of ChatGPT, which they term a low-stakes setting to raise questions they may not feel confident to bring up in the classroom. In the same way, McCulloh et al. (2025) showed that ChatGPT was used to close the proficiency gap by learners with varied levels of skills, allowing them to learn the basics of programming at their own pace. Psychological safety that ChatGPT promises seems particularly im pactful. Students can often say that they feel freer to explore queries and problem solving solutions in the presence of AI than with human-mediated instruction (Programiz, 2023). This reduces anxiety levels related to failure and creates perseverance in looking at difficult problems. According to the survey by Programiz, 62 percent of learners actively used ChatGPT more than once per week, and 75 percent of them thought that programming education should evolve to formally embrace AI technology, which shows that most have acknowledged the usefulness of the technology. Moreover, cooperative learning is improved by generative AI. ChatGPT in a group can act as a neutral facilitator by suggesting other solutions, which will come up in conversation and may be subject to critical analysis. Lopez-Fernandez and Vergaz (2024) claimed that students who integrated ChatGPT texts with peer conversations displayed a higher level of the reasoning process compared to students who applied human collaboration only. Notably, engagement does not only result in motivation but also in the concrete performance gains, such as the pass rates, submission of assignments, and attrition drops in introductory computer science classes.



2.3 Challenges and Risks of AI Integration

Although there are these advantages, the implementation of ChatGPT in education is complicated. The most urgent issue is academic honesty. Due to the ability of ChatGPT to provide a full solution to tasks, it poses a threat of plagiarism and shallow learning (Humble, 2024). Students can avoid the process of intellectual challenge that comes with programming by providing AI generated solutions thus the problem solving capabilities fade. It is becoming challenging to recognize such practices because outputs of AI tend to be similar to genuine student work. There are other risks relating to reliability and accuracy. ChatGPT also tends to give out hallucinations, or plausible but wrongful responses that will mislead learners and support false information (Sun et al., 2024). Code errors, or wrong interpretation of algorithms will not only stop learning, but can also guide students who do not have the knowledge to detect a mistake. According to Bringuga (2024), there is a risk of overpatterned outputs, which are generic solutions offered by ChatGPT that might not match with the particularities of educational setting. Excessive dependence on the instrument is also a risk to creativity and intellectual interest, since students can become habituated to relinquishing their own solutions to machine results rather than developing original strategies. Integration is further complicated by the existence of a “digital divide. Lopz and Fernandez (2024) identified that the advantage is skewed favoring high-achieving students with high levels of prompting skills where weaker learners are less inclined to take advantage of AI. Generative AI should not be used to create disparities instead of reducing them, which can only be achieved by the means of fair access and training.

2.4 Ethical, Social, and Institutional Considerations

Ethical and social impacts of the use of ChatGPT have taken center stage in the literatures. Strategy Bias in training data may lead to stereotype perpetuation or the lack of minority voices (Albadarin et al., 2024). Such biases may be expressed in implicitly biased descriptions of algorithms or through distortion of varying contributions to the discipline in computer science education. The transparency is also posed by the opacity of the ChatGPT black box, which the students and the teachers can no longer be sure of the origin and reasoning of AI responses. The institutional studies emphasize the significance of the governance structures. In 2024, a survey at IIT Delhi found that 80 percent of students and 77 percent of faculty had used generative AI, but raised data privacy, accuracy, and accountability concerns. Some suggestions were AI-use disclosure policies, embedded ethics training, and institutional support of responsible integration (Times of India, 2024). On the same note, Humble (2024) and Albadarin et al. (2024) emphasize the importance of universities implementing explicit policies that would cover plagiarism, fair access, and professional preparedness. On a more general social level, unequal access to AI technology will pose a risk to increase current gaps between well-resourced and under-resourced establishments. Provided the integration of generative AI into the pedagogy, those learners who are marginalized and do not have access to it face the risk of being marginalized in the new forms of digital learning. Responsible integration is thus advocated by scholars to bring balance between innovation and inclusiveness and accountability.

Synthesis

The literature together brings out a delicate topography. Empirical researches (Kiesler and Schiffner, 2023; Ma et al., 2024; McCulloh et al., 2025) indicate high short-term learning, motivation, and performance effects. Simultaneously, the skeptic voices (Humble, 2024; Bringula, 2024; Sun et al., 2024) produce the warning about the danger of overdependence, prejudice, and unfairness. Governance, ethics, and preparedness of educators are highlighted in institutional perspectives (IIT Delhi, 2024; Albadarin et al., 2024). There is still a dead air: there are not many longitudinal studies to evaluate the long-term effect of ChatGPT on critical thinking, professional preparedness, or lifelong learning. The ability to close this gap will be essential to evidence-based integration of generative AI in computer science education.

3.0 MATERIALS AND METHODS

A good methodological framework is needed to carry out a systematic literature review (SLR) which is comprehensive and reproducible. The purpose of this study was to identify the use of ChatGPT and other generative artificial intelligence (AI) systems in the teaching of computer science through a synthesis of the research published in 2020-2025. Transparency and bias reduction as well as relevance and quality maximization of findings were implemented via a structured approach. The methodology is based on the Preferred Reporting Items of Systematic Reviews and Meta-Analyses (PRISMA) rules that are internationally accepted when it comes to systematic reviews on education, technology, and social sciences (Moher et al., 2009). Materials and methods section is presented in six sub- subsections; research design, data sources, search strategy, inclusion and exclusion criteria, study selection and screening process, and data extraction and synthesis.

3.1 Research Design

The paer asserted the systematic literature review approach as an assessment of the current empirical and theoretical studies regarding ChatGPT and generative AI in the sphere of computer science education. Systematic reviews are particularly suitable in the topics whose technological change is high because they allow the researcher to synthesize the findings of a number of studies to establish cross-cutting patterns, gaps and areas of future research (Kitchenham and Charters, 2007). One of the key research questions that characterized the study was as follows: How does ChatGPT and generative AI assist teaching, learning and assessment in computer science education, and what are the challenges and ethical issues, denoted by its usage? Additional

questions of secondary research were drafted to investigate pedagogical affordances, participation of the learners, implementation issues and institutional policies. The design that was adopted was an evidence synthesis design that was mixed and interwoven with the findings of both the qualitative and quantitative effects. Quantitative research provided data that were measurable (student performance, level of engagement, or programmer success rate) but qualitative research gave a picture of perceptions, experience, and pedagogical practice. A combination of this kind allowed getting a full picture of the impact of generative AI on students and teachers. In addition, a well-structured and explicit methodology ensures the reproducibility and reduces selection bias that is significant in the presence of new technologies with mixed evidence.

3.2 Data Sources

Multi-disciplinary academic data bases were used to include the educational and technological perspectives in the review. Database choices were Scopus, Web of science, E IEEE xplore, ACM digital library, springer, Taylor and Francis online, Elsevier science direct, and Google Scholar. A combination of these platforms includes peer-reviewed journals, conference proceedings, preprints and technical reports resulting in full coverage of suitable research. Grey literature (institutional reports, white papers, preprints on sites like arXiv) was also included in the review as AI research is often published informally before publication in a regular journal. The inclusion of grey literature improves the timeliness and coverage of evidence, especially of rapidly changing areas like generative AI. Also, the reference chaining was utilized through review of the bibliographies of major studies to find more relevant articles that were not retrieved during the initial search. This cyclic process complies with the best practices in a systematic review and reduces the chances of omission of influential studies (Wohlin, 2014).

3.3 Search Strategy

A structured search strategy was developed using Boolean operators, keywords, and synonyms to maximize retrieval of relevant studies. Sample search strings included:

- *"ChatGPT" AND "computer science education"*
- *"generative AI" AND "programming instruction"*
- *"large language models" AND "student engagement" AND "higher education"*
- *"AI chatbot" AND "learning outcomes" AND "curriculum"*

The search process was conducted iteratively between January and May 2025, with multiple rounds to refine keywords based on preliminary results. Filters were applied to limit results to publications in English and within the 2020–2025 timeframe. Following database searches, duplicate records were removed using reference management software (Mendeley and Zotero) to ensure efficiency in subsequent screening stages.

3.4 Inclusion and Exclusion Criteria

To ensure relevance and methodological rigor, explicit inclusion and exclusion criteria were defined prior to study selection:

Inclusion Criteria:

- Studies published between 2020 and 2025.
- Peer-reviewed journal articles, conference proceedings, validated technical reports, or preprints with empirical or theoretical contributions.
- Research addressing ChatGPT or other generative AI tools within computer science education contexts, including programming, algorithm design, database systems, software engineering, and computational thinking.
- Empirical studies employing quantitative, qualitative, or mixed-method approaches with measurable outcomes or detailed analysis.
- Studies written in English to maintain consistency in analysis.

Exclusion Criteria:

- Studies focused on AI applications outside education, such as in healthcare or business analytics.
- Opinion pieces, non-peer-reviewed blogs, or unsubstantiated commentaries without empirical or theoretical backing.
- Studies inaccessible in full text or not published in reputable outlets.
- Articles discussing general AI applications in education without specific reference to ChatGPT or generative AI.

Clearly defining these criteria ensured that the review captured studies that directly address the research questions while maintaining methodological quality.

3.5 Study Selection and Screening Process

The study selection process followed the four-stage PRISMA flow model: identification, screening, eligibility, and inclusion (Moher et al., 2009).

- Identification: The initial search yielded 512 records across all databases. Duplicates were removed, leaving 428 unique records.
- Screening: Titles and abstracts were screened to remove irrelevant studies, reducing the pool to 176 studies.
- Eligibility: Full-text review applied the inclusion/exclusion criteria, eliminating 92 studies that were out of scope, leaving 84 studies for in-depth review.
- Inclusion: After final quality assessment, 48 studies were included in the synthesis, comprising 31 journal articles, 12 conference papers, and 5 institutional or technical reports.

Quality assessment involved evaluating the methodological rigor, clarity, sample size, study design, and data reporting. Studies with weak methodologies were noted but given lower weight during synthesis, ensuring that conclusions reflect reliable evidence.

3.6 Data Extraction and Thematic Synthesis

For each selected study, a data extraction sheet captured key details:

- Author(s) and year of publication
- Country or context of study
- Research aim(s) and questions
- Study design (quantitative, qualitative, mixed methods, case study, experimental)
- AI tools used (ChatGPT-3.5, GPT-4, or others)
- Educational context (introductory programming, algorithms, databases, software engineering)
- Key findings on pedagogical benefits, engagement, risks, and institutional considerations

A thematic analysis approach was employed to synthesize findings. Studies were coded into four primary themes: (i) pedagogical affordances, (ii) learner engagement and outcomes, (iii) challenges and risks, and (iv) ethical, social, and institutional considerations. Thematic synthesis allowed the integration of both quantitative metrics (e.g., performance improvements) and qualitative insights (e.g., student perceptions). This approach facilitates a nuanced understanding of how generative AI tools function across diverse learning contexts.

3.7 Ethical Considerations

Although the SLR involved no human participants, ethical research practices were observed. Proper attribution of all sources was ensured, and transparent reporting of search strategies, inclusion/exclusion criteria, and synthesis methods maintained research integrity. Ethical considerations also informed interpretation, particularly regarding recommendations on AI use in classrooms to avoid unintended negative consequences such as inequity or overreliance.

Summary

Finally, the Materials and Methods are presented as an intensive, 5-step procedure that considered PRISMA requirements to search, filter, and synthesize research on ChatGPT and

generative AI in computer science education. Reliability, transparency, and replicability were ensured with comprehensive database searches, well-stated inclusion/exclusion criteria, systematic screening, and thematic synthesis. This approach offers a solid basis to examine the pedagogical potential, student achievement, obstacles, and ethical issues of AI integration in computer science education as the methodology entails the integration of qualitative and quantitative evidence. The following part is the results and discussion where synthesis of evidence is interpreted to present findings in this structured framework.

4.0 RESULTS AND DISCUSSION

The synthesis of 48 studies on ChatGPT and generative AI in computer science education highlights the multifaceted impact of these tools, revealing both pedagogical opportunities and implementation challenges. The results and discussion are organized into **four themes**: (i) pedagogical affordances, (ii) learner engagement and outcomes, (iii) challenges and risks, and (iv) ethical, social, and institutional considerations.

4.1 Pedagogical Affordances

A primary theme emerging from the literature is the pedagogical utility of ChatGPT as a teaching and learning assistant. Studies consistently demonstrate that generative AI can support personalized instruction, adaptive feedback, and immediate problem-solving assistance (Kiesler & Schiffner, 2023; Phung et al., 2023). For example, GPT-4 has been shown to approximate human tutor-level performance in coding tasks, offering explanations tailored to student questions, debugging support, and examples of correct implementation. López-Fernández and Vergaz (2024) reported that students who actively used ChatGPT for database administration exercises not only completed tasks faster but also demonstrated improved comprehension of complex concepts such as normalization and query optimization. In addition to coding assistance, ChatGPT contributes to content generation for instructors, including quizzes, practice problems, and illustrative examples (Bringula, 2024). This functionality reduces educator workload and provides students with a more diverse set of learning materials. Moreover, the interactive, conversational nature of ChatGPT aligns with constructivist learning principles, encouraging students to construct knowledge actively through inquiry, iteration, and reflection. By offering explanations in multiple ways and responding dynamically to learner queries, ChatGPT fosters deeper understanding of abstract computational concepts such as recursion, object-oriented design, and algorithmic logic. Collectively, these findings underscore the tool's potential to augment traditional teaching methods by providing a flexible, scalable, and student-centered learning environment.

4.2 Learner Engagement and Outcomes

The second theme emphasizes the impact of ChatGPT on student engagement, motivation, and academic performance. Across multiple studies, students reported increased confidence in tackling programming assignments and a greater willingness to experiment with challenging tasks (Ma et al., 2024; McCulloh et al., 2025). The availability of AI-driven support on-demand reduces barriers associated with instructor accessibility, enabling learners to engage in self-paced, autonomous learning. Programiz (2023) found that 62% of students used ChatGPT multiple times per week, and 75% advocated for the inclusion of AI in curricula, suggesting broad recognition of its utility in promoting engagement. Beyond individual learning, ChatGPT also enhances collaborative problem-solving. López-Fernández and Vergaz (2024) observed that in group projects, students used ChatGPT-generated solutions as starting points for discussion, critique, and refinement, resulting in richer, more analytical dialogue. Quantitative data indicate improvements in assignment completion rates, test performance, and conceptual understanding, particularly for students in large introductory programming courses where individualized instructor support is limited. These results collectively highlight that ChatGPT fosters both cognitive and motivational benefits, supporting learners to persist in challenging computational tasks and facilitating active participation in learning processes.

4.3 Challenges and Risks

Despite its advantages, the literature identifies significant challenges and potential risks associated with integrating ChatGPT into computer science education. Academic integrity is a primary concern, as AI-generated solutions can be submitted with minimal modification, potentially undermining student learning and skill development (Humble, 2024). The literature emphasizes that while ChatGPT can scaffold understanding, overreliance may erode problem-solving abilities and critical thinking. Another risk involves the accuracy and reliability of AI outputs. Studies report instances of "hallucinations," where ChatGPT produces plausible but incorrect code or explanations (Sun et al., 2024). Without careful monitoring, such outputs can reinforce misconceptions, leading to errors in learning and assessment. Furthermore, access and digital literacy disparities influence the effectiveness of AI tools. López-Fernández and Vergaz (2024) found that students with stronger prior knowledge and better prompt skills disproportionately benefited from ChatGPT, highlighting a risk of widening performance gaps among learners. Implementation challenges also extend to educator readiness, as instructors must develop the skills to effectively integrate AI into teaching, scaffold student use, and monitor for misuse. The literature consistently emphasizes that pedagogical integration is key; AI tools should complement rather than replace human instruction, with instructors guiding learners to critically engage with AI outputs.

4.4 Ethical, Social, and Institutional Considerations

The fourth theme addresses the ethical, social, and institutional dimensions of ChatGPT integration. Bias in AI training data presents ethical concerns, as generative models may unintentionally propagate stereotypes or marginalize minority perspectives (Albadarin et al., 2024). Transparency and explainability are also critical; students and educators often cannot discern how AI produces certain outputs, raising issues of trust and accountability. Institutional factors play a significant role in successful adoption. Evidence from IIT Delhi (2024) highlights that while student and faculty adoption was high, stakeholders raised concerns about data privacy, accuracy, and equity, prompting calls for explicit AI-use policies, ethics guidelines, and faculty training. Humble (2024) and Bringula (2024) similarly stress the importance of structured governance frameworks to regulate AI use, uphold academic integrity, and ensure inclusive access. Addressing equity concerns is particularly important, as unequal access to AI technologies can exacerbate existing educational divides, disproportionately disadvantaging students in resource-constrained settings. Overall, the literature underscores that effective implementation of ChatGPT requires institutional support, ethical oversight, and educator preparedness, alongside pedagogically informed integration strategies. When these conditions are met, generative AI can enhance learning experiences while mitigating risks related to ethics, equity, and academic quality.

Synthesis across themes

The synthesis of findings across these four themes highlights a dual narrative: ChatGPT offers transformative pedagogical and motivational benefits, enhancing learning outcomes and engagement, while simultaneously presenting challenges related to accuracy, overreliance, equity, and ethics. The literature consistently supports the view that balanced, deliberate integration—combining AI tools with instructor oversight, scaffolding, and ethical guidance—is essential to maximize benefits. A notable gap remains in longitudinal research examining sustained effects on higher-order cognitive skills, professional readiness, and long-term educational outcomes, indicating a key area for future investigation.

5.0 CONCLUSION

This is a systematic literature review that seeks to analyze the importance of ChatGPT and generative artificial intelligence (AI) in computer science education and summarize the evidence regarding the topic by conducting 48 studies published in 2020-2025. The results show that ChatGPT is an effective tool that can change the way learning and teaching are carried out in

various aspects, although it also presents challenges and ethical concerns that it needs to address so that the integration can be done responsibly. The review establishes that certain generative AI applications are pedagogically and motivationally beneficial and contribute to accessibility, engagement and learning outcomes in computer science. Pedagogically, ChatGPT can be used as an addition to personalized teaching and can be applied to assist students with specific learning requirements by providing them with real-time feedback, clarifying the content, and supporting it (Kiesler and Schiffner, 2023; Phung et al., 2023). In contrast to the conventional learning materials, which tend to be inactive and narrow, ChatGPT delivers active interactive instructions, giving learners the opportunity to study more intricate computational ideas, including algorithms, recursion, data structures, object-oriented programming, and so forth, on their own time. Also, with the help of ChatGPT, educators can use it to produce learning resources such as problem sets, quizzes, coding examples, and lab activities (Bringuna, 2024), which decrease the amount of effort required to prepare and increase the variety of learning resources. Interactive, adaptive ChatGPT features are consistent with constructivist and human-centered pedagogical frameworks, which contribute to knowledge construction by inquiry, reflection, and problem-solving. The review also shows that ChatGPT has a positive effect on the process and performance of learners. Levels of confidence increase, the desire to experiment with difficult tasks, and the readiness to continue working in case of difficulties are reported by the students (Ma et al., 2024; McCulloh et al., 2025). The empirical data show an increase in the rates of assignment completion, academic performance, and conceptual understanding, especially in introductory programming courses, where individualized instructor attention is scarce (Programiz, 2023). Moreover, ChatGPT promotes group learning, where alternative solutions and explanations are offered that encourage peer conversation, critical analysis, and the development of insight (Lopez-Fernandez and Vergaz, 2024). These results point out that generative AI can be a source of cognitive scaffold and engagement supplement, helping to promote independent learning without replacing the conventional classroom education. Irrespective of these advantages, the review finds that there are serious challenges involved in integrating ChatGPT. The first issue is that of academic integrity since the tool has the potential to produce full solutions, which can contribute to plagiarism or lack of development of problem-solving skills (Humble, 2024). Mistakes in AI responses, or hallucinations, are even more dangerous, and they can guide learners in the wrong direction and support wrong beliefs unless the instructors observe the use closely (Sun et al., 2024). ChatGPT does not equally benefit all learners, and students who possess higher levels of prior knowledge or are more adept at prompt formulating are all advantaged, and this raises equity and access issues (López-Fernández and Vergaz, 2024). Also, the excessive use of AI can negatively impact creativity and critical thinking, so it is necessary to implement a balanced approach of integrating AI that will make students more active participants of the content instead of receivers of AI-generated solutions. There are also ethical, social, and institutional issues that make it even harder to adopt AI in computer science education. Subconscious biases in the training data can affect the AI results, thus continuing stereotypes or discriminating against any group (Albadarin et al., 2024). Explainability and transparency are also issues as students and educators tend to have no idea how AI arrives at responses, casting doubt on accountability and trust. Institutes are important in the control of the application of AI, in the formulation of explicit policies regarding academic honesty, non-discriminatory access, and ethical practice, and equip teachers to adopt AI in pedagogy appropriately (IIT Delhi, 2024; Humble, 2024; Bringula, 2024). The potential to transform that ChatGPT can offer will be lost in inequity, abuse, or lower quality of education, unless the technology is governed and ethically controlled. There are also gaps in the literature pointed out in this review. The majority of the research is limited to interventions on a short-term basis or cross-sectional studies, and the long-term effects of interventions on critical thinking, professional preparedness and lifelong learning remain unexplored. More studies should be

carried out to understand the long-term effects of AI-enabled learning and the most ideal ways of integrating AI into various settings and coming up with solid frameworks to support ethical, fair, and effective application in higher education. To sum up, ChatGPT and generative AI have a lot of potential in improving the education of computer science. They can offer interactive, personalized and scalable learning support, increase student involvement and can reduce workload pressures on teachers. These advantages, however, depend on careful integration that responds to issues of accuracy, academic integrity, equity and ethics. Academic institutions should enact policies, training and control mechanisms so as to help maximize benefits and minimize the risks. Incorporating AI-based assistance with human-facilitated learning and ethical management, ChatGPT can be implemented as a supplemental tool that enhances learning experience, aids knowledge creation, and helps to develop both technical and cognitive skills essential to computer science learners. The results of this review highlight the revolutionary possibility of generative AI in education and offer a roadmap to responsible and evidence-based application that balances technological innovation with pedagogical objectives, student needs and ethical considerations.

6.0 RECOMMENDATIONS

Based on the systematic review of 48 studies exploring the role of ChatGPT and generative AI in computer science education, several strategic recommendations emerge to ensure effective, ethical, and equitable integration of AI technologies in teaching and learning. First and foremost, it is recommended that ChatGPT be adopted as a complementary instructional tool, enhancing rather than replacing traditional pedagogical approaches. Educators should leverage its capabilities to provide personalized instruction, immediate feedback, and adaptive scaffolding, particularly in complex areas such as algorithm design, programming logic, database management, and computational problem-solving (Kiesler & Schiffner, 2023; Phung et al., 2023). By integrating AI into structured exercises and assignments, instructors can guide learners to critically interact with AI outputs, analyze alternative solutions, and reflect on discrepancies, thereby fostering deeper understanding and encouraging higher-order thinking skills. Scaffolded approaches—beginning with guided AI use and progressively emphasizing independent evaluation—can reduce overreliance, enhance cognitive engagement, and build learner confidence while promoting technical competence.A second recommendation emphasizes the importance of developing AI literacy and digital skills among learners. The review indicates that students with prior knowledge and strong prompting abilities benefit most from ChatGPT, suggesting that disparities in AI proficiency can exacerbate existing educational inequalities (López-Fernández & Vergaz, 2024). Institutions should therefore provide targeted training to equip students with the skills necessary to interact effectively with AI, including constructing precise prompts, evaluating the accuracy and relevance of outputs, identifying potential errors or biases, and reflecting on AI-assisted solutions. Embedding AI literacy modules within the curriculum, offering workshops, and providing hands-on practice opportunities can empower students to maximize AI benefits, foster self-directed learning, and develop critical thinking skills. Educators should also encourage reflective exercises that prompt students to compare AI-generated solutions with traditional methods, document reasoning processes, and collaboratively discuss outcomes, thereby strengthening cognitive engagement and collaborative problem-solving. Thirdly, there is a clear need for ethical, social, and institutional governance frameworks to guide responsible AI integration. The literature highlights concerns regarding academic integrity, bias in AI outputs, transparency, and equitable access (Humble, 2024; Albadarin et al., 2024; IIT Delhi, 2024). Institutions should establish explicit policies that define acceptable AI usage, including disclosure requirements for AI-assisted work, standards for attribution, and parameters for AI participation in assignments and assessments. Professional development programs for educators are essential to ensure they can effectively scaffold AI usage, monitor student engagement, identify potential misuse, and facilitate reflective learning activities.

Attention should also be given to infrastructure and accessibility, providing equitable access to AI tools, stable internet connectivity, and supportive learning environments to prevent digital divides and ensure that all students can benefit from AI-assisted learning. Transparency in AI processes should be emphasized, teaching students to critically interrogate outputs and understand the limitations and decision-making processes of generative AI models. Fourthly, ongoing monitoring, evaluation, and continuous improvement of AI integration practices are recommended. Institutions should regularly assess how ChatGPT and similar tools impact student learning outcomes, engagement, and professional readiness, using both qualitative and quantitative metrics. Feedback mechanisms from students and instructors can help refine implementation strategies, identify challenges, and optimize instructional design. Additionally, pilot programs and controlled interventions may be used to test the effectiveness of AI-assisted pedagogical models, informing scalable integration strategies across departments or curricula. Finally, the review identifies several research gaps, leading to recommendations for future scholarly work. Longitudinal studies are needed to evaluate the sustained effects of ChatGPT on learner outcomes, including critical thinking, problem-solving, creativity, and career preparedness. Comparative research across different educational contexts, disciplines, and demographic groups will provide insights into best practices for equitable and inclusive AI integration. Furthermore, studies examining AI-supported collaborative learning, project-based learning, and interdisciplinary instruction can inform the development of innovative pedagogical models. Ethical and governance research should also continue, exploring frameworks that ensure responsible AI use, transparency, and accountability while maintaining learner engagement and motivation. In conclusion, the integration of ChatGPT and generative AI in computer science education offers substantial pedagogical, cognitive, and motivational benefits, but its effective and responsible adoption requires a multi-faceted approach. Key strategies include structured pedagogical integration, the development of AI literacy and critical evaluation skills among learners, robust ethical and institutional governance, ongoing monitoring, and targeted research to guide evidence-based practice. By implementing these recommendations, educators and institutions can harness the transformative potential of generative AI, enhancing learning outcomes, fostering engagement, and preparing students with the competencies required for success in the evolving digital and technological landscape. Ultimately, responsible integration of AI aligns technological innovation with pedagogical objectives, ethical standards, and learner needs, ensuring sustainable and impactful educational experiences.

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SUKUK AL-SAFAR: A CONCEPTUAL FRAMEWORK FOR SHARİAH-COMPLİANT FİNANCİNG İN GREEN TOURİSM AND SUSTAİNABLE ECONOMİC EMPOWERMENT

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Abstract

In the context of global sustainability challenges and the principles of Islamic finance, this conceptual paper proposes Sukuk al-Safar as an innovative Shariah-compliant instrument designed to fund green tourism initiatives. Rooted in Islamic ethical principles such as risk-sharing, asset-backing, and the prohibition of riba (interest), Sukuk al-Safar integrates environmental, social, and governance (ESG) criteria to support low-carbon tourism infrastructure, including eco-friendly accommodations and sustainable transport systems. Drawing from existing literature on Islamic finance, sukuk innovations, and sustainable tourism, the paper develops a theoretical framework that aligns with Maqasid al-Shariah—particularly the preservation of the environment (hifz al-bi'ah) and wealth (hifz al-mal)—while contributing to United Nations Sustainable Development Goals (SDGs), such as SDG 8 (decent work and economic growth) and SDG 13 (climate action).

The conceptual model outlines the structural design, Shariah compliance mechanisms, risk mitigation strategies, and comparative advantages of Sukuk al-Safar over conventional bonds. By utilizing tourism-related assets as collateral and incorporating performance-based ESG metrics, the instrument aims to mobilize ethical capital for inclusive economic development in tourism-dependent regions. Theoretically, it advances Islamic finance scholarship by embedding sustainability paradigms. Practically, it offers a blueprint for financiers and policymakers to foster green tourism. The paper concludes with implications for regulatory reforms and suggestions for future empirical validation.

Keywords:

Islamic finance; Sukuk; Green tourism; Sustainable development; Maqasid al-Shariah; ESG investing

SEROLOGICAL PROFILE (ANTI-CCP AND RHEUMATOID FACTOR) FOR THE DIAGNOSIS OF RHEUMATOID ARTHRITIS IN PATIENTS FROM THE BATNA REGION, ALGERIA

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Abstract

Rheumatoid arthritis (RA) is a systemic autoimmune disease with a multifactorial origin, resulting from the interaction of genetic, environmental, and immunological factors. The aim of our study was to identify the main autoantibodies involved in the immunological diagnosis of RA and to evaluate their sensitivity and specificity.The study was conducted in the immunology laboratory of Batna University Hospital (CHU de Batna) on a sample of 76 RA patients. The autoantibodies evaluated were rheumatoid factor (RF), anti-cyclic citrullinated peptide antibodies (anti-CCP), and antinuclear antibodies (ANA). The techniques used were: ELISA (Alegria 2) for anti-CCP, nephelometry and immuno-agglutination for RF, and indirect immunofluorescence (IIF) for ANA detection.

The average age of patients was 52.6 years, with a marked female predominance (76%, sex ratio = 0.31). ANA was positive in 57.9% of patients. Serologically, 56.41% showed positivity for both antibodies. None of the control subjects tested positive. Statistical analysis revealed a significant association between RF and anti-CCP ($Chi^2 = 20.78$; $p < 0.0001$; OR = 0.01714; 95% CI: 0.00098–0.299).These findings suggest a frequent association between RF and anti-CCP in RA patients. However, their combination does not improve diagnostic specificity, thereby limiting their combined utility in ruling out the disease.

In conclusion, these results highlight the importance of a combined panel of immunological analyses to improve the diagnosis and prognosis of RA and to enable earlier and more appropriate patient care.

Keywords: Rheumatoid arthritis – RF , Anti-CCP antibodies, ANA , Autoimmune diseases.

ANALYSİS OF STEADY MHD MİXED CONVECTİON WİTH STREAMİNG POTENTİAL İN CU, SNO_2, AND $SİO_2$ NANOFLUİDS:

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Abstract

This study investigates steady magnetohydrodynamic (MHD) mixed convection flow with streaming potential in a vertical channel filled with three water-based nanofluids—Cu, SnO_2, and SiO_2. The governing nonlinear momentum and energy equations were solved analytically under appropriate boundary conditions to examine the combined effects of electromagnetic, buoyancy, and electrokinetic forces on flow, skin friction, and mass transport. The influence of keyparameters, including the magnetic parameter (M), mixed convection parameter $\left(\frac{Gr}{Re}\right)$ Reynolds number (Re), Debye–Hückel parameter (K), and wall slip parameter (α), was analyzed. Results indicate that increasing M suppresses the fluid velocity in the channel core due to Lorentz forces while slightly enhancing near-wall velocity, whereas higher $\frac{Gr}{Re}$ values promote buoyancy-driven acceleration at the upper wall and induce reverse flow at the lower wall. Velocity increases with Re and K, reflecting stronger inertial and electrokinetic effects. Among the nanofluids, Cu exhibits the highest velocity, skin friction, and mass flow rate, followed by SnO_2 and SiO_2, attributed to its superior thermal and electrical conductivities. Skin friction and mass flow rate increase with M and stabilize at higher $\frac{Gr}{Re}$, while critical $\frac{Gr}{Re}$ values rise with magnetic strength and decrease with wall slip, highlighting the competing effects of magnetic damping and slip-induced flow acceleration. Overall, the results demonstrate that the interplay between magnetic, buoyancy, and electroosmotic forces governs transport behavior, with Cu–water nanofluid providing the most effective enhancement in momentum and heat transfer. These findings offer valuable guidance for the design and optimization of MHD-driven microchannel systems, electrokinetic devices, and thermal management applications.

ÇİFT GÖZENEKLİLİK VE VİSKO-GÖZENEKLİ SÖNÜMLEME İÇEREN TEK BOYUTLU BİR ELASTİK SİSTEMİN KARARLILIK ANALİZİ

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ÖZET

Bu çalışmada, çift gözeneklilik yapısına sahip olan ve her iki gözenek alanında visko-gözenekli (sürtünmeli) sönümleme etkilerine maruz kalan tek boyutlu bir elastik sistemin kararlılık davranışı incelenmektedir. Ele alınan sistem, katı matris ile birbiriyle bağlantılı iki gözenek ağı arasındaki etkileşimi modellemekte olup, bağlı bir hiperbolik–hiperbolik dinamik yapı ortaya koymaktadır.

Öncelikle, yarıgrup teorisi kullanılarak sistemin iyi konululuğu (well-posedness) ortaya konulmakta; başlangıç verilerine göre çözümlerin varlığı, tekliliği ve sürekli bağımlılığı ispatlanmaktadır. Ardından, modelin içsel bağlanma ve sönümleme mekanizmalarını yansıtan, χ_0 ve χ_1 ile gösterilen iki karakteristik kararlılık sayısı tanımlanmaktadır.

Temel sonuç olarak, $\chi_0 = 0$ ve $\chi_1 \neq 0$ kararlılık koşulu sağlandığında sistem enerjisinin üstel olarak azaldığı gösterilmektedir. İspat, uygun bir Lyapunov fonksiyonelinin inşası ile geliştirilmiş enerji kestirimlerine dayanmaktadır. Buna karşılık, bu koşulun sağlanmaması durumunda, uygun çözüm dizilerinin kurulması ve spektral analiz tekniklerinin uygulanması yoluyla üstel kararlılığın bulunmadığı ortaya konulmaktadır.

Elde edilen sonuçlar, kararlılık koşulunun keskinliğini açığa çıkarmakta ve visko-gözenekli sönümleme ile bağlanma parametrelerinin sistemin uzun zamanlı davranışının belirlenmesindeki kritik rolünü vurgulamaktadır. Ayrıca, bu bulgular literatürde mevcut olan, özellikle [5] ve [14] numaralı çalışmalarda sunulan sonuçları önemli ölçüde iyileştirmekte ve genelleştirerek, çift gözeneklili elastik sistemlerde üstel azalımın ve bunun yokluğunun daha kapsamlı bir karakterizasyonunu sunmaktadır.

Anahtar Kelimeler: çift gözeneklilik, iyi konululuk, üstel azalma, üstel azalmanın yokluğu.

STABILITY ANALYSIS OF A ONE-DIMENSIONAL ELASTIC SYSTEM WITH DOUBLE POROSITY AND VISCO-POROUS DISSIPATION

ABSTRACT

we investigate the stability behavior of a one-dimensional elastic system exhibiting a double-porosity structure and subject to visco-porous (frictional) damping effects acting on both porous fields. The system under consideration models the interaction between the solid matrix and two interconnected pore networks, leading to a coupled hyperbolic–hyperbolic dynamic framework.

First, we establish the well-posedness of the system by employing semigroup theory, proving the existence, uniqueness, and continuous dependence of solutions with respect to the initial data. Subsequently, we introduce two characteristic stability numbers, denoted by χ_0 and χ_1, which encapsulate the intrinsic coupling and dissipation mechanisms of the model.

Our main result shows that the energy of the system decays exponentially provided that the stability condition $\chi_0 = 0$ and $\chi_1 \neq 0$ is satisfied. The proof relies on the construction of a suitable Lyapunov functional combined with refined energy estimates. Conversely, when this

condition fails, we demonstrate the absence of exponential stability by constructing appropriate sequences of solutions and applying spectral analysis techniques.
These results reveal the sharpness of the stability condition and highlight the crucial role played by the visco-porous damping and coupling parameters in determining the long-time behavior of the system. Moreover, our findings significantly improve and generalize earlier results available in the literature, notably those reported in [5] and [14], by providing a more complete characterization of the exponential decay and its failure in double-porosity elastic systems.
Keywords: double porosity, well-posedness, exponential decay, lack of
exponential decay.

DEVELOPMENT AND OPTIMIZATION OF AN INTEGRATED SOLAR DESALINATION SYSTEM WITH THERMAL STORAGE AND ENERGY RECOVERY

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Abstract:
This work focuses on the development and optimization of an integrated solar desalination system that combines photothermal evaporation, thermal energy storage, and energy recovery to enhance freshwater production. The system uses high-efficiency photothermal materials to convert solar radiation into heat, enabling rapid water evaporation under low energy consumption. A thermal storage unit - typically based on molten salts or phase-change materials ensures continuous desalination during periods of low or no sunlight, thereby stabilizing the system's performance. Additionally, energy recovery components, such as heat exchangers or thermoelectric modules, are incorporated to capture and reuse waste heat, improving the overall thermodynamic efficiency. The integration of these technologies results in a highly sustainable, autonomous, and cost-effective desalination solution suitable for remote and coastal regions facing water scarcity. This approach contributes to reducing reliance on conventional, energy-intensive desalination methods while promoting clean and renewable water production.

Keywords:
Solar desalination, photothermal materials, thermal energy storage (TES), molten salts
Thermal efficiency, Hybrid solar system, Freshwater production

ASSESSING COGNITIVE FUNCTIONING AND BASIC CONCEPT DEVELOPMENT IN CHILDREN WITH AUTISM AND TYPICALLY DEVELOPING CHILDREN

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Abstract

This study examines cognitive functioning and basic concept mastery in children with Autism Spectrum Disorder (ASD) compared to their typically developing (TD) peers. The research aims to explore cognitive differences, their implications for learning, and the role of socio-cultural factors in shaping cognitive development. A comparative research design was utilized, employing the Cognitive Failure Questionnaire to assess cognitive abilities and the Boehm Test of Basic, selected through convenience sampling from educational and therapeutic institutions. Statistical analyses, including t-tests and correlation analyses, examined group differences and relationships between cognitive functioning and basic concept mastery. Results indicated that children with ASD scored significantly lower in basic concept mastery ($M = 29.30$, $SD = 8.517$) than TD children ($M = 47.96$, $SD = 2.368$). Similarly, cognitive failure functioning was higher in children with ASD ($M = 58.55$, $SD = 11.532$) compared to TD children ($M = 34.67$, $SD = 17.322$), with statistically significant differences ($p < .05$). A significant correlation between cognitive functioning and basic concept mastery reinforced the interconnected nature of executive functioning and conceptual learning in ASD. Gender-based differences within the ASD group were not statistically significant. These findings underscore the need for targeted interventions and culturally adapted educational strategies to enhance cognitive development in autistic children. Future research should focus on longitudinal studies and culturally relevant assessment tools to better support children with ASD in diverse socio-economic contexts.

Keywords: Autism Spectrum Disorder (ASD), Cognitive functioning, Basic concept mastery, Executive functioning

POTENTIAL OF BIOMATERIALS DERIVED FROM AGRICULTURAL WASTE FOR THE TREATMENT OF HOSPITAL EFFLUENTS: APPLICATION TO DATE PITS AND CLOVES

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Hospital effluents are a major source of emerging pollution due to their high load of organic pollutants, pharmaceutical residues, pathogens, and antibiotic resistance genes, posing a significant risk to aquatic ecosystems and public health. In light of these threats, the implementation of advanced and effective treatment strategies is essential to limit the spread of these pollutants and protect environmental health. This not only eliminates micropollutants and pathogens, but also recovers a valuable resource for other uses such as cleaning, irrigation of green spaces, cooling circuits, etc. Due to the economic and environmental limitations of conventional treatment technologies, there is growing interest in exploring sustainable solutions based on the recovery of agricultural waste. This is the subject of the present study, which aims to explore the potential of biomaterials derived from agricultural waste, in particular date pits and cloves, for the treatment of hospital effluents. Date pits were used as a natural filter material after preparation and conditioning, while cloves were studied for their antimicrobial and adsorbent properties. The performance of the biomaterials was evaluated through the analysis of physicochemical and microbiological parameters.

The results obtained show a significant improvement in the quality of treated effluents, with a notable reduction in organic load and microbiological contamination. This innovative approach offers an environmentally friendly and economically viable alternative for complementary treatment of hospital effluents, particularly suited to developing countries, and opens up promising prospects for the development of water treatment technologies based on local natural resources.

Keywords: Hospital effluents, biomaterials, date pits, cloves, wastewater treatment.

DETECTIVE OF CRIME AND DEVIATION, FAMILY RELATIONS IN THE CITY AND THEIR ROLE IN THE SPREAD OF VIOLENCE IN IT

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Abstract *–Man is a social being by nature, as he started from the tribe, then the village, to the city, where different social relations arise between these individuals, and the latter interact from the family, the street, the school, and religious institutions to regulate behavior, and this integration results in positive and negative reactions. Conflict, competition and selfishness are the negative social processes that result in violence, especially if the direction and guidance have taken the wrong approach.*

The focus in this study is on the internal relationships of the family, the family roles, the most important processes that take place within the family, the factors that change them, and the most important problems facing the family.

Keywords – family; family relation; city; violence

II. INTRODUCTION

The family is the first social unit that aims to preserve the entity of society, as it performs the first social process, which is the upbringing and preparation of the social climate for the individual through care and guidance in the various stages of his life. And his beliefs, and in light of the rapid urban growth of the city and the continuous population increase, societies have known changes and transformations in various buildings. This change led to the emergence of many social problems, most notably the phenomenon of violence, which took different forms and dimensions, which posed a threat to society and the city became a fertile field for the growth of this phenomenon due to its availability on the The factors that lead to violence, especially major cities, and this is confirmed by studies, where violence has become a behavior that distinguishes the city and one of the most dangerous phenomena that afflict the entity of society, and the city is a space for expressing the various relationships and interactions between social actors.

The urban environment has contributed greatly to changing the family's structure and abandoning its role, values, customs and traditions, which caused imbalance and loss, and produced negative and violent behaviors as a result of differences, conflicts and family problems that occur as a result of the wrong method of upbringing and the impact of the internal relationships of the family in terms of the relationship of the husband, wife, parents and children. And the children are among themselves, just as societies today are moving towards the pattern of gender equality. We notice the spread of the nuclear family, the woman's exit to work and her liberation, which has played a role in her family and her husband's participation in decision-making, and a clear reduction in the authority of the father and a change in family roles, as well as the weakness of family ties and the abandonment of some family members from Their roles, the nuclear family has limited relations in urban society. These changes and transformations have had different effects on the family's structure and functions and on the nature of its social relations, as well as the reduction in its size from extended to nuclear and the emergence of social relations between its members in its surroundings, which threatens its cohesion and stability, weakening family ties and changing roles As well as the method of family upbringing produces secretions that help spread violence in the city, and these issues are considered Important in the field of family relations and their changes.

The problem of studying

The family is the first and main cell that makes up society. It is the first social unit known to man. It is responsible for producing the individual and preparing him to continue life, through the infiltration of opinions, ideas, beliefs and values prevailing in his society, which helps to

develop a special family style. He described “Wirt” urban society. With the change of the family in terms of shape and structure, size and pattern of kinship, economic progress and jobs, especially education and social control, from here the study of the family and the characteristics of its members and their family relations was an important subject of study.

The family is the first social organization that forms the structure and personality of its children, by teaching them social behavior and indoctrination of values, trends, religion and morals. For its members, as the child learns within the family social processes such as cooperation, competition, conflict, and the family indirectly affects the behavior of the children, and the methods of upbringing affect the patterns of their personalities and psychological compatibility, which allows the continuity of society, the stability of its systems and standards, and the development of social behavior.

There have been many transformations in family construction in light of the social and economic changes of society, especially technological and information developments, which increased the complexity of life in the city, its intertwining and diversity of its problems, the most important of which is the emergence of the phenomenon of violence and deviation in its forms. This building and its containment of population elements of different origins brought together the indigenous population and the expatriates and their views differed on the nature of living and residence. Violence is linked to the city. The greater the size of the city, the higher the number of crimes. The city is linked to the institution of the family, which is the most important institution for upbringing and social control, which aims to preserve the upbringing of the individual in line with the norms and customs of society. With the size of the family shrinking and women leaving for work, their role has changed and is looking for independence On the one hand, and on the other hand, she tries to maintain the family balance, especially with the decline in the authority of the father.

The family in the city began to suffer from many problems that affected its internal relationship between its members and the weakness of family interaction. The change did not affect the structures of society only, but it penetrated into the arms of the family, so the nature of the relationship that binds members of the same family changed. Hostility towards self and others, which involuntarily pushes its members to violence and deviation. The family may contribute to the deviation of its children and their slipping towards violence in their surroundings, and some families have turned into a source of threat to their children, as violence is an instinctive response to frustration or being attacked. Or for not meeting the expectations of parents and note Children's behavior of adults in the family, which is dominated by tantrums or temper temper, which makes the child filled with feelings of guilt and fear and often writes his emotions until the tension becomes unbearable, which leads them to deviate. From here came the question of the study:

Do family relations play a role in the spread of violence in the city?

Sub-questions

- Does the weakness of family ties lead to the spread of violence in the city?
- Does the method of family upbringing lead to the spread of violence in the city?
- Does changing family roles lead to the spread of violence in the city ?

Study hypotheses

After formulating the problem accurately, we moved to the stage of formulating hypotheses to get closer to the aspects of the problem and identify them.

general hypothesis

The spread of violence in the city is linked to the tension of family relations, and we have relied on three hypotheses to answer the questions of the study and reveal the role of family relations in the spread of the phenomenon of violence in the city. To verify the validity of the study’s hypotheses, we set a set of indicators as follows:

First partial hypothesis:

- The weakness of family ties in the city leads to the spread of violence there.

To verify the validity of this hypothesis, we relied on the following indicators indicating the type of relationship within the family:

- Dialogue, understanding, cooperation, interest.
- Dialogue and consultation in matters of the family and children.
- Involvement of children in their private affairs and giving them advice.
- Understanding in resolving disputes.
- Attention and kindness to the children and the wife.

The second partial hypothesis:

- The method of family upbringing contributes to the city and the spread of violence in it.

To verify the validity of this hypothesis, we relied on the following indicators indicating the type of upbringing method.

- Punishment, neglect, justice, pampering.
- Punishment of children and the use of cruelty and beatings when they commit mistakes.
- Neglecting the needs of children and the family and not following up on their behavior.
- Justice between children and no preference between males and females.
- Pampering children, accompanying them, and indifference to their behavior.

The third partial hypothesis:

Changing family roles in the city leads to the spread of violence in it.

To verify the validity of the third hypothesis, we relied on the following indicators indicating the change in family roles

- Domination, disagreements, harmony, evasion.
- Dominate one of the parents in making decisions for children and the family.
- The occurrence of the parents in the tendencies and disagreements on various matters of the family and children.
- One of the parents evaded his responsibilities towards the children and the family.
- Women going out to work and reducing their role in the home.

Reasons for choosing the topic

- The nature of family relations in the city and its implications for some social aspects of life in the city.
- The importance of the family's role in limiting the spread of violence in the city.
- The negative repercussions of the phenomenon of violence in the city.
- Attempting to understand the phenomenon of violence and know its causes and the resulting effects.
- Understand the real role that family relations play in reducing the phenomenon of violence in the city.
- The study deals with an important aspect of the life of the individual and society.

The importance of studying

The family is the first and main cell of society, and given the importance of the family in preserving the offspring and heritage and the cohesion of the unity of its members through the strength of family ties of affection, kindness, cooperation and love, as well as through the method of sound upbringing, hence the importance of the study in:

The study deals with the concept of family relations and their importance in the secret life in the city.

Parents' failure to perform their social roles and what negatively reflects on them in producing unbalanced individuals in society.

- Advancement of family affairs and the role of its members in the success of family relations to reduce the phenomenon of violence in the city.
- The importance of this study lies in the information it will provide about the role of family relations in the spread of violence in the city.

Objectives of the study:

Scientific goals:

- Obtaining a balance of knowledge on the subject of family relations and their role in the spread of violence in the city to facilitate the study and achieve the desired results.
- Enriching the library of the Sociology Department with an important topic, which is one of the current topics.
- Considering the study as a scientific fruit for the reader and researcher to benefit from.

Practical Objectives

- Educating families about the importance of understanding and family cohesion among their members.
- Recognize the negative repercussions of weak family relationships.
- Educating families and sensitizing them to their role in the sound family upbringing of their children.
- Presenting a set of suggestions to reduce the phenomenon of violence.
- Identify the reasons behind the spread of the phenomenon of violence in the city, as well as the effects resulting from it.
- Shedding light on the various propositions and ideas about the importance of family relationships.

Understand the nature of the internal family relations within the city as well as the various family roles.

- Detection of various family problems.

Define study concepts

Defining concepts is important in sociological research, the more clarity and accuracy it is for researchers to understand and understand them, and since our study dealt with family relations in the city and their role in the spread of violence in it, we relied on a number of concepts as follows:

Family, relationship, family relations, city, violence, some concepts related to violence: delinquency, crime, aggression.

1. The concept of family

Given the importance of the family and its role in society, we found several definitions of the family. Some see it from a social angle as a social cell, and others view it from a legal point of view as a legal link.

Malinowski defined it as “a group of individuals who have a close relationship that distinguishes them from other groups, live in a common home, and are bound by common emotions.”

2. The concept of family relations

It means those relationships that exist between the roles of the husband, wife and children, and it also means the nature of the preoccupations and interactions that occur between family members who reside in one house, and from that the relationship that falls between the husband and wife and between the children themselves.

3.City concept:

Many scholars have been interested in defining the city according to several specializations, some of them know it in the light of ecological factors and cultural values, and some know it statistically, legally, volumetrically, functionally, historically, locally and socially.

It is difficult to put a clear definition that differentiates between a city and a village. Some say that the difference is in the number of residents, others say that the difference is in the type of profession or the economic basis of the population unit, and some third people say that the difference is in the administrative level or urban appearance...etc.

Louis Wirth defines it: The contemporary world is no longer this world that consists of small isolated groups of people spread over a wide area of the earth. and practices that call it the city.

4.The concept of violence:

Violence from a social perspective:

He defined "Kayem's role" as: "a social condition that arises from the disintegration and collapse of a set of values and norms that bind the elements of society and its institutions to each other."

The American sociologist "Honeyberg" defined violence as: "acts of destruction, sabotage, damage and loss directed at selected targets, victims, environmental conditions, means, or tools, and whose effects are of a political nature that modify, restrict or modify the behavior of others in a situation Equality which has consequences for the social system.

From a legal perspective:

Most laws define violence as every positive or negative, direct or indirect, material or moral act directed at harming oneself, another, group, or property of any of them.

And violence in criminal legislation: it is any violation of the integrity of the body of the victim that would inflict harm on him and infringe upon him.

According to the definition of the United Nations: It is an act based on violent behavior that results in abuse or suffering (sexual, psychological) and psychological deprivation of freedom in public or private life.

CONCLUSIONS

The family remains the first social institution in which children receive social upbringing, in which interaction and communication take place between the individual and his group.

The family also instills in the children the societal principles, values and standards that control their behavior according to the society in which they live. And communication between groups has vanished, and kinship and family ties have vanished, so values, standards, and various methods of upbringing have changed. Following wrong educational methods leads, to a large extent, to weak interaction between individuals, which emerged through discrimination and articulation between children and the use of cruelty and beatings that negatively affect the behavior of children and their acquisition of violent and deviant behavior. Changing family roles plays a major role in the deviation of children, and through strained relations between spouses about family tasks and duties, the decline of the traditional father’s authority, and the woman’s exit to work, which affected her role in caring for children, instilling moral and religious values in them, raising them to respect the values and rules of society, and teaching them the basics of interaction and effective communication with others.

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Topics: Social and Humanity Studies

ACCESSİBLE AR FOR EFL LEARNERS İN THE GLOBAL SOUTH: BRİDGİNG DİGİTAL INEQUALİTİES THROUGH LOW-COST PEDAGOGİES

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Abstract:
This paper explores how digital inequalities across the Global South impact the integration of augmented reality (AR) in English as a Foreign Language (EFL) teaching. It synthesizes research demonstrating the viability of low-cost AR solutions including mobile, marker-based, and simple location-aware applications within resource-limited educational settings. The paper highlights accessible tools and platforms compatible for teachers with minimal technical training. It details how such affordable AR can transform pedagogy by boosting student engagement and interactive learning. Crucially, the paper posits that these strategic, low-cost implementations not only enhance instruction but also work to moderate the digital divide itself, making immersive learning more feasible and scalable. Consequently, accurately implemented AR can foster more inclusive EFL education and expand opportunities for all learners in underserved regions.
Keywords: *Augmented Reality, EFL instruction, Global South, AR-based instruction.*

FEASIBILITY OF USING RICE STRAW BALE AS A WALLING MATERIAL FOR SUSTAINABLE AND AFFORDABLE LOW-COST MASS-HOUSING IN GOMBE METROPOLIS, NIGERIA

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Abstract
The escalation in the cost of conventional construction materials, compounded by prolonged insurgency in North Eastern Nigeria, has significantly exacerbated the housing scarcity prevalent in Gombe State. Factors influencing housing deficit in the region include rapid population growth, urbanization, migration from neighbouring states affected by insurgency, and insufficient investment in the housing sector. The building industry consumes approximately 40% of the world's total energy which is unsustainable. Straw bale as a sustainable and affordable material is therefore considered as an ideal building *material* because of its renewable nature and low environmental impact with a rich history of utilization in North America, Europe and Asia. Although it remains largely underutilized in Nigeria, often disposed by open burning which exacerbates to the challenges of climate change in the built environment. Gombe State, emerging as a significant player in the rice production industry with an annual production capacity of over 140,107 metric tonnes, stands to leverage rice straw bale as a construction material, which would enhance housing sustainability and affordability within the region. Qualitative research approach was adopted for this study and data were collected through face to face interview. Thematic analysis was adopted to interpret the data, from the findings. 25 persons across the three categories of the participants (Civil Servants, Farmers and Professionals in the building industry) are of the opinion that straw bale is an affordable building material than conventional building material with 4 participants having the opinion of choosing conventional building materials to be more affordable and more accessible than straw bale, while 1 person did not make comment. This research also found 19 out of the 30 interviewees are of the opinion of building with straw bale as a walling material stating reasons such as: local material availability, sustainability, insulation, cost savings, and potential economic development as the major benefits of using straw bale as a construction material. However, concerns for inadequate awareness, scarcity of skilled professionals and artisans, funding constraints, susceptibility to termite infestation, fire rating, durability, public acceptance, weather resistance, adherence to building codes, and aesthetic considerations were identified as challenges for the adoption and application of straw bale. In conclusion, this research suggest the treating the straw bales using sodium borate also known as borax powder or used engine oil to prevent termite infestations, mixing of breathable stucco such as clay with lime in plastering to assist in achieving indoor air quality (IAQ) and prevention of plant sprout from the bales, organising multi-media workshops, trainings and issuing certification such as Breeam, Leeds can also aid in creating public awareness on using straw bale as a walling material. Additionally, involvement of private sector stakeholders, estate developers, policy makers and robust research efforts on affordability, applicability and sustainability of straw bale is emphasized.

Keywords: Climate Change, Indoor air quality, Sustainable building material, Straw bale

UNMASKING THE MARGINS: A BIBLIOMETRIC ANALYSIS OF GEOGRAPHICAL BIAS IN AFROCENTRIC ARCHITECTURAL RESEARCH AND PATHWAYS TO PAN-AFRICAN EQUITY

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Abstract
Afrocentric architecture represents a decolonial paradigm that centers African cultural, spiritual, and environmental principles in contemporary design, countering Eurocentric dominance in architectural theory and practice. Rooted in Afrocentricity, it emphasizes indigenous technologies, climatic responsiveness, and cultural symbolism to foster sustainable, context-sensitive built environments. Despite its promise for epistemic reclamation and pan-African unity, the field is plagued by profound geographical imbalances, with research predominantly concentrated in West and Southern Africa due to established academic infrastructures, colonial legacies, and funding disparities. This bias fragments the discourse, neglecting vibrant traditions in Central, East, and North Africa, such as Nubian vaults, Swahili coral-stone houses, and Congolese earth structures, thereby limiting a comprehensive continental framework. This study addresses this critical gap through a PRISMA-guided systematic literature review and bibliometric analysis of Afrocentric architectural research from 2015 to 2025. Using Google Scholar, a Boolean search strategy identified 20,306 initial articles, refined to 139 relevant peer-reviewed publications based on inclusion criteria focusing on English-language studies in built environment fields with geographical context. Data extraction included authorship, affiliations, countries of origin, and publication trends, analyzed via network mapping and density visualizations to quantify regional representation. Results reveal a stark West/South dominance, with West Africa contributing 55 outputs (e.g., Nigeria: 42) and Southern Africa 53 (e.g., South Africa: 51), while East Africa (12), Central Africa (2), and North Africa (1) remain severely underrepresented. Diaspora contributions (16) from the U.S., U.K., and Europe underscore external epistemic influence. Publication trends peaked at 26 in 2020, reflecting growing decolonial interest, but declined thereafter, highlighting data limitations and uneven methodological approaches across regions. These findings expose structural inequalities that

hinder theoretical integration, sustainability discourse, and architectural education, perpetuating epistemic injustice. By mapping biases, the study advocates for equitable interventions to achieve a truly inclusive Afrocentric paradigm. Recommendations include multilingual bibliometric databases, intra-African collaborations, open-access platforms, targeted funding for underrepresented regions, and curriculum diversification to incorporate diverse case studies. Ultimately, addressing geographical bias is essential for redefining Afrocentric architecture as a unified, representative continental narrative that honors Africa's full cultural and environmental spectrum.

Keywords: Afrocentric architecture, geographical bias, bibliometric analysis, decolonization, epistemic equity

REWARDS AND RECOGNITION AS DRIVERS OF EMPLOYEE RETENTION: A HUMAN-CENTRED STUDY

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Abstract

In today's rapidly changing workplace, employee retention has become a major challenge for organizations worldwide. While many companies focus on hiring new talent, the real need is to understand what motivates employees to stay. This study takes a human-centred approach to explore how rewards and recognition influence employee behaviour, job satisfaction, and long-term commitment.

The research examines both financial rewards (salary, incentives, performance-based benefits) and non-financial rewards (recognition, appreciation, learning opportunities, work–life balance, supportive culture). It also highlights how different demographic groups respond to various forms of rewards, showing that employees today value respect, growth, and meaningful acknowledgement as much as monetary benefits.

Using insights from existing literature, organizational practices, and behavioural theories from the social sciences, this study shows that a well-structured rewards and recognition system can significantly reduce attrition and improve employee loyalty. The findings emphasize that retaining employees is not just an HR strategy but a social and human need, rooted in motivation, psychological safety, and the desire for appreciation.

This research aims to contribute practical recommendations for organizations seeking to build positive workplaces, strengthen employee commitment, and create more sustainable, human-focused work cultures.

Keywords

Employee Retention, Rewards Strategy, Recognition, Total Rewards, Job Satisfaction, Employee Motivation, Organizational Behaviour, Employee Engagement, Workplace Wellbeing, Human Resource Management

THE DAWN OF DEFINED COLLAGEN: UTILIZING UNNATURAL AMINO ACID INCORPORATION FOR HIGHLY STABLE, NON-IMMUNOGENIC CARRIERS IN COSMECEUTICALS AND DRUG DELIVERY

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Abstract

The rapid expansion of recombinant protein technology is reshaping dermatology and precision medicine, demanding ultrapure, safe, and scalable structural proteins. Traditional animal-derived collagen is limited by immunogenicity, pathogen risk, and severe batch variability. This review assesses the stabilization of recombinant Collagen-Like Proteins (CLPs), cost-effectively produced in microbial hosts like *E. coli*. The main technical challenge is the host's lack of Prolyl-4-hydroxylase, resulting in insufficient Hydroxyproline (Hyp) content. This deficiency makes unmodified CLPs unstable, with thermal denaturation temperatures (T_m) often below 30°C, compromising storage and structural integrity. Such unstable CLPs fail to form the necessary organized triple-helical fibres required for predictable material function. We detail the Unnatural Amino Acid Incorporation (UAAi) strategy, specifically the proline auxotroph method, as the most effective route to generate CLPs with near-stoichiometric Hyp content. This technique forces the incorporation of exogenous Hyp during translation, leading to predictable, enhanced thermal stability and superior biophysical properties, including controlled self-assembly. These highly stable, non-immunogenic CLPs are vital for advanced biomedical applications. We analyse their emerging use as dermal fillers that resist rapid degradation, advanced cosmetic ingredients, and precision drug delivery vehicles with stable, controlled release kinetics. This represents a paradigm shift from unreliable animal extracts to customizable, high-purity recombinant collagen materials.

Keywords: Collagen-Like Proteins (CLPs), Unnatural Amino Acid Incorporation (UAAi), Proline Auxotroph, Hydroxyproline (Hyp), Thermal Stability, Customizable

GLOBAL RESEARCH TRENDS İN FLİPPED LEARNİNG: A COMPREHENSİVE BİBLİOMETRİC ANALYSİS ACROSS THE SDG ERA (2015–2026)

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Flip learning has become an essential mechanism during Sustainable Development Goals (SDGs) implementation period, serving as a widely, used active scientific teaching, learning and transformative pedagogical approach within global education systems. This paper presents a comprehensive bibliometric review of flip learning during the SDG period between 2015 to 2026, demonstrating its intellectual structure, thematic evaluation, emerging scholarly directions, and identifying growth trends within the fast-growing SDG era research body. The study uses a single string on flipped learning with a systematic inclusion-exclusion criteria, which finally resulted 3681 reports retrieved from Scopus throughout the SDG period. We applied VOSviewer software incorporating bibliometric packages in R to chart the scientific documents. It then isolates the key research themes, keywords Co-occurrence map, Citation structures, average citation and high impact production with the most relevant sources and affiliation. The geographical invention and network decidedly concentered in USA, China and Europe, while Australia and Indonesia also display as emerged contributor in the flipped learning domain during the SDG era. The findings also revel positive trends in flipped learning across the SDG era, with prominent clusters around themes including flip classroom, active learning, problem-based learning, medical education, human experience, inverted classroom, online learning, gamification and controlled study.

The scientific dissemination denote the first SDG period focused bibliometric mapping of flip learning and provides valuable insight into global intellectual research foundations, future trajectories and collaborative patterns. The findings offer evidence-based guidance for educators, policymakers and researchers understanding and advancing filliped pedagogies in the metamorphosing global educational landscape to meets UN 2030 educational targets.

A MACHİNE LEARNİNG-BASED APPROACH FOR AUTOMATED FAKE NEWS DETECTİON İN ONLİNE MEDİA

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ABSTRACT
The proliferation of digital platforms has led to a surge in unverified information, resulting in widespread misinformation and public confusion. Fake news has far-reaching consequences, influencing political decisions, shaping social behavior, and altering individual beliefs.This research focuses on designing an automated model to detect fake news using machine learning techniques. A labeled dataset of online news articles is subjected to preprocessing, including tokenization, stop-word removal, lemmatization, and TF-IDF vectorization. Three supervised learning models are implemented and evaluated: Logistic Regression, Multinomial Naive Bayes, and Support Vector Machine.Notably, the Support Vector Machine model demonstrates superior accuracy and balanced performance across metrics, highlighting the potential of machine learning techniques in identifying misleading news content. This study showcases the effectiveness of automated solutions in developing reliable information verification systems, ultimately contributing to a more informed public discourse.

[1] INTRODUCTION
The internet has revolutionized communication, information sharing, and social interaction, with people accessing vast amounts of content across social media, news websites, and blogs. However, this digital transformation has also created an environment where misinformation spreads rapidly. Fake news, intentionally crafted to deceive or manipulate, can have severe consequences, influencing opinions, triggering emotional responses, and impacting societal well-being.The effects of fake news are far-reaching, with the potential to manipulate voting patterns during elections, trigger harmful behavior during health crises, and escalate social conflicts. Detecting fake news is crucial to maintaining the reliability of digital communication.Machine learning offers a promising solution, analyzing language patterns to classify content as authentic or fake. This research focuses on developing and evaluating machine learning models that detect fake news based on textual features, contributing to improved misinformation detection systems and promoting a safer online environment.

[2] PROBLEM STATEMENT
Existing online platforms struggle to effectively identify and filter misinformation at scale. Manual fact-checking is labor-intensive, requiring specialized expertise, and is impractical for the vast volume of content uploaded hourly. As a result, fake news often spreads rapidly, influencing individuals before corrections can be made.This research tackles the challenge of developing a machine learning system that can automatically classify news articles as authentic or fake based on textual information. The system aims to analyze linguistic features, learn patterns associated with misinformation, and provide accurate classification results, ultimately helping to mitigate the spread of fake news.

[3] OBJECTIVES OF THE STUDY
3.1 Primary Objectives

- To pre-process text data effectively for model training.
- To implement multiple machine learning algorithms for fake news classification.
- To evaluate and compare their performance using standard metrics.

3.2 Secondary Objectives

- To identify the strengths and weaknesses of classical ML models.
- To propose suggestions for future enhancement using advanced deep learning techniques.
- To contribute to the development of reliable misinformation detection tools.

[4] LITERATURE REVIEW

Fake news detection has gained significant attention in recent years, evolving from rule-based systems and keyword filtering to more advanced techniques. Initially, researchers relied on Bag-of-Words, TF-IDF, and n-gram models to extract features, pairing them with classical algorithms like Naive Bayes and Logistic Regression. As deep learning emerged, models like CNNs, LSTMs, and transformers (e.g., BERT) improved accuracy by capturing contextual meaning. However, these require large datasets and substantial computational resources. Combining linguistic features with metadata (author info, publication date, social media engagement) also boosts detection effectiveness. For simpler academic research, classical machine learning models remain a practical and interpretable choice. This study focuses on implementing these models to assess their efficiency in fake news detection.

[5] METHODOLOGY

5.1 Dataset Description

A publicly available dataset containing labeled real and fake news articles is used. Each record contains:

- **Title**
- **Text Body**
- **Label (real/fake)**

The dataset is cleaned to remove duplicates, irrelevant entries and incomplete records. The training-testing split is performed using 80:20 ratio.

5.2 Data Preprocessing

Text preprocessing is essential to convert raw textual data into a suitable format for machine learning.

Steps followed:

1. **Text Cleaning** – Removal of punctuation, numbers and special characters.
2. **Tokenization** – Splitting text into individual words.
3. **Stop-word Removal** – Removing common words like “the”, “and”, “is”.
4. **Lemmatization** – Converting words to base form (e.g., “running” → “run”).
5. **Vectorization using TF-IDF** – Converting text into numerical features based on term frequency.

TF-IDF helps highlight important words while reducing the importance of frequently occurring common terms.

5.3 Machine Learning Algorithms Used

5.3.1. Logistic Regression

A linear model widely used for binary classification problems. It works well when the relationship between features and labels is approximately linear.

5.3.2. Multinomial Naive Bayes

A probabilistic model based on Bayes’ theorem. It is simple, fast and performs effectively on text classification tasks.

5.3.3. Support Vector Machine (SVM)

A powerful classifier that identifies an optimal boundary (hyperplane) to separate classes. It performs well in high-dimensional spaces, making it ideal for TF-IDF features.

5.4 Evaluation Metrics

To measure performance, the following metrics are used:

- **Accuracy** – Percentage of correct predictions.
- **Precision** – How many predicted fake news articles are actually fake.
- **Recall** – How many fake news articles were successfully identified.
- **F1-Score** – Harmonic mean of precision and recall.

These metrics provide a balanced understanding of model performance.

[6] EXPERIMENTAL RESULTS

6.1 Model Performance

Model	Accuracy	Precision	Recall	F1-Score
Logistic Regression	92.3%	91.8%	90.5%	91.1%
Naive Bayes	89.7%	88.2%	87.4%	87.8%
SVM	94.5%	94.1%	93.6%	93.8%

The Support Vector Machine achieved the highest performance among all models, indicating that SVM is more effective for high-dimensional text features.

TABLE 1: Experimental analysis of the model performance

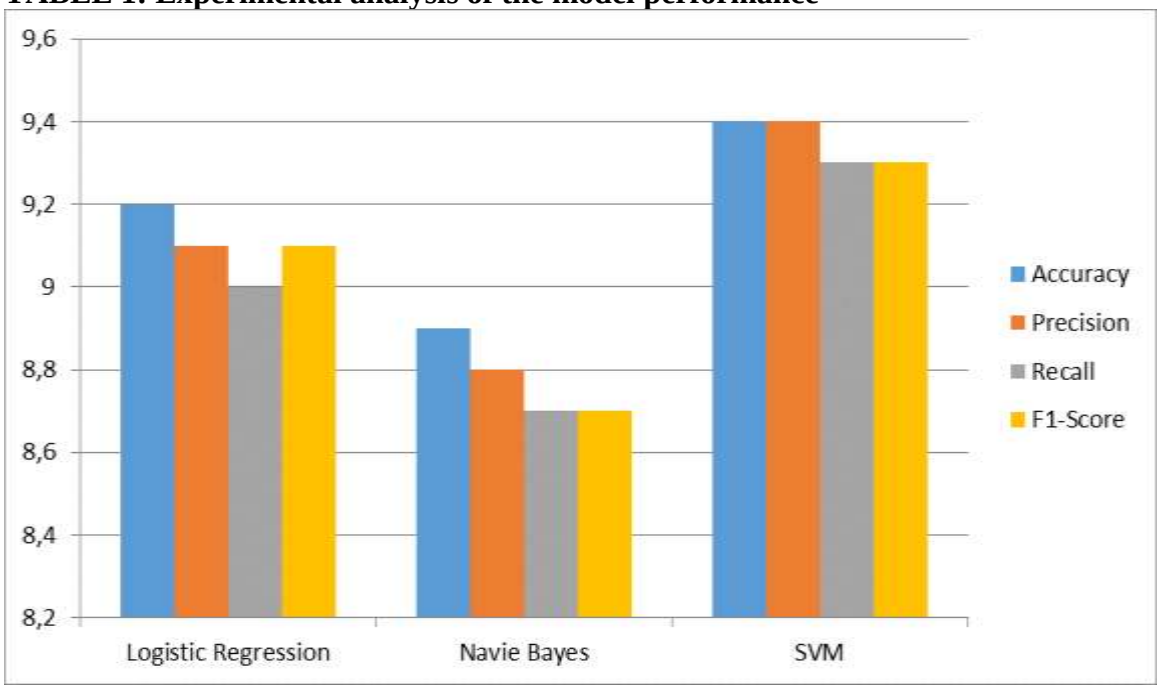


FIGURE 1: Experimental Result of the Model Performance

6.2 Analysis of Results

The results show that SVM performs better due to its ability to handle sparse data and high-dimensional numerical vectors. Logistic Regression also provided strong results but slightly lower recall. Naive Bayes performed well but was affected by the independence assumption, which may not hold true for all textual features. Overall, SVM's balanced accuracy and F1-score make it the most reliable model for fake news detection in this study.

[7] DISCUSSION

The study highlights the effectiveness of machine learning in identifying misinformation. The high performance of SVM suggests that linear separability exists in TF-IDF feature space. Although deep learning methods might yield better accuracy, classical models are more explainable and computationally efficient. Another observation is that preprocessing plays a crucial role in improving accuracy. Without cleaning, tokenization and TF-IDF transformation, the models would not be able to extract meaningful patterns. Fake news articles show specific linguistic traits such as emotional language, sensational headlines and specific keyword patterns. Machine learning models capture these hidden patterns and use them for classification.

[8] CONCLUSION

This research demonstrates that machine learning algorithms can effectively detect fake news based on textual features. Among the three models implemented, the Support Vector Machine provided the highest accuracy and most balanced metrics. The findings indicate that classical machine learning approaches are efficient and practical for fake news detection tasks, especially when computational resources are limited. The developed model can be integrated into digital platforms, browser extensions or news verification systems to help users identify misleading content quickly and reliably.

[9] FUTURE WORK

To enhance this research, the following directions can be explored:

9.1 Deep Learning Models – Using LSTM, GRU or transformer-based models like BERT.

9.2 Multimodal Analysis – Combining text with images, metadata and user engagement patterns.

9.3 Real-time Deployment – Developing an API or browser plugin for live fact-checking.

9.4 Regional Language Support – Expanding detection to Tamil, Hindi and other Indian languages.

9.5 Larger and Diverse Datasets – Improving generalization across topics and writing styles.

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ISOLATION, CHARACTERIZATION AND THERAPEUTIC APPLICATIONS OF BACTERIOPHAGES AGAINST PATHOGENIC BACTERIA OF THE ESKAPE GROUP

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Resistance to antimicrobials, including commonly used antibiotics, is a serious global health problem with significant risks to the public.

The emergence of antibiotic resistance compromises our ability to treat common infections, increases the cost of treatment, disrupts the progress we have made in the fight against disease, and thus poses a serious problem for our communities, healthcare systems and economies.

According to the WHO, every year antibiotic-resistant infections cause more than 750,000 deaths, equivalent to more than one death every minute, a figure predicted to rise to 10 million by 2050.

Faced with the scarcity of new antimicrobials on the market and the rapid evolution of bacterial resistance mechanisms, alternative strategies to antibiotic therapy are being developed for the treatment of bacterial infections. These new approaches include the fight against virulence factors, vaccination and modulation of host immunity, as well as protection or regulation of the microbiota and phagotherapy.

Phage therapy is based on the use of natural phages to infect and lyse bacteria at the site of infection. Advances in biotechnology have further expanded the repertoire of potential phage therapies to include new strategies using bioengineered phages and purified phage lytic proteins.

Current research into the use of phages and their lytic proteins, particularly against multi-drug resistant bacterial infections, suggests that phage therapy could be used as an alternative or complement to antibiotic treatments.

The aim of this study is to build up a bank of bacteriophages specific to bacteria in the ESKAPE group and then to characterize them functionally and genetically.

Keywords :

Antibiotic resistance; Bacteriophages; Phagotherapy; ESKAPE pathogens; Wastewater.

DİGİTAL INNOVATİONS İN CONSTRUCTİON PROCUREMENT AND THEİR IMPACT ON QUANTİTY SURVEYORS

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Abstract
Construction procurement is undergoing rapid transformation due to advances in digital technologies such as Building Information Modelling (BIM), artificial intelligence (AI), blockchain, cloud platforms, robotic process automation (RPA), and digital twins. These innovations are redefining traditional procurement workflows and reshaping the role of Quantity Surveyors (QSs) in cost management and contract administration. Quantity Surveyors, traditionally positioned as cost experts and contract administrators, now must operate within a data-driven ecosystem that demands new competencies, new workflows and greater strategic influence. This paper investigates the major digital innovations influencing construction procurement and examines their implications for QS practice. Drawing on current literature, industry standards, and global digitalization trends, the study highlights emerging competencies, opportunities, risks, and professional identity shifts. Findings suggest that digital procurement increases efficiency, transparency, and accuracy but also requires QSs to evolve into data-centric commercial strategists with enhanced digital literacy. Barriers such as skill gaps, cultural resistance, and legal uncertainty remain critical. The paper concludes with recommendations for industry stakeholders, professional bodies, and educational institutions to support the digital transformation of cost and procurement management.

Keywords: Digital procurement, Quantity Surveyors, Building Information Modelling, Artificial intelligence, Blockchain, Construction technology, Cost management.

ENERGY-EFFICIENT AND LOW-EMISSION MANUFACTURING OF IRON TAILINGS BASED GEOPOLYMERS THROUGH MICROWAVE CURING FOR GREEN APPLICATIONS

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Abstract

This study presents a rapid and innovative approach for synthesizing iron ore tailings (IOT)-based geopolymers using acidic activation coupled with volumetric microwave irradiation, applied for the first time to enhance geopolymerization and significantly reduce synthesis time. The raw IOT, composed of 16 wt.% SiO_2, 5 wt.% Al_2O_3 (SiO_2/Al_2O_3 3.6), and 50 wt.% Fe_2O_3, proved to be a suitable aluminosilicate precursor. Comprehensive characterization (CS, SEM-EDX, ATR-FTIR, ATD-ATG, XRD) revealed that optimal conditions (14 M H_3PO_4, 700 W, 10 min) induced strong structural densification and the formation of Al–O–Si, Al–O–P, and mixed Al–O–Si–O–P linkages corresponding to $AlPO_4$, $Al(PO_3)_3$, $Al(H_2PO_4)_3$, and $AlSi_2(PO_4)_3$ crystalline phases. Mechanical performance improved markedly, with compressive strength rising from 4 to 32 MPa with increased acid concentration, from 6 to 45 MPa under higher microwave power, and from 5 to 23 MPa with irradiation time up to 10 min before declining due to overexposure. The resulting geopolymers also exhibited excellent resistance to aggressive environments, confirming this method as a sustainable, energy-efficient alternative to conventional geopolymer curing processes.

Keywords: Keywords: IOT-based geopolymer, phosphoric acid activation, Microwave irradiation, High performance geopolymers

PERFORMANCE OPTIMIZATION OF QUASI-2D $(BA)_2(MA)_2PB_3I_{10}$ PEROVSKITE SOLAR CELLS: A COMPARATIVE TCAD STUDY OF NIOX, PTAA, CUL, AND SPIRO-OMETAD AS HTL MATERIALS

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ABSTRACT

Quasi-2D Ruddlesden–Popper (RP) perovskites have emerged as promising candidates for stable and high-performance photovoltaic devices. In this work, we investigate the impact of different hole-transport layers (HTLs) on the performance of an n–i–p perovskite solar cell based on the quasi-2D perovskite $(BA)_2(MA)_2Pb_3I_{10}$ (n = 3) using the Silvaco ATLAS TCAD simulator. The reference structure FTO/TiO_2/$(BA)_2(MA)_2Pb_3I_{10}$/HTL/Metal was modeled with four widely used HTLs—NiOx, PTAA, CuL, and Spiro-OMeTAD—each implemented with identical thickness (213 nm).

Simulation results reveal a strong dependence of device performance on the hole-transport material. CuL delivers the highest power conversion efficiency (24.89%) with Jsc = 32.06 mA/cm², Voc = 1.3346 V, and a fill factor of 58.18%, outperforming both organic and inorganic HTLs. NiOx also exhibits excellent performance (22.92% efficiency) with high photocurrent density (31.97 mA/cm²) and the highest open-circuit voltage (1.3359 V). Conversely, PTAA and Spiro-OMeTAD show reduced efficiencies (20.09% and 16.69%, respectively), primarily due to lower charge extraction capability and higher resistive losses.

These results confirm that inorganic or copper-based HTLs significantly enhance charge transport and overall photovoltaic performance in quasi-2D RP perovskite solar cells.

Keywords: *Quasi-2D Ruddlesden–Popper perovskites, Hole-transport layers, $(BA)_2(MA)_2Pb_3I_{10}$, Perovskite solar cells*

ULTRASOUND ASSİSTED SYNTHESİS, *IN VİTRO* AND COMPUTATİONAL INVESTİGATİON OF TRİAZOLE CONJUGATES AS EFFECTİVE THERAPEUTİCS AGAİNST TYROSİNASE

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Tyrosinase is a copper containing enzyme which is responsible for melanin biosynthesis, converting tyrosine to DOPA and ultimately melanin. In this manuscript, a library of triazole conjugates have been synthesized in good to excellent yields. All the compounds were screened against tyrosinase to identify potential inhibitors. Among all, most of the compounds exhibited high potency than standard ascorbic acid. The potent derivatives were subjected to molecular docking studies to gain deep insight about the binding interactions with enzyme active site. All of the docked compounds gave good docking scores even better than reference compound ascorbic acid. They were involved in making H-bonding and π-π interactions within the copper vicinity. These compounds were further exposed to evaluate pharmacokinetic parameters. All conjugates possessed acceptable absorption profile. Furthermore, toxicity analysis showed these compounds are safe based on chronic and oral acute toxicity studies. These findings suggest that triazole hybrids might emerge as potential therapeutics against tyrosinase.

Keywords: H-bonding, Pharmacokinetic parameters, Potential therapeutics, Tyrosinase, π-π interactions

INNOVATİON, CULTURE, AND SOCİETY: INTERDİSCİPLİNARY PERSPECTİVES FOR A CHANGİNG WORLD

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Abstract
This paper explores how the Ajanta and Ellora Caves reflect the dynamic interaction between artistic innovation, cultural values, and spiritual traditions in ancient India. It examines how the detailed murals of Ajanta and the diverse rock-cut temples of Ellora represent not only technical mastery but also deep cultural storytelling and religious coexistence. The study argues that these sites demonstrate an early form of interdisciplinary creativity, where architecture, philosophy, and social life shaped one another. By analysing the evolution of Buddhist, Hindu, and Jain expressions within the caves, the paper highlights how India's past fostered inclusive cultural development. By examining these monuments through historical, artistic, and social lenses, the research shows that Ajanta and Ellora continue to offer insights into India's ability to merge innovation with spiritual identity, thereby strengthening cultural continuity across centuries.
Keywords: Rock-cut Architecture, Buddhist Art and Murals, Jataka Tales, Religious Syncretism, Cultural Heritage, UNESCO World Heritage Sites, Ellora Cave Temples, Ajanta Cave Paintings, Ancient Indian Engineering, Spiritual Traditions

UNLEASHİNG THE VALUE OF TALENT MANAGEMENT STRATEGİES İN DİGİTAL TRANSFORMATİON AND GROWTH OF SERVİCE FİRMS

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Abstract

The fourth industrial revolution has redefined the organizational dynamics, necessitating Digital Transformation for sustainable market competitiveness. Central to this transformational journey is the role of Talent Management within organizations, which enables organizations to align their workforce with the technological changes. To understand the human-centric roles in the digital transformation process, this quantitative study uses the McKinsey 7S framework. Data was collected from 357 respondents across the Fintech, Banking, and IT industries via a survey and analyzed using Structural Equation Modelling in SmartPLS 4.0. The results suggest that there is a strong impact of talent management on digital transformation. Furthermore, transformational leadership also moderates the relationship between talent management and digital transformation. However, there is no mediation of resistance to change in the process. The study has practical and theoretical implications. The outcomes of this study suggest that organizations going through digital transformation need to develop a comprehensive human resource policy in line with the needs of digital changes led by transformational leaders who develop a comprehensive change management policy. By cultivating resilient change management strategies, organizations can sustainably navigate through the digital transformation process.

Keywords: Digital Transformation; McKinsey 7S Model; Change Management; Talent Management; Transformational Leadership.

EVALUATION OF BIOAUGMENTATION FOR THE REMOVAL OF HEAVY METALS FROM BRASSWARE EFFLUENTS IN THE CITY OF FES, MOROCCO

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Abstract

Industrial effluents represent a significant source of environmental pollution due to their high pollutant load. Among them, wastewater from brassware workshops is particularly concerning, as it contains high levels of organic matter and heavy metals. Therefore, a suitable pretreatment adapted to their composition is essential. Bioaugmentation emerges as a promising, eco-friendly, and cost-effective solution to enhance wastewater treatment efficiency. This approach involves introducing microorganisms capable of detoxifying or removing the contaminants present in the water.

The objective of this study is to isolate new bacterial strains capable of reducing the concentrations of nickel and silver. More specifically, these microorganisms were isolated from the roots of two plants integrated into our treatment system for brassware effluents. The main objective of this study is to improve the efficiency of our treatment system by increasing bacterial diversity. As part of the bioaugmentation test, brassware effluents were inoculated with a bacterial biomass and then incubated at 37 °C for 48 hours. Different inoculum concentrations (2%, 4%, and 6%) were evaluated to determine their impact on treatment performance.

The results indicated that the two isolated bacteria, P1 and P2, achieved silver removal rates of over 91% and 68%, respectively, across all tested concentrations. For nickel, removal rates exceeded 86% for P1 and 65% for P2, irrespective of the concentration. We can conclude that these results demonstrate a significant reduction in pollutant load through the use of these bacterial strains.

Keywords: *Bioaugmentation; brassware effluents; silver; nickel; bacteria*

DYNAMICS OF HYBRID NANOFLUID FLOW OVER A EXTENDING SURFACE WITH NON-UNIFORM HEAT SOURCE

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Abstract
The mass, momentum, and heat transfer characteristics of stretched surfaces in the presence of non-uniform heat source/sink, thermophoresis, and Brownian motion as they relate to Jeffrey, Maxwell, and Oldroyd-B hybrid nanofluids were investigated in this work using a mathematical model that we devised. In this study, engine oil (the base liquid) was combined with AA7072 and AA7075 nanoparticles to produce a hybrid nanofluid. The flow-governing boundary-layer PDEs are first transformed into nonlinear ordinary differential equations using similarity transformations, and then they are solved using the bvp5c MATLAB program. The discussion's visual depiction is on how non-dimensional factors affect the concentration, velocity, and temperature profiles. The Sherwood number, local Nusselt number, and skin friction coefficient are computed and shown numerically in tables. According to the findings, the Maxwell hybrid nanofluid seems to perform better in terms of heat transmission than the Jeffery and Oldroyd-B hybrid nanofluids.

BINDU - A NON-INVASIVE BLOOD GROUP DETECTION SYSTEM USING FINGERPRINT

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ABSTRACT
Every person has different fingerprints. One person's fingerprint does not match another person's fingerprint.so we can identify the fingerprint pattern, ridges, loops, whorls, arches, where the finger line stops every little detail of every blood group type fingertip image with help of deep learning and predict the blood type. This project is based on Machine learning and deep learning. It combined ML with an user friendly UI to present an integrated web system for blood group classification using fingerprint image. Using Python based machine learning server to analyses fingerprint image pattern and blood group prediction. A Node.js/Express backend used for safe data management and API services. It is React-based frontend for seamless user interaction form three primary parts of the solution. register themself, authenticate then Users upload their fingerprint images manually or by scanner, our high accuracy CNN model analysis the fingertips pattern and get blood group classification result by the system. Applying a dedicated dashboard, admin can supervise detections result and manages user. The machine learning server used to combine backend and called model API to predict the blood group and show the result to user. MongoDB use for reliable data storage. Through modernizing the blood group identification procedure, this project hopes to deliver a dependable, handy tool for use in medical sectors.
Keywords: Classification, CNN, Deep Learning; Detection; Machine Larning; Image Processing.

1. INTRODUCTION
A non-invasive system for blood typing means there is no need to take out any blood to determine patient’s blood type rather, the system applies complex image processing and use deep learning. It circulates around classifying blood types based on fingertip photographs and analyses the pattern of fingertips and detect the blood type. The current development of blood testing which is being made possible by the use of non-invasive technologies is primarily driven by the need to speed up clinical assessments and increase their safety. However, little attention is paid to the fact that modern technologies still depend on testing and analysis methods that are outdated and slow such as emergencies, natural disasters or rural areas. The proposed system uses the power of machine learning accurately to analyze the unique pattern of fingerprints, eliminating the need for blood tests. This allows immediate, accurate and seamless blood testing without surgery which maintains patient comfort and facilitates fast decision making in critical situations. Those initiative addresses critical problems in healthcare and provides a framework for developing more realistic, easily adaptable and commercially reliable solutions that can help ensure better overall health outcomes. Blood typing is critical for diagnosing patients, offering treatment even in emergency situation. Therefore, standard techniques are highly invasive, slow, and dependent on available lab facilities. For these reasons procedures, which include blood sample collection and reagent tests, risks of pain and discomfort are also high not to mention the fact that these techniques are time consuming in a crisis or with limited resources available. There is a lack of a blood typing system that is non-invasive, fast and reliable. Recent development in image processing and machine learning, it is achievable to analyze images of fingertips and determine

blood type using specific patterns or biometrics. (Vijaykumar Patil, D. R. Ingle, 2021). The aim is to devise an approach that is not only safe, fast and scalable but also addresses the shortcomings of current blood typing methods. Consequently, blood typing would be easier to conduct in and outside a hospital, in emergency or rural cases, reaching non-clinical environments. But creating this system is complex. Building high-quality diverse datasets, efficient image processing methods for feature extraction, and use machine learning algorithms to ensure accurate results for diverse populations are extremely challenging. This system requires clinical level accuracy so that the design process has to be iterative in order to comply with strict guidelines.

2. LITERATURE REVIEW

The writer (V. Patil and D. Ingle, 2021), tries to analyze the correspondence allying fingerprint patterns and blood groups as well as the inclusion of lifestyle related diseases such as hyper tension, arthritis and type-2 diabetes using fingerprint imaging. This research introduces new techniques of identifying and diagnosing the illness at an early stage. In my opinion, there is an opportunity for wider sample scope, meaning examine more than just loops, arches, whorls and other primary patterns.

The author (T. Nihar, K. Yeswanth, et al ,2024) , looks into how fingerprints can determine blood group by performing an analysis of sweat antigens, which qualifies the process harbored to do so as less invasive. The benefits encapsulate the ease of use due to reduced invasiveness compared to standard blood drawing or sampling and forensics where the procedure can be done blindly. The drawbacks include the requirement for future research to accomplish more precise and accurate results and currently limited information due to small data set sizes. Further research can hone in on increasing elderly finger- print sample sizes, more employed anatomical features, better sensor technology and data processing algorithms, and raised level of accuracy of deep learning methods.

In this study (Varsha Karunakaran, et al., 2022) reveals a potentially non-invasive, rapid test for COVID-19 utilizing SERS and AI technology, with high confidence in the stated data sets, yet needs validation via larger populations which will require sophisticated multi cohort machine learning to mitigate overfitting issues and for validation of the technology for large scale epidemiological screening.

This publication (Álvaro Azueto-Ríos, et al.,2016) describes a method for obtaining and processing infrared pictures to identify vein patterns with potential medical assistance for procedures such as venipuncture This method employs a GUI with which an operator can acquire, process, and save both images and demographic information of the patient. Further- more, methods for contrast enhancement and segmentation are incorporated in order to accentuate the patterns of vein distribution. Research could be enhanced if, on the one hand, the carrying of the device was facilitated, and if, on the other side, it was optimized for speed of operation.

This author (Turgul, et al.,2017) tries to addresses the problems of non-invasive blood glucose evolution through RF/microwave measurement, In particular concerning measurements of fingerprint sensitivity. The study locates several problem that can largely falsify the accuracy and reliability of these calculation such as differences in fingerprint patterns and skin thickness, finger position and pressure and other substances. The authors point out strategies such as observing the pressure and alterations to the sensor surface to optimize measurement quality for a calculation procedure to adjust to the individual characteristics. Even though the research was mostly simulation-based, it is recommended that these factors should be taken seriously to decrease the Blood Glucose Lavel measurement errors during non-invasive monitoring.

This paper (Xiang Zhang, et al.,2021) provides a total view of recent progresses in non- invasive EEG/MEG/fNIRS signal analysis using deep learning methods. It provides a complete and detailed taxonomy of the signals that originate from the brain (EEG, fNIRS, fMRI and MEG) as well comparison between approaches in deep learning models (discriminative, representative,

hybrid approaches). The paper is structured appropriately describing the processing of brain signals, Deep Learning state of the art techniques and hypothetical real-world scenarios. A big resource for computer scientists as well as biomedical experts, the authors also provide open challenges and future directions in subject-independent classification or interpretable deep-learning from here

In this research work (Rehman, A, Abbas, et al.,2018), it present a computer-aided system for Acute Lymphoblastic Leukemia diagnosis using image processing and deep learning technology in the paper. In this lab session, a new segmentation method based on the HSV color scheme for bone marrow images lymphoblasts extraction, then classification by AlexNet model with pre-trained layers of CNN has suggested. The system achieves a very good accuracy of 97.78% surpassing conventional classifiers like Naïve Bayesian itself , KNN and even SVM. Automated tool for pathologists guide in the diagnosis of Acute Lymphoblastic Leukemia and subtypes of ALL using this work. Future work will need to focus on cell segmentation of overlapping cell but in a bigger database for improved accuracy.

This review (Muhammad Imran Razzak, Saeeda Naz, & Ahmad Zaib,2018) focuses on an extensive up-to-date survey about deep learning implementation in medical imaging. The study concisely brings to light the promising nature as well as substantial hurdles in taking deep learning forward in healthcare. The final chapter examines many of the deep learning methods and architectures in depth, interrogating their ability to automate diagnosis and improve accuracy while also calling out the major problems of limited data, the “black box” problem, and privacy issues that need to be solved for this technology be widely state-of-the-art in medical field. A review also talk about the importance of inter-disciplinary work and breakthroughs in unsupervised learning to break the existing limitations so that deep learning is adopted in healthcare widely.

The writer of this paper (Geethanjali, K. S, et al, 2024) explore the feasibility of utilizing fingerprint patterns in determining blood groups in a non-invasive manner. This is very different from conventional ways of blood typing as mentioned by few of the researchers whom the authors have reviewed, who pointed out the use of, for example, statistical analysis, image processing and deep learning. There is a lot of promises in the concept but the authors have shown that research of this nature would greatly benefit from large diverse datasets, established methodologies, and real-life application to overcome existing problems with accuracy, reliability, and generalizability.

Table 1. Related Works Summary

Author Name	Methods Used	Findings	Limitation
Vijaykumar, Patil N., & D. R. Ingle	Computer Vision, Linear Regression	settled a statistical relation between fingerprint patterns and blood groups.	The model was based on an extremely limited dataset
T. Nihar, K. Yeswanth, et al	Literature Review	Opareted a literature survey showing a relationship between fingerprints, lifestyle diseases, and gender.	analysis without any new experimental method.
Varsha Karunakaran, et al.	Diagnostic Approach	The trained reinforcement vector machine classifier achieved prediction accuracy of 95% for discriminating fit and COVID-19 contaminated patients. The classifier achieved F1-scores of 94.73% for healthy and	Small sample collection

		95.28% for COVID-19 infected patients	
Álvaro Azueto-Ríos, et al.	Infrared (IR) image system based on a commercial digital camera modified with a filter that only allows the pass of light in the near-infrared range	The resulting image of the acquisition system features dark (obscure) gray tones corresponding to the veins	The sources do not mention the limitations
Turgul, et al.	Simulation and Modeling	The non-invasive RF estimate of blood glucose relies on detecting the change in blood permittivity	The change in the permittivity of blood due to glucose variation has a limited range
Xiang Zhang, et al.	Deep Learning	Deep Learning works directly on raw brain signals, thereby avoiding the time-consuming process of preprocessing and feature extraction	Brain signals are corrupted by various biological barriers
Rehman, A, Abbas, et al.	Deep Learning	The achieved results revealed that the proposed approach could be used as a tool to diagnose Acute Lymphoblastic Leukemia and its subtypes, thereby assisting pathologists	The proposed approach still needs improved accuracy to segment overlapped cells
Muhammad Imran Razzak, Saeeda Naz, & Ahmad Zaib	Deep Neural Network (DNN	Globally used with great accuracy. Allows complex non-linear relationships due to more than two layers	The learning process of the model is too slow
Geethanjali, K. S, et al	Machine Learning and Deep Learning	Use of DL models for automatic feature extraction and classification. Techniques also contain multiple Linear Regression and algorithms for classification of fingerprint features	Research show that data are often region-specific and utilize small datasets, which restricts scalable to global populations

3. MATERIAL AND METHODS

3.1. Data Collection

The Data is collected from fingerprint-based blood group dataset We use 6000 fingerprint images from a platform called “Kaggle”. There are 8 groups archived (A+, A-, B+, B-, O+, O-, AB+, AB-).

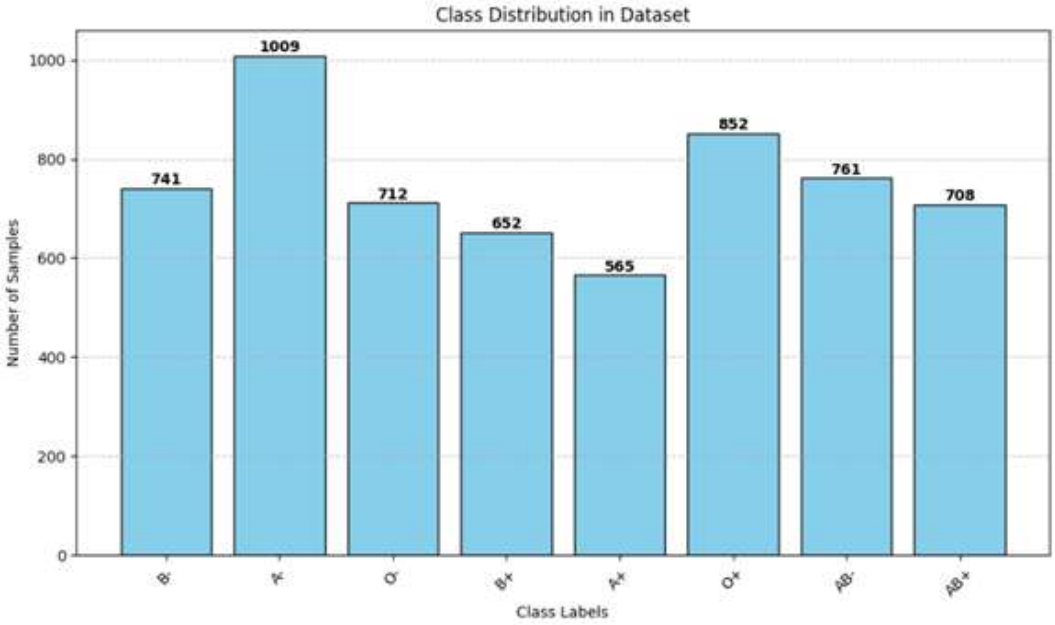


Fig. 1. Class Distribution of Dataset

3.2. Data Preprocessing

Data preprocessing is essential before data processing it ensures that the data is well structed and well fitted for analyzing .

Dataset balancing was accomplished by an oversampling technique to make sure equal representation of all blood group classes. The formal description of the balancing process is given below

- **Initial Distribution**
  - Original class distribution: N = {n_1, n_2, ..., n_8}
  - Maximum class size: max count = max(N)
- **Target Distribution**
  - After balancing: N' = {max count, max count, ..., max count}
  - Total sample after balancing: total samples = 8 × max count
- **Verification**

$\forall i \in \text{classes}: n_i' = \text{max count}$ where n_i', number of samples in class i after balancing

- **Implementation Results**
  - After balancing each class holds equal samples

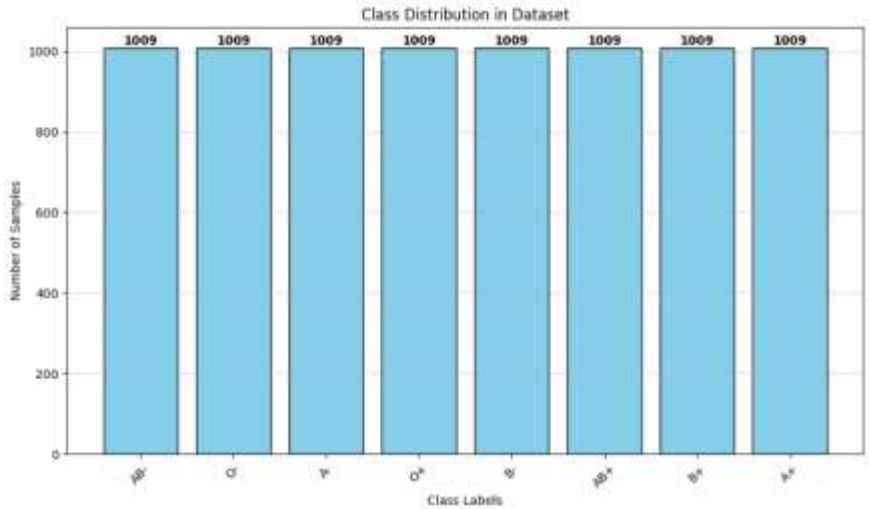


Fig. 2. Class Distribution of Dataset (After Balancing)

The data split as follows:

Total samples in balanced dataset : **8064**

- **Training Set:** 70% of total samples
- **Validation Set:** 20% of total samples
- **Test Set:** 10% of total samples

➢ Number of train sample - **5632**
➢ Number of validation sample - **1600**
➢ Number of test sample is - **800**

3.3. Feature Extraction

Feature extraction layer used for extract patterns, textures and unique characteristics to differentiate blood group type to detect.

- **Convolutional Layer 1:** It pulls low-level features like edges and general textures from the input image. It used 32 filters of size 3×3.ReLU activation and also adds nonlinearity which help the network get complex patterns. This is tracked by MaxPooling2D which then reduces the local dimension height and width of the feature map, get important information and reducing computational cost. It selects the maximum value from each 2×2 window.
- **Convolutional Layer 2:** It learns more complex features like curves and fine tune textures. 64 filters of size 3×3 are applied and ReLU activation is used for tacked by MaxPooling2D (2×2). helps generalize the learned features by further reducing the local dimension and prevent overfitting.
- **Convolutional Layer 3:** It captures the high-level abstract features that needed to be differentiated from different blood groups. It also uses 128 filters of size 3×3 and ReLU activation, tracked by MaxPooling2D (2×2). further it down-samples the feature maps and giving more weight to the important features.

3.4. Classification

- **Flatten Layer:** Convert the 2-D feature maps to 1-D feature vectors, making the data ready for Fully Connected layers.
- **Dense Layer:** It learns complex combinations of every single features to help in classification. It combines features from all previous layers. The layer has 512 neurons and uses ReLU activation to add non-linearity.
- **Dropout Layer:** Reduces overfitting away randomly setting 50% of the input units to zero during training.
- **Output Layer:** Brings the final classification probability for the each of 8 blood group classes. SoftMax function is used to make sure that the sum of the output values is 1 which points the probability of each class.

3.5. System Workflow

The Figures below shows the process methodology of this system. First user ensures that they are authenticate participants. After that upload their fingertips image or captured by the scanners then in backend image goes for preprocessing where it performs resizing, Image Normalization which adjust intensity value from 0-255 range that enhance the model ability of generalization and make the image fit and clean for further processing. The model once loads then it extract the unique feature of the fingerprint and give a output score corresponding to the inputs. Using the row numerical score softmex function transform into probability distribution among 8 possible blood group classes. Probabilities are sum of equal 1. Then the decision module chooses the blood group type with the highest probability as the detected blood group. After that calculate confidence score and display it to the user. Finally store it to the detection record database.

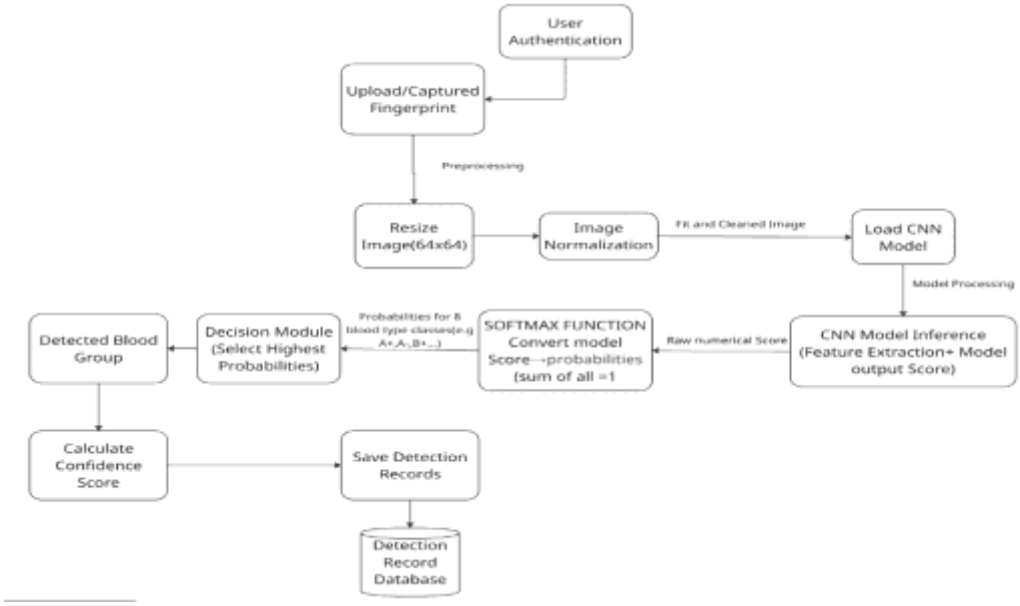


Fig. 3. System Workflow

3.6. Process of Prediction

The Softmax function is refers in the final stage of the classification model where the raw output scores logits are converted into probabilities for every blood group class.

$$y_k = \frac{\exp(a_k)}{\sum_{j=1}^{K} exp(a_j)}$$ *(Bishop, C.M.,2006)*

where,

- a_k : The input score for class k.
- K: The total number of classes.
- $\exp(a_k)$: The exponential function applied to the input for class k.
- $\sum_{j=1}^{K} \exp(a_j)$: The sum of exponentials of all class inputs

Here is the process of prediction shown below:

- **Model Output:** When we give the model a fingerprint image it give us a score for each blood type. Those scores can be any number.
- **Softmax Converts Scores to Probabilities:** The softmax function converts these scores into probabilities that sum to 1. It let us to know how likely each blood type is.
- **Pick the Highest Probability:** The blood group type with the highest probability is the model's prediction.

4. RESULTS AND FINDINGS

4.1. Performance Matrix

Table 2. Performance Metrics Table

Blood Type	Performance Metrics			
	Precision	Recall	F1-score	Test Sample
A+	97%	98%	97%	132
A-	86%	93%	90%	88
AB+	99%	93%	96%	106
AB-	96%	75%	85%	69
B+	90%	98%	94%	85
B-	97%	97%	97%	70
O+	95%	93%	94%	135
O-	91%	97%	94%	115

4.2. Confusion Matrix

The image shown below is a confusion matrix which provides a overall visualization of the classification performance of the blood group prediction model on the test dataset that we build. Each row of the matrix contains the actual true blood group class while each column show the class predicted by the model.

Diagonal elements show the number of rightly classified examples for each blood group which show the accuracy of the model for each class. Elements off the diagonal, point misclassifications where model predicted the wrong blood group. The color deepness of each cell reflects the solidity of predictions where deeper colors indicate a higher number of predictions

For example, the modestly classified 129 examples of class A+, 82 examples of class A- and so on. We see that misclassification is very rare as evident from the low values of the cells off the diagonal. Overall, the confusion matrix shows that the model holds high accuracy and reliable performance across all blood group classes with only a few misclassifications.

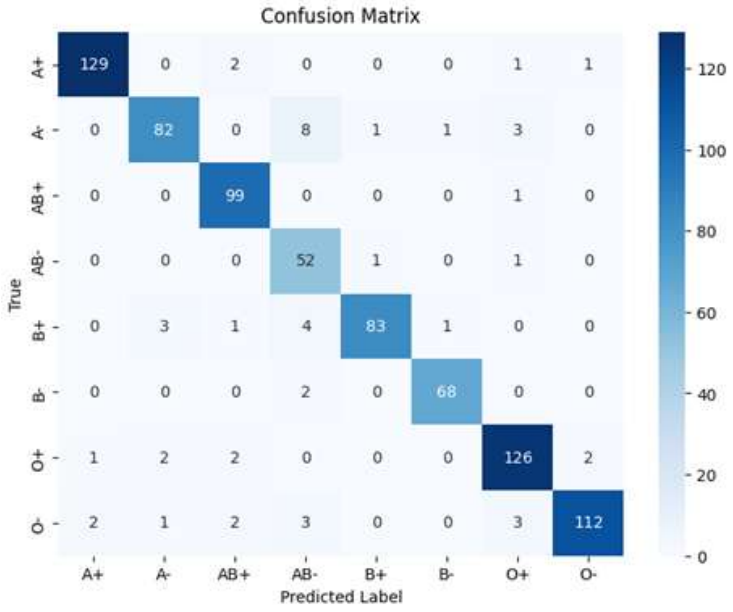


Fig. 4. Confusion Matrix

4.2. Model Accuracy

The diagram below shows overall the state's accuracy curves of the model for the training and validation datasets based on 50 Epochs. The x-axis points the number of training Epochs and the y-axis shows the accuracy hold by the model.

The blue line shows the training accuracy that gradually raised as the number of Epochs increased showing that the model is currently learning from the training data. The orange line points the validation accuracy which is steadily increased and stabilized at a high value which means the model has strong generalization ability on unseen data.

One the close fit of the training and validation accuracy curves especially at the last Epochs shows that the model is not overfitting and maintains strong performance on both datasets.

Overall, the diagram proves that Our system achieved Accuracy: 0.9487500190734863 ~ 0.94 that is 94% provides reliable predictive performance in blood group classification from fingerprint images.

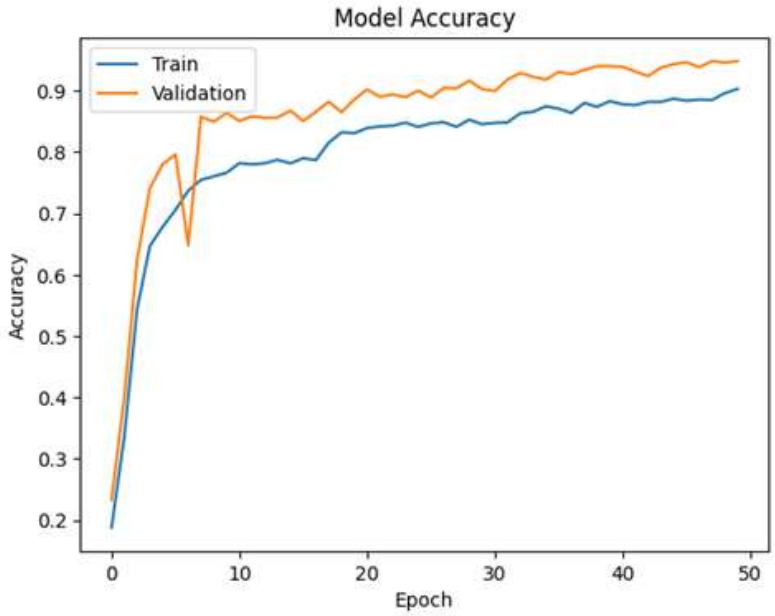


Fig. 5. Model Accuracy

5. CONCLUSIONS

This project is overall execute the design, implication and validation of non-invasive ,deep learning based blood group detection system using fingerprint image by CNN Model. The system successfully check all its primary objective. It achieved approximately 94% accuracy on test data.That confirms that our system is ready for real-world applicability and showcasing significant potential of put in machine learning to solve critical challenges in health diagnostics.

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IMPACT OF CATTANEO - CHRİSTOV HEAT FLUX ON MHD FLOW OF NON-NEWTONİAN FLUİDS OVER A STRETCHİNG SHEET

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Abstract:
This work examines the influence of Cattaneo–Christov heat flux on magnetohydrodynamic (MHD) flow of non-Newtonian fluids, Jeffrey, Maxwell and Oldroyd-B over a stretching sheet, integrating activation energy and velocity slip effects. The governing partial differential equations are converted into similarity-based nonlinear ordinary differential equations and solved numerically utilizing MATLAB's BVP5C solver. Results reveal that higher relaxation-to-retardation ratios, larger Deborah numbers and increased slip significantly reduces fluid velocity with Oldroyd-B fluid and Maxwell fluid exhibits the greatest decrease, while Jeffrey fluid is minimally affected. Thermal Deborah number enhances heat flux relaxation, leading to elevated temperature profiles and a thicker thermal boundary layer. Increased activation energy slows chemical reactions but raises nanoparticle concentration with Jeffrey fluid. Validation against previous studies confirms the accuracy and reliability of the solutions. Furthermore, skin friction decreases with magnetic parameters, relaxation ratio and slip, whereas the Nusselt number increases with heat flux relaxation and radiation but diminishes due to Brownian motion, thermophoresis and non-uniform heat. Sherwood number rises with Lewis number, reaction rate, Brownian motion and reaction strength but decreases with thermophoresis and activation energy. Maxwell fluid consistently exhibits the most favorable transport rates, Jeffrey fluid the least, with Oldroyd-B liquid intermediate due to rheological differences.

WHEATGRASS PREPARATİON MODULATES ANTİGEN PRESENTATİON İN ACUTE LEUKEMİA THROUGH IMMUNOMODULATİON AND EPİGENETİC MECHANİSMS

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Acute leukemia is a highly aggressive hematologic malignancy characterized by rapid progression and substantial mortality in both adults and children. While advances in molecular genetics have enabled the development of targeted therapies, treatment resistance and disease relapse continue to pose significant clinical challenges. As a result, complementary strategies such as wheatgrass supplementation have attracted interest for their potential immunomodulatory and supportive effects in leukemia management. In this study, we employed a wheatgrass preparation (WGP) to modulate the immune response in acute leukemia via epigenetic regulation of antigen-presenting cells, with a primary focus on dendritic cells (DCs). PBMCs were isolated from peripheral blood samples of healthy donors and acute leukemia patients. These cells were then used to produce monocyte-derived dendritic cells (MoDCs), either with or without WGP exposure. MoDCs underwent flow cytometry for characterization, while ELISA measured cytokine levels in co-cultures of MoDCs and PBMCs. Researchers evaluated gene expression via qPCR, probed epigenetic modifications and R-loop formation with ChIP-qPCR and RDIP-qPCR, respectively, and quantified CpG DNA and m6A-RNA methylation. Finally, CTL cytotoxicity against leukemia cells was assessed through an LDH release assay. WGP promoted enhanced maturation of dendritic cells, elevated T_H1 cytokine secretion, and boosted expression of tumor-suppressor genes while suppressing immunosuppressive and oncogenic markers. Epigenetic and epitranscriptomic studies showed WGP triggered chromatin remodeling, heightened m^6A RNA methylation, and decreased R-loop accumulation, all contributing to genomic stability. WGP also markedly improved CTL-driven cytotoxicity toward leukemia cells. WGP demonstrates strong anti-leukemic activity by boosting T_H1 immune responses, activating CD8+ cytotoxic T lymphocytes (CTLs), and inhibiting immunosuppressive cytokines in acute leukemia. Additionally, it triggers beneficial epigenetic and epitranscriptomic modifications, such as elevating TP53 and IFNG expression, reducing VEGFA and c-MYC levels, and enhancing m6A RNA methylation, positioning it as a promising adjunct therapy for acute leukemia. WGP boosts T_H1 immune responses, stimulates cytotoxic T lymphocytes (CTLs), and triggers epigenetic modifications in antigen-presenting cells—primarily dendritic cells—holding potential for acute leukemia immunotherapy.

Keywords: Acute Leukemia, Wheatgrass Preparation, T Helper (T_H) cells, monocyte-derived dendritic cells (MoDCs), Cytotoxic T Lymphocytes (CTLs), Epigenetic and Epitranscriptomic modifications

THREE-DIMENSIONAL CEPHALOMETRIC EVALUATION OF VERTICAL CRANIOFACIAL ARCHITECTURE

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Aim: Cephalometry is fundamental in diagnosis, analysis, and planning of orthodontic surgical treatment as it reveals skeletal relationship between the upper and lower jaw as well as facial aesthetic parameters. Nevertheless, 3D cephalometry has still not become the exam of choice in orthognathic treatment even though today CBCT (Cone Beam Computed Tomography) is routinely used in other branches of dentistry. The aim of this study is to evaluate the advantages and disadvantages of the two methods in orthognathic surgery.

Materials and Methods: In a sample of 13 patients undergoing bimaxillary orthognathic surgery a chin-vertex CBCT exam was prescribed prior to orthodontic treatment (OT)and 12 months after surgery (T1). The DICOM files uploaded to MaterialiseSimplant Ortho software pro 2.1 (Materialise Co., Leuven, Belgium) were analyzed following the multiplane 3D Total Face cephalometry protocol (TFA).

Results: Results comparing pre-op and post-op TFA 3D cephalometry, were then evaluated considering reference values reported in literature. The CBCT, carried out preand post-surgery, were subsequently analyzed employing the superimposition method using cranial base as reference.

Discussion and Conclusions: The TFA 3D cephalometry allows the assessment of various bones not only singularly but also considering the rightproportion with others.The advantages ofTFA cephalometry are mostly due to speed of execution thanks to a user-friendly interfacerequiring a learning curve that is similar to traditional 2D cephalometry methods.This 3D analysis was carried out evaluating the relationship between skeletal structures making the approach especially flexible and dynamic. The 3D visualization allowsthe determination of the extent of skeletal disharmony.

Multiplane 3D TFA allows the clinician to locatewhere major or minor skeletal discrepancies are found with respect to ideal parameters and is alsouseful in classifying skeletal intermaxillary relation. The superimposition method is highly intuitivebut does not provide information on the quantity and location of osteotomic movement.

Keywords: total face approach; superimposition; orthognathic surgery.

A NEW ERA OF ORTHOGNATHIC PLANNING — ZERO RADIATION REQUIRED

S. Leporale[1] , M. Cianfriglia[1] , R. Moramarco[1] , V. Martini[1] , C. Marocco[1], C. Bramucci[2] , F. Sestito[1] , R. Reda[1] , L. Testarelli[1] , T. Testori[3,4,5], G. Perrotti[6];

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Abstract

Aim: The aim of the present study is to evaluate whether a "radiation free" method using 3D facial scan can replace Cone Beam Computed Tomography (CBCT) volumetric rendering of soft tissue of the patient to assess maxillofacial surgery outcomes and compare the reference points and angular measurements of patient facial soft tissue.

Methods: Facial soft tissue scan of the patient's face, before and after orthognathic surgery and a CBCT of the skull for volumetric rendering of soft tissues were carried out. The 3D acquisitions were processed using Planmeca ProMax 3D (ProFace® software Planmeca USA, Inc.; Roselle, Illinois, USA). The positioned in a natural position during the skull participant were scannering. Three sagittal angular measurements were performed (Tr-NA, Tr-N-Pg, Ss-N-Pg) and two verticals (Go-N-Me, Tr-Or-Pg) on facial soft tissue scan and on the patient's 3D soft tissue CBCT volumetric rendering.

Results: A certain correspondence has been demonstrated between the measurements obtained on the Proface and those on the CBCT.

Conclusion: A radiation free method was to be considered an important diagnostic tool that works in conditions of not subjecting the patient to harmful ionizing radiation and it was therefore particularly suitable for growing subjects. The soft tissue analysis based on the realistic facial scan has shown sufficient reliability and reproducibility even if further studies are needed to confirm the research result.

Keywords: CBCT; Ionizing radiation; Soft tissue; Orthodontics; Diagnosis.

MACHİNE-LEARNİNG-DRİVEN OPTİMİZATİON OF BİO-HYDROCARBON–DERİVED MWCNTS FOR HİGH-DENSİTY ENERGY STORAGE İN POWER GRİD APPLİCATİONS

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Abstract

Multi-walled carbon nanotubes (MWCNTs) derived from plant-based bio-hydrocarbons offer a sustainable pathway for developing high-density energy-storage materials suitable for power-grid technologies. In this work, carbon nanostructures were synthesized from various biomass precursors and optimized for improved yield, crystallinity, and current-storage capacity. Machine learning models including Random Forests and Bayesian optimization were employed to predict and refine key processing parameters influencing structural quality and electrochemical behaviour. This integrated synthesis–ML framework enabled rapid identification of optimal conditions, reducing experimental iterations and enhancing overall energy efficiency. The resulting MWCNT structures demonstrated strong potential for high-current storage, highlighting the viability of a combined green-carbon and ML-assisted strategy for next-generation power-grid energy systems.

Keywords: **MWCNTs; bio-hydrocarbon precursors; machine learning optimization; random forests; Bayesian optimization; sustainable carbon nanostructures; high-density current storage; power grid technology; crystallinity enhancement; energy-efficient synthesis**

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UTILIZING SEASONAL EFFECTS THROUGHOUT THE SIR APPROACH TO MODEL DENGUE DYNAMICS IN BANGLADESH

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Abstract:
This study introduces an improved Susceptible-Infectious-Recovered (SIR) compartmental model for evaluating the transmission dynamics of Dengue fever in Bangladesh, specifically integrating the impact of critical meteorological factors. Dengue persists as a substantial public health risk in this tropical country, characterized by marked seasonal peaks corresponding to climatic fluctuations. Our model includes time-dependent transmission rates that are not linearly related to weather data we have seen, such as temperature, rainfall, and relative humidity. These factors are known to affect the life cycle and biting rate of the Aedes aegypti mosquito vector. We use historical case data from major endemic areas to adjust the extended SIR framework. This lets us figure out how weather-driven seasonality affects the effective reproduction number R_e. The results indicate that elevated rainfall and ideal temperatures (generally between 25°C and 32°C) serve as significant catalysts, resulting in an increase in R_e and subsequently, extensive outbreaks, which typically reach their zenith during the monsoon and post-monsoon periods. The model accurately replicates the intricate annual epidemic trends and forecasts prospective risk periods across diverse climate scenarios. This study highlights the necessity of incorporating climate-informed variables into epidemiological models to enhance early warning systems and adaptive public health strategies in Bangladesh.
Keywords: Dengue Fever, Effective Reproduction Number, Meteorological Factors, Climate-Informed Variables, Early Warning Systems.

RECENT METHODOLOGİCAL DEVELOPMENTS FOR THE SYNTHESİS OF CARBAZOLE SCAFFOLDS

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Abstract
Among three-membered nitrogen compounds, carbazole-based compounds possess substantial importance. These compounds have found their applications in almost every field of life. Owing to this, these scaffolds have been synthesized via a number of conventional and non-conventional approaches. Recently, there have been significant methodological developments as well to synthesize these scaffolds in high yields and efficacious manner. A number of named reactions, rearrangements and cyclization/annulation strategies etc. have been employed for the assembly of carbazole scaffold. Herein, a compilation of recently published novel synthetic approaches has been provided.
Keywords: Carbazole; Method developments; Cyclization; Annulation; C-H activation

ULTRASOUND ASSİSTED SYNTHESİS, *IN VİTRO* AND COMPUTATİONAL INVESTİGATİON OF TRİAZOLE CONJUGATES AS EFFECTİVE THERAPEUTİCS AGAİNST TYROSİNASE

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Tyrosinase is a copper containing enzyme which is responsible for melanin biosynthesis, converting tyrosine to DOPA and ultimately melanin. In this manuscript, a library of triazole conjugates have been synthesized in good to excellent yields. All the compounds were screened against tyrosinase to identify potential inhibitors. Among all, most of the compounds exhibited high potency than standard ascorbic acid. The potent derivatives were subjected to molecular docking studies to gain deep insight about the binding interactions with enzyme active site. All of the docked compounds gave good docking scores even better than reference compound ascorbic acid. They were involved in making H-bonding and π-π interactions within the copper vicinity. These compounds were further exposed to evaluate pharmacokinetic parameters. All conjugates possessed acceptable absorption profile. Furthermore, toxicity analysis showed these compounds are safe based on chronic and oral acute toxicity studies. These findings suggest that triazole hybrids might emerge as potential therapeutics against tyrosinase.

Keywords: H-bonding, Pharmacokinetic parameters, Potential therapeutics, Tyrosinase, π-π interactions

DESIGN, SYNTHESIS AND ANTI-VIRAL EVALUATION OF NOVEL PYRAZOLES

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Abstract
The current study deals with the development of a novel, eco-friendly and facile protocol to access pyrazole constituting heterocyclic organic compounds by carrying out reaction between substituted hydrazides and dicarbonyl compound employing the catalytic role of quaternary ammonium salt. Most of the resulting pyrazole constituting derivatives were attained in efficient yields. The synthesized set of organic compounds was also computationally screened against integral viral proteins of Hepatitis C virus, which unveiled their promising anti-viral potential.
Keywords: pyrazole, synthesis, eco-friendly protocol, anti-viral

HIGH-RESOLUTION DROUGHT ASSESSMENT USING PYTHON-BASED REMOTE SENSING AND SENTINEL-2 DATA

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Abstract. Drought is a recurring climatic hazard that significantly impacts agricultural productivity, water availability, and rural livelihoods in northern Bangladesh. Dinajpur, a crucial agricultural district in this region, faces frequent drought conditions that affect crop yields and food security. This study introduces a novel approach by using Python-based remote sensing techniques to assess drought conditions in Dinajpur. Rather than relying on traditional GIS software, Python libraries such as SentinelHub-Py and geopandas are employed to collect and process high-resolution Sentinel-2 satellite imagery via API access. The Vegetation Condition Index (VCI) is calculated to identify agricultural drought through the detection of stress patterns in crop fields. Meteorological drought is analyzed using the Standardized Precipitation Index (SPI), which tracks rainfall anomalies over different time scales. Hydrological drought is assessed using the Standardized Water Level Index (SWI), based on groundwater-level data. These indicators—VCI, SPI, and SWI—are integrated into a Composite Drought Index (CDI), offering a comprehensive view of drought severity and spatial distribution. The Local Indicators of Spatial Autocorrelation (LISA) technique identifies significant drought hotspots and cold spots across the district. The results highlight significant spatial variability in drought conditions, demonstrating the value of Python-based remote sensing for high-resolution monitoring. This research contributes to more effective drought management, agricultural planning, and climate resilience strategies in the region, providing a cost-effective alternative to traditional GIS-based methods.

Keywords: agricultural drought, composite drought index, geopandas, groundwater-level data, python, remote sensing, sentinel-2, standardized precipitation index

"INTERNALİZATİON OF HARAJAON BATAK TOBA AS A FRAMEWORK FOR MANAGEMENT ETHİCS İN CHRİSTİAN RELİGİOUS EDUCATİON"

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This study explores the internalization of the *Harajaon Batak Toba* system as an ethical framework for management in Christian religious education. The research is motivated by the urgency to rediscover local wisdom as a moral foundation for leadership in modern educational institutions. It specifically aims to understand how the social and leadership structure of the Batak Toba kingdom can be used as a model for value-based management in Christian education. The study employs a literature review method relying solely on journal and book sources that discuss traditional Batak governance, kinship, and leadership ethics. The findings reveal that the *Harajaon* system embodies a leadership culture grounded in divine authority or royal authority which is also obtained from the "*God*" (*sahala harajaon*), kinship harmony (*Dalihan Na Tolu*), and communal accountability. The core leadership values respect (*somba marhula-hula*), prudence (*manat mardongan tubu*), and compassion (*elek marboru*) generate ethical governance rooted in humility, justice, and service. The study concludes that internalizing these values into Christian education management fosters servant leadership and spiritual integrity consistent with biblical principles of stewardship. Thus, *Harajaon Batak Toba* presents a culturally grounded yet universally applicable ethical model for leadership in Christian educational contexts.

Keywords: Harajaon Batak Toba, Management Ethics, Christian education

A STUDY OF THE FACTORS CONTRIBUTING TOWARDS EMPLOYEE ATTRITION IN MARUTI SUZUKI

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Abstract
The study titled A Study of the Factors Contributing Towards Employee Attrition in Maruti Suzuki aims to explore and analyze the key organizational and individual factors that influence employees' decisions to leave or remain with the company. In today's competitive industrial environment, employee retention has emerged as one of the most critical challenges for organizations seeking stability, continuity, and productivity. Maruti Suzuki, being one of India's largest automobile manufacturers, depends heavily on the skills, innovation, and motivation of its workforce. Therefore, understanding the reasons behind employee attrition and identifying effective strategies to mitigate it is vital for sustaining growth and maintaining a competitive advantage in the automotive sector.
The research primarily focuses on exploring the impact of factors such as job satisfaction, compensation structure, recognition practices, work environment, career growth opportunities, training and development programs, and managerial support on employee attrition. Each of these components plays a crucial role in determining employee engagement levels and their willingness to continue long-term with the organization. The study emphasizes that attrition is not merely a result of financial dissatisfaction; it stems from a complex blend of psychological, professional, and organizational elements that collectively shape the employee experience. Lack of growth opportunities, inconsistent communication, limited rewards, and stressful work conditions are among the core issues that contribute to workforce turnover. the study identifies the significance of aligning employee career aspirations with organizational objectives to achieve mutual growth. Building transparent promotion systems, ensuring fair compensation, and fostering supportive leadership are suggested as strategic approaches to minimize attrition. The role of mentorship and continuous skill enhancement is highlighted as an effective method to maintain employee motivation and reinforce loyalty. The research underscores that in the modern workplace, employees—especially younger generations—value career progression, work-life balance, and recognition more than mere job security.

A SIMPLE ALGORITHM BASED ON ZERO/POLE CONFIGURATION FOR DESIGNING AN IIR DIGITAL FILTER

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In various filtering applications, infinite impulse response (IIR) filters are used instead of the finite impulse response (FIR) filters. The reason behind this, is that the IIR are recursive which meaning that they require a shorter memory than the FIR for the data processing. An IIR filter is, however, less stable and more difficult to design than an FIR filter. The latter can be designed, easily, by the convolution with the application of an appropriate window to limit the impulse response duration. For the IIR, this convolution cannot, unfortunately, be used in practice because of the infinite duration of the impulse response. To overcome this problem, we, usually, look in Laplace plane for a transfer function H(s) of an analog filter that is equivalent to the desired digital filter, and having expression as the following form (1), and then transform it using the bilinear transform to obtain the desired digital IIR filter transfer function.

$$H(s) = \prod_{i=1}^{i=K} \frac{s_i}{s_i - s} = \frac{\prod_{i=1}^{i=K} s_i}{\prod_{i=1}^{i=K} (s_i - s)} \qquad (1)$$

Where K is the order of the polynomial, s is a complex variable and s_i are the poles (complex roots of the denominator). In this work, we propose a simple and fast algorithm for designing such an IIR digital filter and give an example of its application.

CONTRIBUTION OF INCUBATION SUPPORT SERVICES TO START-UP SUCCESS: A SECTOR-WISE ANALYSIS

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ABSTRACT

Business incubation has become a globally recognised mechanism for enhancing early-stage entrepreneurial success, increasing survival rates, and strengthening innovation capabilities. International research shows that incubated start-ups achieve **higher survival rates—often exceeding 80%—compared to non-incubated ventures** *(NBIA, 2020; OECD, 2019)*. This study analyses the **sector-wise contribution of incubation support services**—including mentoring, seed funding, prototyping facilities, market access and business development training—to start-up success across technology, healthcare, agritech, manufacturing and service industries. Empirical evidence from international studies demonstrates that structured incubation significantly accelerates firm growth, improves resource access and enhances innovation output *(Hackett & Dilts, 2004; Mian, 2016)*. Technology start-ups benefit primarily from specialised infrastructure and investor networks, whereas healthcare and biotech ventures depend on regulatory navigation support and high-end laboratory facilities *(World Bank, 2020)*. Agritech start-ups gain substantially from field-testing opportunities and supply-chain integration facilitated by incubators *(UNIDO, 2021)*. Despite proven benefits, international literature highlights challenges such as variability in incubation quality, limited deep-tech readiness, and unequal regional distribution of support services *(OECD, 2019)*. This sector-wise analysis underscores the need for **customised incubation models**, stronger research–industry collaboration and enhanced innovation infrastructure to maximise the impact of incubators on start-up success.

Keywords: business incubation, start-up success, sectoral analysis, entrepreneurial ecosystems, innovation support services.

AI-ENHANCED AND BIST-DRIVEN DIGITAL SYSTEM TESTING: FROM EARLY METHODS TO NANOMETER TECHNOLOGIES

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Abstract

Digital system testing has undergone a remarkable transformation over the past five decades, driven by increasing device complexity, transistor scaling, and performance demands. Early testing relied on manual procedures and simple fault models, but modern approaches advantage advanced automation, Design for Test (DfT) strategies, Built-In Self-Test (BIST), and Artificial Intelligence (AI) techniques to ensure functionality, reliability, and yield at Nano-meter scales. This paper presents a comprehensive review of digital system testing, tracing its evolution from conventional methods to AI-enhanced and BIST driven environment approaches. Key methodologies, fault models, test generation algorithms, and nanoscale challenges including process variations, soft errors, and aging effects are discussed. The integration of AI with BIST techniques is highlighted as a promising avenue for intelligent, adaptive, and efficient testing in next generation digital systems.

Keywords:
Digital system testing, Built-In Self-Test (BIST), Artificial Intelligence (AI), Design-for-Test (DfT), Fault models, Test generation, Nano-meter technologies, Process variation, Soft errors, Aging effects

PERCEPTIONS OF PENSION MANAGERS AND BENEFICIARIES ON THE NATURE OF PENSION FUND INVESTMENTS IN NIGERIA

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Abstract
Pension managers are main trustees to pension fund providers who believe in their integrity and expertise in managing the funds effectively. The study therefore examines perceptions of pension fund administrators (PERPFA) and perceptions of pension beneficiaries (PERBEN) on the nature of investment that guarantees regular and worthwhile returns on pension funds in Nigeria. The study population consists of pension fund contributors and retirees of seventeen (17) Federal and State Polytechnics in the Southwest, Nigeria. It also included staffers of twenty-one (21) PFAs and four (4) PFCs. Survey research design, using purposive sampling method on structured questionnaire was used to obtain data on the subject matter. Taro Yamane sampling technique was applied to streamline the data for analysis. Both descriptive statistics and regression were employed to obtain results on the study. The result of the findings revealed that there is a joint significant relationship of PERPFA and PERBEN on the nature of investment going by the P-value of F-statistic which is less than 0.05 level of significance and the result of the T-statistic. The study therefore, recommends strict enforcement of the provisions of Investment regulations on the investment of pension assets. PFAs are enjoined to engage investment experts with adequate knowledge of fund management and versatile skills in risk management and portfolio diversification.

Keywords: Nature of investment, Perceptions of Pension Beneficiaries, Perceptions of Pension Managers, Return on investment.

EFFECT OF ZİNC OXİDE NANOPARTİCLES ON MECHANİCAL, MAGNETİC AND DİELECTRİC PROPERTİES OF NANOCOMPOSİTES

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ABSTRACT
The nanocomposites of unsaturated polyester resin with glass wool having different concentration of zinc oxide nanoparticles were fabricated by using hand lay-up method. Five samples were fabricated. Electrical, mechanical and magnetic properties were studied. A polarization mechanism was examined through impedance spectroscopy which was employed to measure the dielectric constant, dielectric loss and ac conductivity at different temperature (30°C to 130°C) and frequencies ranging from 20 Hz to 20 MHz. The measurement were performed at various levels of zinc oxide nanofillers. Results showed that dielectric properties are enhanced and depend upon the quality of added nanoparticles. The polymer-filler interaction improved the polarization. The dielectric constant, tan loss and ac conductivity increased with concentration of nanofillers increased in polyester resin and raising temperatures. Activation energy was calculated that was decreased with filler concentration of nanoparticles by using universal testing machine (UTM). The young modulus and tensile strength elevated with addition of 1.5wt% zinc oxide nanoparticles in polyester resin. Further addition of nanofillers in polyester resin decreased the young's modulus and tensile strength. The magnetic properties such as saturation magnetization, coercivity and remanance were investigated by using vibrating sample magnetometer (VSM). Polyester nanocomposites indicate the ferromagnetic behavior with incorporation of zinc oxide nanoparticles. The magnetic parameter such as saturation magnetization, coercivity and remanence increased with increase the nanofiller concentration in polyester resin.

SİNGULAR NONLİNEARİTİES İN NON-LOCAL ELLİPTİC EQUATİONS

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Abstract
In the present paper, we study the existence of solutions for the singular nonlinearities in non-local elliptic equations. We consider the problem

$$\begin{cases} A(u) = \dfrac{f(x)}{u^{\alpha}} \quad , \quad in\ \Omega, \\ \quad u = 0 \quad , \quad on\ \mathbb{R}^N \setminus \Omega, \\ A(u) = \Delta^s u + \beta(x), \end{cases}$$

where β is a non-decreasing real function, continuous on $\mathbb{R}$, surjective, such that $\beta(0) = 0$ and satisfying $|\beta(x)| \leq M\,|x|$ where M is a positive constant. $\alpha \geq 1, s \in (0,1)$ is the fractional order, Ω is a bounded regular domain in $\mathbb{R}^N, N \geq 2$ and f is a non-negative function belonging to an appropriate Lebesgue space $L^m(\Omega)$. We adapt the results of N. Elharrar, J. Igbida and H. Talibi on the $p(\cdot) - Laplacian$ problem with nonlinear singular terms to the fractional case with $p(x) = 2$.

Keywords: Fractional Laplacian problem, nonlinear singular terms to the fractional, existence of solutions for the fractional Laplacian problem.

BRİDGİNG EVİDENCE AND PRACTİCE: KNOWLEDGE AND CLİNİCAL USE OF NON-SPEECH ORAL MOTOR EXERCİSES AMONG SPEECH AND LANGUAGE THERAPİSTS İN BANGLADESH

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Background: Non-speech oral motor exercises are undoubtedly the most controversial speech and language therapy treatment techniques throughout the whole world. Though a large number of Speech Language Therapists use this technique on regular basis but the debate is also ongoing.
Objective. This study investigates the awareness, usage patterns, and perceptions of NSOMEs among Bangladeshi clinicians, aiming to evaluate their integration into speech and language therapy practices.
Methods: A quantitative cross-sectional study has been done with a purposive sampling procedure. A structured questionnaire was used and data were analyzed using descriptive statistics.
Results: The total number of participants, use NSOMEs in their clinical sessions. The highest number of participants (92%) use this for treating Motor Speech Disorders. 89% of total participants believe NSOMEs develop motor aspect of articulators and 55.7% of total participants are fully satisfied with this technique.
Conclusion: 100% of SLTs use and believe about the effectiveness of NSOMEs which is the highest till this date. The study reveals widespread, unquestioned reliance on NSOMEs among Bangladeshi SLTs, influenced by educational learning rather than evidence-based practice.
Keywords: Non-speech Oral Motor Exercise, Speech and Language Therapists, Knowledge, Awareness.

ADHERENCE TO THE MEDITERRANEAN DIET AND METABOLIC PARAMETERS IN PATIENTS UNDERGOING RENAL REPLACEMENT THERAPY IN MOROCCO

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Background: Chronic kidney disease (CKD) is a serious public health problem worldwide, with a significant public health burden, associated with aging and a higher prevalence of comorbidities, such as diabetes, obesity and hypertension. Obviously, chronic kidney disease leads to end stage renal disease (ESRD) requiring dialysis or transplantation. Indeed, patients on chronic kidney disease stage-five Dialysis (CKD-5D) are consistently subject to particular dietary restrictions. Current guidelines provide general recommendations for hemodialysis (HD) patients focus on achieving a sufficient energy and protein intake without exceeding Phosphorus, Potassium, Sodium, and fluid intake limits. **Objectives:** The aim of this study was to assess the adherence of patients undergoing maintenance dialysis to the Mediterranean Diet, and investigated what factors influence it. **Methodology:** In a cross-sectional study, data on sociodemographic, lifestyle factors, clinical, biochemical parameters and diet were collected on a sample of 157 haemodialysis patients. Adherence to MD was assessed according to a MD score (MDS) based on the daily frequency of intake of eight food groups (vegetables, legumes, fruits, cereals, fish, red meat, dairy products and MUFA/SFA), using the sex specific sample medians as cut-offs. A value of 0 or 1 was assigned to consumption of each component according to its presumed detrimental or beneficial effect on health. **Results :** According to the MDS, the study data show that high adherence (**34,6%**) to MD was characterized by intakes high in vegetables, fruits, fish, cereals, olive oil, and low in meat and moderate in dairy. Furthermore, patients with high adherence to MD had significantly high intakes of calories, protein, carbohydrates, iron and vitamins (C, B1, B9). **Conclusion:** In Morocco, maintaining the traditional MD pattern play pivotal role for public health system. More research is needed in this field to precisely measure this association especially for this category of chronic disease.

Keywords : Hemodialysis patients, nutritonal status, Mediterranean diet, MDS, Morocco

EFFECTS OF PRAISE SONGS ON DOGUWA

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Abstract

In traditional and modern Africa, people still worship their supernatural forces through ritual songs, incantations, spells, praise songs and so on in order to gain something from the deities. In fact, Arewa people adore and honor Doguwa spirit, a family of potent female spirits native of Arewa (Idrissa & Samuel 2012) despite the propagation of Abrahamic religions like Christianity and Islam. This study analyzes the effects of praise songs on that spirit in some selected songs collected, transcribed into Arewa dialect and translated into English. The rhetorical theory is used to analyze Akazama Band songs Kuji Baka and Shakirari because this theory deals with forms, functions, effects and so on. The study reveals that praise songs have both positive effects like wealth, protection, healing, good harvest and negative effect such as: death, sickness, insanity, and infirmity.

Key words: **Traditional belief, Doguwa Spirit, Praise Songs, Arewa People, Akazama Band**

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THE IMPACT OF GEOPOLİTİCAL TENSİONS ON BLUE ECONOMY SUPPLY CHAİNS: A COMPARATİVE ANALYSİS OF MAJOR TRADE BLOCS

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https://ror.org/0278jft56[a]; https://ror.org/00j6r8583[b]; https://ror.org/049pzty39[c]; https://ror.org/0278jft56[d]

Abstract
The global ocean economy is a critical driver of trade, economic development, and technological innovation, yet a comprehensive, comparative analysis of ocean goods trade across the world's major economic blocs remains absent from the literature. This study conducts a longitudinal and comparative assessment of ocean goods trade for BRICS, the European Union (EU), G-20, G-77, and the OECD from 2012 to 2023, utilizing nominal and real trade data from UNCTAD. The research employs a quantitative methodology to analyze total trade values, sectoral composition, growth trajectories, and per capita trade, interpreting the findings through the theoretical lenses of Comparative Advantage, Global Value Chains, and Structural Transformation. The results reveal a global ocean economy characterized by a persistent but shifting hierarchy. The EU and OECD maintain dominance in high-value, technology-intensive sectors such as ships, port equipment, and high-technology manufactures, underpinned by their abundant capital and advanced innovation ecosystems. In contrast, BRICS emerges as a dynamic and disruptive force, demonstrating the most rapid growth, particularly post-2021, and a strategic transition from a resource-based to a manufacturing-oriented ocean economy, heavily reliant on importing capital goods for industrial upgrading. The G-77 retains a comparative advantage in resource-intensive sectors like marine fisheries but shows nascent signs of moving into value-added processing, while the G-20 acts as an aggregate barometer of global trends. A profound developmental disparity is uncovered through per capita analysis, with the EU's per capita trade exceeding that of BRICS and the G-77 by more than a factor of ten, highlighting a significant "blue wealth" gap. This study concludes that the geography of the global ocean economy is undergoing a significant rebalancing. It provides a critical evidence base for policymakers in developed blocs to foster innovation, for emerging economies to strategize their ascent in global value chains, and for developing nations to avoid the resource curse by promoting value addition and equitable growth. The findings underscore the necessity for targeted, bloc-specific strategies to harness the ocean's economic potential sustainably and inclusively.
***Keywords*:** Economic blocs, Global value chains, International trade, Ocean economy, Sustainable development.

1.0 INTRODUCTION

1.1 Background of the Study

The global ocean, covering over 70% of the Earth's surface, is not merely a geographical feature but a fundamental pillar of the global economy. The "ocean economy," encompassing a diverse range of sectors from marine fisheries and aquaculture to shipping, offshore energy, and marine biotechnology, is a critical driver of economic prosperity, trade, and employment. According to the Organisation for Economic Co-operation and Development (OECD), the ocean-based industries are projected to double in size to over $3 trillion by 2030, outperforming the growth rate of the global economy as a whole (Sarangi, 2023; Tide, 2021). This growth is fueled by increasing demands for food, energy, and transportation, positioning the ocean at the forefront of strategic economic planning for both developed and developing nations.

International trade in ocean goods—tangible products derived from or for marine activities—serve as a primary conduit through which the economic value of the ocean is realized and distributed globally (Currie, 2024; Brent *et al*., 2020). This trade is not homogenous; it reflects deep-seated patterns of comparative advantage, technological capability, and resource endowment (Nguyen, 2024). However, this critical flow of goods is increasingly vulnerable to and shaped by geopolitical tensions, which can disrupt key maritime chokepoints, drive strategic rerouting of supply chains, and influence bloc-level investments in maritime security and alternative trade corridors, thereby directly impacting the cost, reliability, and direction of ocean commerce. Major regional economic blocs have emerged as the principal architects of this trade landscape. The European Union (EU), with its advanced maritime technology and integrated market; the OECD, representing the world's most industrialized economies; the G20, a forum of systemically important developed and emerging economies; BRICS (Brazil, Russia, India, China, and South Africa), a dynamic association of major emerging markets; and the G77, the largest intergovernmental organization of developing countries, all shape and are shaped by the currents of global ocean commerce. Understanding the trade dynamics within and between these blocs is therefore essential to comprehending the evolving structure of the global economy itself (UNCTAD, 2022).

1.2 Problem Statement

Despite the ocean economy's recognized significance, significant knowledge gaps persist in the systematic, comparative analysis of ocean goods trade at the level of major regional blocs. Existing literature and reports often focus on a single sector (e.g., fisheries in the FAO's annual reports) or a single country or region, failing to provide a holistic, comparative picture that captures the competitive and complementary relationships between the world's most influential economic groupings (Chávez *et al*., 2021; Costello & Ovando, 2019). There is a lack of synthesized, multi-bloc analysis that simultaneously examines:

1. The structural composition of ocean goods exports and imports, revealing whether blocs are exporters of raw materials or high-value, technology-intensive manufactured goods.
2. The growth trajectories and volatility of different sectors across blocs, particularly in response to global shocks like the 2015 commodity slump and the COVID-19 pandemic.
3. The intensity of ocean trade engagement when normalized for population size, which is a critical indicator of how effectively an economy translates its maritime potential into per capita prosperity.
4. The influence of escalating geopolitical tensions on trade routes, supply chain resilience, and strategic investment patterns, which are reconfiguring the security and economic calculus of global maritime commerce.

Consequently, this study directly addresses this gap by integrating a quantitative analysis of long-term trade performance with an assessment of how geopolitical fragmentation and supply chain security concerns are shaping the strategic calculus of major economic blocs, offering a novel, comparative perspective on the interplay between economic policy and security in the maritime domain. Further, this lack of a consolidated, comparative framework makes it difficult for policymakers, investors, and researchers to identify strategic opportunities, vulnerabilities, and the shifting balance of economic power within the global ocean economy. Without this granular, bloc-level understanding, strategies for sustainable ocean development may be misdirected, and the potential for intra- and inter-bloc cooperation remains underexploited.

1.3 Justification for the Study

This study is justified by its potential to fill the identified gaps and provide actionable insights for a diverse range of stakeholders. The research offers several critical contributions:

- For Policymakers: A clear, data-driven mapping of their bloc's (and their country's) position within the global ocean value chain is essential. For leaders in the EU and OECD, the findings highlight the need to innovate to maintain a competitive edge in high-technology sectors. For BRICS and G77 policymakers, the analysis illuminates the path of development, underscoring the importance of investing in maritime infrastructure, technology acquisition, and value-added processing to climb the oceanic value chain and avoid the "resource curse" (Hoegh-Guldberg *et al.*, 2015). Understanding trade dependencies is also crucial for crafting resilient supply chain policies.
- For Academic and Research Communities: This study contributes to the fields of maritime economics, international trade, and regional studies by providing a comprehensive, longitudinal dataset and a robust analytical framework for comparing major economic blocs. It builds upon and tests theories of comparative advantage and global value chains in the specific context of the ocean economy (Kaplinsky & Morris, 2016). The findings can serve as a benchmark for future research and inform more nuanced economic models.
- For International Organizations (e.g., UNCTAD, World Bank, FAO): The analysis provides a macro-level evidence base to guide targeted technical assistance and capacity-building programs. For instance, identifying the G77's strength in marine fisheries but weakness in high-technology exports can help focus efforts on supporting value addition and sustainable resource management in developing nations, directly supporting the aims of Sustainable Development Goal 14 (United Nations, 2023).
- Timeliness and Relevance: The study covers the period 2012-2023, a timeframe that includes pivotal global economic events, culminating in a projected 2023 outlook. This recency is crucial for understanding the post-pandemic recovery and the current state of the global ocean economy, providing a timely snapshot for decision-making in an era of rapid change.

1.4 Research Objectives

To address the problem statement systematically, this study aims to achieve the following specific objectives:

1. To quantify and compare the scale and growth trends of total nominal and real ocean goods exports and imports for the selected economic blocs from 2012 to 2023.
2. To analyze the sectoral composition and performance of ocean goods trade within each bloc, focusing on five key categories: Marine fisheries, aquaculture and hatcheries;

Seafood processing; Sea minerals; Ships, port equipment and parts thereof; and High-technology and other manufactures.

3. To assess the differential impact of global economic shocks, particularly the 2015 downturn and the COVID-19 pandemic (2020-2021), on the trade resilience and recovery patterns of the selected regional blocs.
4. To evaluate the per capita ocean goods trade for each bloc to determine the relative intensity and developmental disparity in their engagement with the global ocean economy.

By fulfilling these objectives, this research will provide a comprehensive, evidence-based portrait of the competitive dynamics of the global ocean goods trade, offering valuable insights for shaping the future of this critical economic frontier.

2.0 LITERATURE REVIEW

2.1 Theoretical Framework

To systematically analyze the complex dynamics of ocean goods trade among major regional blocs, this study is anchored in a multi-theoretical framework. This framework integrates established theories of international trade with contemporary models of global production and development to provide a comprehensive lens for interpreting the data.

2.1.1 The Foundation: Comparative Advantage and the Heckscher-Ohlin Model

The cornerstone of our analysis is the theory of Comparative Advantage (Ricardo, 1821), which posits that countries (and by extension, blocs) benefit from specializing in the production and export of goods where they have a lower opportunity cost. This foundational principle explains why certain blocs dominate specific sectors of the ocean economy. However, to understand the *sources* of this advantage, we employ the Heckscher-Ohlin (H-O) Model (Heckscher *et al*., 1991). The H-O model predicts that regions will export goods that intensively use their abundant factors of production and import goods that require factors that are relatively scarce.

In the context of this study:

- The G-77 bloc, abundant in natural resources and labor, is theorized to have a revealed comparative advantage in resource-intensive and labor-intensive sectors such as Marine fisheries, aquaculture and hatcheries, as the data confirms. Their exports are predicted to be concentrated in these primary goods.
- The EU and OECD blocs, endowed with abundant physical capital, advanced infrastructure, and human capital (skilled labor and technological innovation), are expected to specialize in and export capital-intensive and knowledge-intensive goods. This aligns perfectly with their dominance in Ships, port equipment and High-technology manufactures, as shown in the results.
- BRICS presents a dynamic case. It possesses an abundance of certain natural resources (e.g., sea minerals) but is also rapidly accumulating physical capital and, in certain members like China, a growing stock of human capital. The H-O model would predict its ongoing transition from a exporter of primary products to an exporter of manufactured goods, a pattern evident in its growing export base in shipbuilding and seafood processing.

2.1.2 Structural Transformation and the "Flying Geese" Model

To explain the dynamic shifts in comparative advantage over time, particularly for emerging economies, we incorporate the concept of Structural Transformation (Lewis, 1954) and the "Flying Geese" model (Akamatsu, 1962). This model describes a pattern where a leading

economy (the "lead goose") pioneers an industry, and as it loses comparative advantage due to rising costs, production migrates to follower economies ("following geese") with lower factor costs.

Applied to ocean goods trade:

- Japan, South Korea, and later China have historically been the "lead geese" in shipbuilding, with production gradually shifting through Southeast Asia and now to other parts of BRICS and the G-77 (Shi & Xue, 2025; Jolliffe *et al*., 2021). The data on the volatile but high growth of BRICS in this sector reflects this ongoing process of industrial relocation and catch-up.
- In seafood processing, a similar pattern is observable. The EU, as a high-cost economy, maintains its position through high-quality branding and technology but imports raw seafood for processing and re-export, a pattern noted by Greenwood (2019); Bush & Oosterveer (2019). Meanwhile, countries within BRICS and the G-77 are increasingly becoming the "following geese," capturing more of the processing value-added as the industry globalizes.

2.1.3 Global Value Chains (GVCs) and Governance

The contemporary ocean economy is best understood not as a series of discrete product trades but as a set of Global Value Chains (GVCs)—the full range of activities required to bring a product from its conception to its end use (Gereffi *et al*., 2005). The GVC framework moves beyond the final product to analyze a bloc's position within the international division of labor. A key concept is GVC Governance, which describes how lead firms in developed economies coordinate and control decentralized production networks across the globe.

This framework is critical for interpreting the data:

- The EU and OECD's dominance in High-technology manufactures signifies their role as lead firms in GVCs, occupying the high-value, strategic roles of R&D, design, and marketing. They often outsource manufacturing or component production to other regions.
- The import patterns of BRICS, which show heavy reliance on Ships and port equipment and High-technology goods, reveal its strategy of GVC integration. It is importing advanced capital goods and technology to upgrade its domestic productive capacity and move from being a supplier of raw materials to a manufacturer of intermediate and final goods within global maritime networks (World Bank, 2020).
- The G-77's position is often in the low-value, resource-extractive segments of the GVC. The challenge for these economies, as per GVC theory, is to use this initial integration as a platform for industrial upgrading—a process of moving into higher-value activities within the chain, such as the processing evident in their seafood sector data.

2.1.4 The "Resource Curse" and Sustainable Development

Finally, the analysis is contextualized within the discourse on the "Resource Curse" or "Paradox of Plenty" (Auty, 1993), which hypothesizes that resource-rich countries may experience less economic growth and worse development outcomes than countries with fewer natural resources, due to factors like volatile revenues, Dutch disease, and weak institutions. This theoretical concern is directly relevant to blocs like the G-77 and some BRICS nations that are heavily reliant on marine resource exports.

The data on per capita trade is a crucial test of this theory. While a bloc may have high total export values from resources, a low per capita figure indicates that the wealth generated is not translating into broad-based prosperity, potentially validating the concerns of the resource curse thesis. Conversely, the high per capita figures of the EU and OECD demonstrate their

success in translating maritime activities, both resource-based and industrial, into significant economic value per citizen. This ties directly into the theory of Sustainable Development (WCED, 1987), emphasizing that ocean economic growth must be not only economically viable but also socially equitable and environmentally sustainable to avoid the pitfalls of the resource curse in the long term.

By integrating these four theoretical pillars—Comparative Advantage, Structural Transformation, Global Value Chains, and the Resource Curse—this framework provides a robust and multi-faceted tool for interpreting the empirical findings, moving beyond mere description to explain the *why* and *how* behind the evolving patterns of global ocean goods trade.

2.2 Conceptual Framework

The conceptual framework for this study visually and logically structures the relationship between the key variables and concepts under investigation, illustrating how the analysis will proceed from data to insights (Figure 1). It integrates the core components of the research to explain the dynamics of ocean goods trade across regional blocs. The framework is presented below, followed by a detailed explanation.

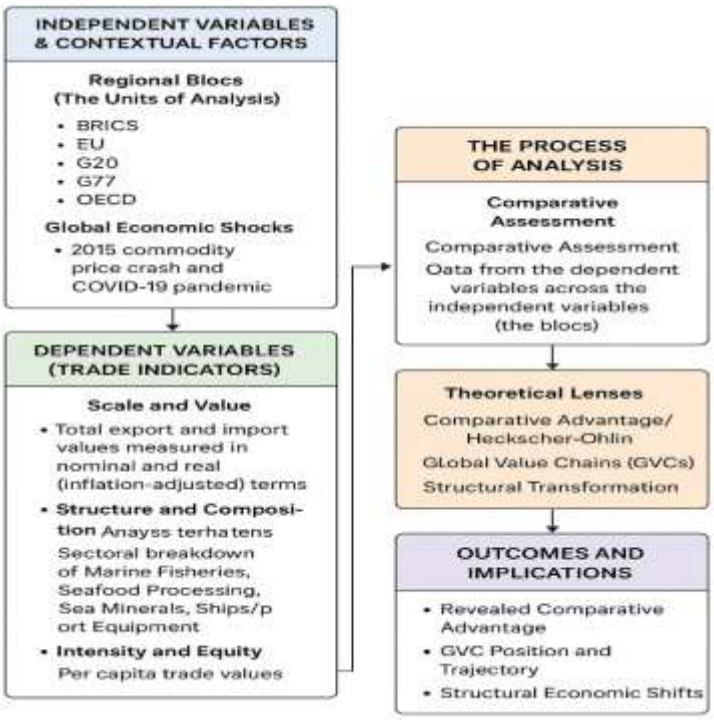


Figure 1: Conceptual framework

Explanation of the Conceptual Framework:

1. **Independent Variables & Contextual Factors:**
   - **Regional Blocs (The Units of Analysis):** The five selected blocs (BRICS, EU, G20, G77, OECD) form the core units of comparison. Their inherent characteristics—such as level of development, resource endowment, technological capability, and institutional structure—are the foundational independent variables that predispose them to certain trade patterns.
   - **Global Economic Shocks:** External factors, such as the 2015 commodity price crash and the COVID-19 pandemic, are treated as significant intervening variables. These shocks

disrupt normal trade flows and test the resilience and adaptive capacity of each bloc, influencing the dependent variables.

2. **Dependent Variables (Trade Indicators):** These are the measurable outcomes that the study investigates. They are grouped into three categories:
   - **Scale and Value:** Measured by total export and import values, in both nominal terms and real (inflation-adjusted) terms to understand true growth.
   - **Structure and Composition:** Analyzed through the sectoral breakdown of trade (Marine Fisheries, Seafood Processing, Sea Minerals, Ships/Port Equipment, High-Technology Manufactures). This reveals the nature of specialization.
   - **Intensity and Equity:** Captured by per capita trade values, which indicate how deeply the ocean economy permeates the bloc's population and its relative developmental benefit.
3. **The Process of Analysis:**
   - The **Comparative Assessment** involves analyzing the data from the dependent variables across the independent variables (the blocs). This is not done in a theoretical vacuum.
   - The analysis is guided by the theoretical lenses of Comparative Advantage/Heckscher-Ohlin, Global Value Chains (GVCs), and Structural Transformation. These theories provide the "why" behind the observed patterns. For instance, the H-O model helps explain sectoral composition, while the GVC framework interprets what a bloc's import and export structure says about its position in global production networks.
4. **Outcomes and Implications:**
   - The culmination of the analysis is the derivation of key outcomes. These include:
     - **Revealed Comparative Advantage:** Identifying which blocs have a competitive edge in which sectors.
     - **GVC Position and Trajectory:** Determining whether a bloc is a technology leader, a manufacturing hub, or a resource supplier, and assessing its potential for upgrading.
     - **Structural Economic Shifts:** Documenting the movement of blocs from primary production to more advanced industries over time.
     - **Evidence-Based Policy Implications:** The entire framework is designed to generate actionable insights for policymakers in each bloc to harness their ocean economy for sustainable and equitable development, considering both economic and social (per capita) outcomes.

In summary, this conceptual framework posits that the ocean goods trade patterns of regional blocs (dependent variables) are determined by their intrinsic economic structures and factor endowments (independent variables), are disrupted and tested by global shocks, and can be intelligently interpreted through established economic theories to yield critical insights about competitiveness, development, and sustainability.

2.3 Empirical Review

A substantial body of empirical research has examined various facets of the ocean economy, from fisheries management to shipping logistics. However, few studies have undertaken a holistic, comparative analysis of ocean *goods* trade across the world's major regional economic blocs. This review synthesizes the existing empirical literature, structured around the key themes of this study, to establish a foundation and highlight the niche this research fills.

2.3.1 Global Patterns and Bloc-Specific Performances

Empirical studies consistently confirm the dominance of developed economies and advanced regional blocs in the high-value segments of the ocean economy. UNCTAD's Annual Review of Maritime Transport provides robust empirical data showing that the global maritime trade

fleet is predominantly owned and financed by entities in OECD member states and East Asia (Ferdowsi, 2010). This aligns with our findings of the EU's and OECD's dominance in the export of ships, port equipment, and high-technology manufactures. Furthermore, a study by the OECD (2019) on the future of the ocean economy empirically demonstrated that innovation and value capture are concentrated in developed countries, which specialize in high-tech marine industries such as marine robotics, advanced aquaculture systems, and offshore engineering.

Conversely, empirical work on developing economies often highlights their role as resource providers. Research by the Food and Agriculture Organization (Sharma *et al*., 2025; Bartley, 2022; ACTION, 2020) showed that developing countries account for over 80% of global fish production and are critical exporters of marine resources. This empirically supports our finding of the G-77's strong performance in the Marine fisheries and aquaculture sector. However, our data also reveals the G-77's growing capacity in seafood processing, a nuance that aligns with emerging empirical work. For instance, Bush & Oosterveer (2019) empirically traced the globalization of seafood value chains, documenting how developing nations are increasingly engaged in processing activities for export, often driven by foreign investment, though the highest value segments (e.g., branding, retail) often remain in developed markets.

The rise of emerging economies, particularly China within BRICS, is a well-documented empirical trend. Stopford (2009) and subsequent analyses by Zhou *et al*.(2022); Xie (2012) have empirically shown the meteoric rise of Chinese shipbuilding, which has fundamentally reshaped global market shares over the past two decades. This provides a clear empirical backdrop for the dynamic growth observed in the BRICS bloc's exports of Ships and port equipment, illustrating a tangible shift in comparative advantage.

2.3.2 Sectoral Dynamics and Value Chain Integration

Empirical research into specific sectors reveals the complex dynamics that our bloc-level data captures. In the Sea minerals sector, that includes offshore oil, gas, and nascent deep-sea mining, empirical evidence points to a new frontier of competition. The International Renewable Energy Agency (IRENA, 2021) has documented the rapid growth of offshore wind, with significant investments and capacity additions in both the EU (particularly the North Sea) and China. This offers an empirical explanation for the high growth rates in the "Sea minerals" category for both the EU and BRICS, as it encompasses investments in offshore energy infrastructure.

The high-technology and other manufactures sector is empirically linked to a bloc's capacity for innovation. A study by Ali (2025) on technological upgrading in the maritime industry found a strong positive correlation between R&D expenditure, patent filings in maritime technologies, and export performance in high-tech marine goods. This empirically validates the dominant position of the R&D-intensive EU and OECD economies in this sector, as shown in our data, and explains the relative lag of other blocs.

The import structure of economies is equally telling. Empirical studies on capital goods imports, such as those by Kaplinsky & Morris (2015), have shown that rapidly industrializing economies are characterized by high levels of imports of machinery and technology. This is a strategic move to build productive capacity. Our finding that BRICS is a major importer of Ships, port equipment, and High-technology goods is empirically consistent with this development pattern, indicating a deliberate strategy of technological assimilation and industrial upgrading within global value chains.

2.3.3 Economic Shocks and Resilience

The impact of economic shocks on trade is a rich area of empirical inquiry. The World Trade Organization (Chakraborty & Dey, 2024; Eyvazova, 2024; Citaristi, 2022; dos Reis *et al*., 2021) empirically documented the sharp, but heterogeneous, impact of the COVID-19 pandemic on global trade. Their findings showed that trade in goods proved more resilient than trade in services, and that the recovery was uneven, with developing countries often facing more significant logistical and fiscal constraints. This provides a context for our empirical observation that the EU and OECD demonstrated relative resilience in 2020, while BRICS and the G-77 experienced sharper declines but also more explosive rebounds in 2021. This V-shaped recovery in emerging markets is empirically supported by research from the International Monetary Fund (Citaristi, 2022), which highlighted the role of strong fiscal stimuli in large emerging economies and a faster rotation of demand towards goods rather than services.

The 2015 global commodity price slump, as empirically analyzed by the Baffes & Nagle (2022), led to severe terms-of-trade shocks for commodity-exporting nations. Our data, showing a significant downturn in export growth for several blocs in 2015, empirically reflects this global event. The particularly severe impact on the G-77's exports during this period, as our data indicates, is empirically consistent with the bloc's higher dependency on primary commodity exports, making it more vulnerable to such price cycles.

2.3.4 Per Capita Trade and Developmental Outcomes

The disparity in per capita economic benefits from the ocean economy is a central concern in the empirical literature on sustainable development. The Sharma *et al*. (2025) report, "The Sunken Billions Revisited," empirically demonstrated the significant economic losses from poor fisheries management, losses that disproportionately affect the poor in developing countries. This speaks to the broader issue reflected in our per capita trade data: low aggregate value capture per person. Our empirical finding of a vast gulf between the EU/OECD's per capita ocean trade and that of the G-77 and BRICS is a stark quantitative confirmation of the "blue wealth" gap discussed in policy circles. Empirical work by Hoegh-Guldberg (2015) has argued that without deliberate policies for value addition and equitable benefit-sharing, the growth of the ocean economy may bypass local communities in developing nations, a risk that is underscored by our low per capita figures for the G-77.

In summary, the existing empirical literature provides strong, albeit fragmented, support for the individual patterns observed in our data. Previous studies have documented the dominance of developed blocs in high-tech sectors, the resource base of developing blocs, the rise of Asian shipbuilding, and the disruptive impact of global shocks. However, the novelty of this study lies in its synthetic and comparative approach. It brings these disparate empirical threads together into a unified, quantitative framework that allows for direct, simultaneous comparison of five major blocs across multiple sectors and metrics over a critical 12-year period. By doing so, it fills a significant gap in the literature, providing a comprehensive, evidence-based map of the competitive and developmental landscape of the global ocean goods trade.

3.0 RESEARCH METHODOLOGY

This section outlines the methodological framework employed to conduct the comparative analysis of ocean goods trade among the selected regional blocs. It details the research design, data sources, variable construction, and the specific analytical techniques used to ensure a robust and credible investigation.

3.1 Research Design

This study adopts a quantitative, longitudinal, and comparative research design. The quantitative approach facilitates the objective measurement and statistical comparison of trade

flows. The longitudinal dimension, covering the 12-year period from 2012 to 2023, allows for the analysis of trends, growth trajectories, and the impact of economic shocks over time. Finally, the comparative design is intrinsic to the study's objective, enabling a systematic evaluation of trade dynamics within and between the five regional blocs: BRICS, the European Union (EU), G-20, G-77, and the OECD.

3.2 Data Sources and Collection

The primary source of data for this study is the United Nations Conference on Trade and Development (UNCTAD). UNCTAD provides comprehensive and harmonized international trade statistics, which are widely regarded as a reliable source for cross-country and cross-bloc comparative analysis (Citaristi, 2022b).

- **Data Extraction:** Data on nominal export and import values for ocean goods trade were extracted for each bloc and for each year from 2012 to 2023. Likewise, the nominal CPI data was extracted but its data for 2023 was projected using a 3% growth rate.
- **Sectoral Classification:** The trade data was categorized into five distinct sectors, as defined by UNCTAD or the source's own classification:

1. Marine fisheries, aquaculture and hatcheries
2. Seafood processing
3. Sea minerals
4. Ships, port equipment and parts thereof
5. High-technology and other manufactures

- **Population Data:** To calculate per capita trade values, population data for each bloc for the corresponding years was sourced from the UNCTAD database, a standard source for demographic and macroeconomic data.

3.3 Variable Description and Measurement

The study operationalizes its analysis through the following key variables:

- **Dependent Variables:**
  - **Export/Import Performance:** Measured in millions of current US Dollars (nominal values) and constant US Dollars (real values).
  - **Trade Growth:** Calculated as the year-on-year percentage change (%) for total trade and for each sector.
  - **Sectoral Composition:** The proportion of each sector's value to the total ocean goods trade value for a given bloc and year.
  - **Trade per Capita:** Calculated as the total ocean goods trade value (exports + imports) divided by the total population of the bloc for that year. This is presented in nominal and real US Dollars.
- **Independent/Grouping Variable:**
  - **Regional Economic Bloc:** A categorical variable with five levels: BRICS, EU, G-20, G-77, and OECD.

3.4 Data Processing and Analysis

The collected data was processed and analyzed using a structured approach:

1. **Calculation of Real Values:** To account for inflation and allow for meaningful inter-temporal comparison, nominal values were converted to real values. The methodology note states that a Consumer Price Index (CPI) was used to deflate the nominal values for the entire period. This is a standard practice in economic analysis to isolate volume changes from price effects (Wooldridge, 2016). The formula for converting nominal to real values in a given year ‘t’ is:

$$RV = (CPI_{t-1}/CPI_t) * NV_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where,
RV = Real value; NV = Nominal value; CPI = Consumer price index; t = current period; t-1 = lagged period

2. **Descriptive Statistics:** Measures of central tendency (mean) were calculated for all trade values and growth rates over the study period for each bloc. This provides a summary overview of the scale and average performance of each bloc.
3. **Growth Rate Analysis:** Year-on-year growth rates were analyzed to identify periods of expansion, contraction, and recovery. Special attention was paid to pivotal years like 2015 (commodity slump) and the 2020-2021 period (COVID-19 pandemic) to assess economic resilience.
4. **Comparative Analysis:** This was the core of the analytical process, involving:
   - **Within-Bloc Analysis:** Examining the sectoral composition and growth trends for a single bloc over time to understand its internal economic structure and evolution.
   - **Between-Bloc Analysis:** Comparing the mean values, growth rates, and sectoral shares across blocs to identify patterns of comparative advantage, competitiveness, and developmental disparity.
   - **Per Capita Analysis:** Comparing the trade intensity per person across blocs to highlight differences in the depth of ocean economy integration and its potential for broad-based prosperity.
5. **Thematic Interpretation through Theoretical Lenses:** The empirical findings from the quantitative analysis were interpreted through the established theoretical framework (Comparative Advantage, Global Value Chains, Structural Transformation). This moved the analysis from mere description to explanation, linking the observed patterns to underlying economic theories.

3.5 Limitations of the Methodology

While rigorous, this methodology has certain limitations:

- **Projection for 2023:** The 2023 data of CPI is a projection based on a 3% growth rate. Actual 2023 data may differ due to unforeseen global economic conditions.
- **Aggregation Bias:** Analyzing data at the bloc level masks the significant heterogeneity among member countries. For instance, the performance of BRICS is heavily influenced by China, and the G-77 comprises countries at vastly different development stages.
- **Exclusion of G-7:** The non-availability of G-7 data from the source limits the scope of comparison with another major group of advanced economies.
- **Focus on Goods:** The study is limited to ocean *goods* trade and does not cover trade in maritime *services* (e.g., shipping, insurance, marine tourism), which constitutes a significant and growing part of the ocean economy.

Despite these limitations, the methodology provides a systematic, transparent, and robust framework for achieving the research objectives and delivering a comprehensive comparative assessment of ocean goods trade dynamics.

4.0 RESULTS AND DISCUSSION

The ocean economy, encompassing sectors from marine fisheries to high-technology shipbuilding, is a critical engine for global trade, economic development, and technological advancement. This paper provides a comprehensive analysis of the ocean goods trade for five major and competitive regional blocs—BRICS, the European Union (EU), G-20, G-77, and the OECD—over the period 2012-2023. Utilizing data sourced from UNCTAD and incorporating projections for 2023, this study examines both nominal and real trade values (exports and imports), their year-on-year growth trajectories, and per capita trade figures. The core objective

is to conduct a rigorous comparative assessment, elucidating the structural differences, competitive advantages, and vulnerabilities within and between these economic groupings.

The analysis is structured to first provide a macro-level overview of total trade trajectories, followed by a deep dive into sectoral compositions (Marine Fisheries, Seafood Processing, Sea Minerals, Ships & Port Equipment, and High-Technology manufactures). This is complemented by an examination of import patterns to understand demand dynamics and a per capita analysis to gauge the intensity of ocean trade relative to population size. Throughout, the discussion is interwoven with insights from previous scholarly work to contextualize the findings within the broader discourse on maritime economics, regional development, and global value chains.

4.1 Macro-Trends in Ocean Goods Exports: Divergent Paths and the COVID-19 Shock

The export data reveals starkly divergent trajectories and scales among the blocs (Figures 2). The G-20 and OECD consistently dominate in sheer volume, with mean annual nominal exports of $457.7 billion and $451.5 billion, respectively (Figures 2c & 2e, respectively), reflecting their entrenched position as the core of the global trading system (Owusu-Peprah, 2024; Wade, 2023). The EU follows as a heavyweight in its own right ($236.2 billion mean), while BRICS ($144.5 billion) and G-77 ($244.1 billion) show significant, yet more variable, export footprints (Figures 2b, 2a & 2d).

A critical observation is the differential impact of and recovery from global economic shocks. The year 2015 marked a significant downturn for most blocs, coinciding with the global commodity price crash and economic slowdown in emerging markets (IMF, 2016). The EU and OECD experienced severe contractions in export values (-10.7% and -8.0% nominal, respectively), more pronounced than the G-20 (-4.8%) and BRICS (-0.4%). This suggests a higher sensitivity of developed, diversified economies to global demand shocks in high-value ocean sectors at that time. Conversely, the more severe impact on the G-77 (-3.4%) highlights the vulnerability of developing economies to fluctuations in primary commodity markets.

The COVID-19 pandemic period (2020-2021) offers a fascinating case study. In 2020, while global trade contracted sharply (Chakraborty & Dey, 2024), the EU and OECD saw modest declines in their nominal export growth (-1.1% and -4.4%), while BRICS and G-20 experienced more significant drops (-1.1% and -3.6%). However, the rebound in 2021 was nothing short of dramatic, particularly for BRICS, which registered a staggering 29.4% growth in nominal exports, far outstripping the EU (15.2%), G-20 (18.9%), and OECD (14.7%). This V-shaped recovery in BRICS aligns with findings by Didier et al. (2021), who noted that many emerging economies rebounded faster in trade volumes due to a combination of fiscal stimulus, less stringent initial lockdowns, and strong demand for the primary and manufactured goods they produce. The G-77's impressive 20.2% growth further underscores this trend, indicating a resilient and rapidly expanding export capacity within the developing world.

When adjusted for inflation, these trends largely hold but with nuanced differences (Figure 3). The mean real export growth for BRICS (4.0%) remains robust, slightly outperforming the EU (3.9%) and significantly surpassing the OECD (2.2%). This indicates that the BRICS expansion is not merely a function of price inflation but represents a genuine increase in the volume and value of its ocean trade, a sign of deepening integration into global maritime value chains (UNCTAD, 2022).

4.2 Sectoral Composition and Revealed Comparative Advantage

Deconstructing the export data by sector reveals the underlying economic structures and "revealed comparative advantages" of each bloc, a concept pioneered by Balassa (1965).

4.2.1Ships, Port Equipment, and High-Technology Manufactures: The High-Value Arena

This sector cluster represents the technological frontier of the ocean economy. The EU (Figure 2b) and OECD (Figure 2e) demonstrate an overwhelming dominance here. The "ships, port equipment and parts thereof" category constitutes the largest share of exports for the OECD ($188.5 billion mean nominal) and is a massive component for the EU ($90.5 billion) and G-20 ($230.3 billion). This aligns with the historical expertise and industrial capacity of traditional shipbuilding nations in Europe and East Asia (Shi & Xue, 2025). The "High-technology and other manufactures" sector further cements this lead, with the EU ($104.1 billion) and OECD ($173.5 billion) leading the pack. This underscores their competitive edge in knowledge-intensive, high-margin maritime technologies, such as navigation systems, offshore engineering solutions, and specialized vessel components (Stopford, 2009).

In stark contrast, while BRICS has a substantial absolute value in ships and port equipment ($73.5 billion mean), its high-technology exports ($42.4 billion) are comparatively low (Figure 2a). This point to a specialization in more standardized, lower-technology segments of shipbuilding and repair. The growth data is telling: BRICS saw volatile, often negative, growth in ship exports pre-2021, followed by a massive 34.3% spike in 2021. This volatility suggests a less stable and mature industrial ecosystem compared to the steady, albeit slower, growth in the OECD and EU. The G-77's profile in this sector is even less pronounced, indicating a continued reliance on importing, rather than exporting, high-tech maritime equipment.

4.2.2. Marine Resources: Fisheries, Aquaculture, and Sea Minerals

The Marine fisheries, aquaculture and hatcheries sector reveals a different story. Here, the G-77 (Figure 2d) has the highest mean export value ($34.9 billion), followed by the EU ($22.6 billion) and BRICS ($17.2 billion) (Figures 2b & 2a respectively). This is a classic reflection of resource endowment, where many G-77 member states, particularly in Asia and Africa, possess rich fishing grounds and are major global suppliers of marine resources (Sharma *et al*., 2025). However, the value capture is often low without advanced processing capabilities.

This is where Seafood processing becomes critical. The EU leads in this value-added sector with a mean export value of $18.5 billion, significantly higher than the G-77's $16.6 billion, despite the G-77's larger raw material base. This indicates that the EU excels at importing raw or semi-processed seafood and re-exporting it as higher-value products, a pattern consistent with the findings of Jolliffe*et al*. (2021) on the globalization of seafood value chains. BRICS shows strong growth in this area (mean 5.9%), suggesting a strategic move up the value chain.

The Sea minerals sector, while the smallest in absolute terms, shows explosive growth potential. BRICS exhibited a meteoric 43.8% growth in nominal exports in 2022, and the G-77 also saw strong growth (24.9% in 2022). This likely reflects the early-stage development and scaling of offshore oil, gas, and mineral extraction activities in countries like Brazil, South Africa, and India (IRENA, 2021). The EU and OECD show more stable but modest growth, as their offshore sectors are more mature and face stricter environmental regulations.

4.3 Import Dynamics: Mapping Demand and Structural Deficits

Analyzing imports provides a mirror image of the export structure, revealing demand patterns and structural dependencies (Figures 4).

The EU stands out as the world's largest import market for ocean goods, with a mean nominal import value of $201.0 billion (Figure 4b). Its imports are diversified but heavily weighted towards High-technology and other manufactures ($82.1 billion mean) and Ships and port equipment ($66.0 billion). This reinforces its role as a high-tech hub that both consumes and adds value to sophisticated maritime equipment. The EU is also a massive importer

of Seafood ($17.7 billion), underlining its status as a high-consumption market that supplements domestic production with foreign supply to meet demand (EUMOFA, 2020).

The G-20 and OECD show similar import profiles (Figures 4b & 4e, respectively), characterized by high demand across all sectors, reflecting their large, diversified economies. The BRICS import profile, however, is highly instructive. Its imports are dominated by ships and port equipment ($31.2 billion mean) and high-technology manufactures ($33.1 billion) (Figure 4a). The growth rates in these categories are often dramatic, such as the 14.5% and 20.9% growth in 2021, respectively. This signifies a massive ongoing investment in maritime infrastructure and technological upgrading. BRICS is essentially importing the capital goods and technology needed to build and modernize its ocean economy—a pattern observed in rapidly industrializing nations (Kaplinsky & Morris, 2016).

The G-77's import structure is less skewed towards high-tech, with a more balanced distribution, including a significant share for Marine fisheries and Seafood (Figure 4d). This suggests a mix of consumption goods, inputs for re-processing, and essential equipment, reflecting the heterogeneous nature of the bloc itself.

4.4 Per Capita Trade: Intensity and Developmental Disparities

Trade per capita is a crucial metric that normalizes for population size, offering a perspective on the intensity of a bloc's engagement with the ocean economy and, by proxy, its potential for wealth generation from this sector (Figure 6).

The results are stark and reveal a profound developmental divide. The EU consistently has the highest ocean goods trade per capita, ranging from $451 to $661 in nominal terms over the period. This is more than ten times the per capita value of BRICS ($37-$58) and the G-77 ($34-$49). The OECD also maintains a high per capita level ($304-$378), comparable to the EU. This immense disparity underscores the findings of the Alii (2025) on the "blue wealth" gap, where advanced, often geographically smaller, economies with advanced maritime clusters generate far more economic value per person from the ocean than large, populous developing nations.

The data for BRICS and the G-77, while low on a per capita basis, shows a clear and steady upward trajectory in both nominal and real terms. For instance, BRICS' real per capita trade grew from $40.3 in 2012 to $55.3 in 2023—a significant 37% increase. This indicates that while the absolute disparity remains vast, the process of "catching up" is underway. The growth in per capita trade in these blocs is a positive indicator of their increasing integration into the global ocean economy and its potential to contribute to broader economic development goals, as highlighted in the UN's Sustainable Development Goal 14 (Chakraborty & Dey, 2024).

4.5 Comparative Assessment Within and Between Blocs

4.5.1 The EU vs. OECD: The Mature Titans

The EU and OECD (which has significant membership overlap with the EU) represent mature and high-income ocean economies. Their strengths are in high-value, technology-intensive sectors (ships, high-tech manufactures). They are characterized by stable but modest growth, high per capita trade, and a role as both leading consumers and innovators. The key difference lies in the EU's more pronounced profile in seafood processing, leveraging its single market and proximity to fishing grounds. Both blocs face challenges from aging fleets, high labor costs, and intense competition from East Asian shipbuilders, a trend documented by the Sharm *et al*. (2025).

4.5.2 BRICS: The Ascent of the Disruptor

BRICS is the most dynamic and rapidly evolving bloc in this analysis. Its trajectory is one of aggressive catch-up and scale. It possesses a strong resource base (marine fisheries, sea

minerals) but is rapidly building capacity in manufacturing (ships, seafood processing). Its most defining feature is its role as the world's foremost importer of maritime capital goods, fueling this expansion. This dual role—as a burgeoning exporter and a voracious importer of technology—epitomizes the middle-stage of maritime industrial development. However, its low per capita trade indicates that the benefits of this growth are spread thinly across its vast population, a common challenge in large emerging economies (Barreix & Velayos, 2021; Busso & Messina, 2020). Its volatility, as seen in the 2023 export contraction (-1.0%), also points to underlying vulnerabilities to global economic headwinds.

4.5.3 G-77: The Heterogeneous Giant with Untapped Potential

The G-77 presents a complex picture due to its vast size and diversity. As a whole, it is a major player, with export values sometimes rivaling the EU. Its comparative advantage remains firmly rooted in resource extraction (marine fisheries). However, the data shows promising signs of diversification and value addition, particularly in seafood processing and sea minerals. The primary challenge for the G-77, as a collective, is to overcome the "resource curse" in the ocean sector—transitioning from being mere suppliers of raw materials to developing domestic processing industries and maritime service sectors (Hoegh-Guldberg, 2015). The bloc's low and volatile growth in high-technology exports underscores this developmental hurdle.

4.5.4 G-20: The Macrocosm of the Global Ocean Economy

The G-20, encompassing both developed and major emerging economies, effectively serves as a barometer for the global ocean economy. Its trends are an aggregate of the forces described above: the stability of the developed world and the dynamism of the emerging markets. Its large size means it dominates global totals, but its internal composition is the very story of the shifting geography of maritime economic power.

5.0 CONCLUSION, RECOMMENDATIONS, AND POLICY IMPLICATIONS

5.1 Conclusion

This study has provided a comprehensive, data-driven portrait of the global ocean goods trade from 2012 to 2023, revealing an economic landscape characterized by both enduring hierarchies and dynamic rebalancing. The analysis conclusively demonstrates that the ocean economy is not a monolithic entity but a complex, multi-tiered system where regional blocs occupy distinct and evolving roles based on their factor endowments, technological capabilities, and developmental strategies.

The European Union (EU) and OECD blocs continue to function as the established anchors of the high-value, technology-intensive segments of the ocean economy. Their dominance in sectors like ships, port equipment, and high-technology manufactures is underpinned by deep-rooted capital, advanced innovation ecosystems, and a focus on knowledge-based production. However, their growth is mature and susceptible to global demand shocks, indicating a need for continuous innovation to maintain their competitive edge.

In contrast, BRICS has emerged as the primary disruptor and the most dynamic force in this arena. Its trajectory is marked by explosive growth, a strategic shift from raw material exports to manufacturing, and a massive import-driven campaign of maritime infrastructure and technological upgrading. BRICS represents the vanguard of a structural transformation within the global ocean economy, rapidly climbing the value chain but still characterized by volatility and a low per capita translation of its trade volume.

The G-77, while a significant player in absolute terms, remains the most reliant on primary resource extraction, as evidenced by its strength in marine fisheries. However, the data shows promising signs of initial diversification into processing, indicating the first steps toward value addition; though it continues to be constrained by the lowest per capita engagement globally.

The starkest finding across all blocs is the profound "blue wealth" gap, quantified by the order-of-magnitude difference in per capita ocean trade between the EU/OECD and the G-77/BRICS. This highlights that the benefits of the growing ocean economy are far from equitably distributed.

In essence, the global ocean economy is at a crossroads. The traditional centers of power retain their advantage in high-tech sectors, but the economic gravity is unquestionably shifting towards major emerging economies. The challenge for the future is to ensure that this growth is not only economically robust but also sustainable and inclusive, bridging the vast developmental disparities that this research has illuminated.

5.2 Recommendations

Based on the findings, the following targeted recommendations are proposed for the key stakeholders:

For the EU and OECD:

1. **Foster innovation leadership:** Double down on R&D in next-generation maritime technologies, such as green shipping, autonomous vessels, and advanced marine biotechnology, to secure their position in the high-end market.
2. **Invest in skills and digitalization:** Address potential skills gaps by investing in education and training for a digital and green ocean economy, ensuring the workforce can support a high-tech maritime cluster.
3. **Strengthen sustainable standards:** Leverage their market power to promote and globally harmonize high environmental and social standards for ocean-based production, creating a level playing field that rewards sustainability.

For BRICS:

1. **Strategic industrial policy:** Continue targeted policies to move from manufacturing to innovation, fostering domestic R&D and branding in maritime sectors to capture more value.
2. **Invest in human capital:** Accelerate investments in education and specialized skills development to support the technological sophistication of its ocean industries and reduce dependency on imported technology in the long run.
3. **Enhance supply chain resilience:** Diversify sources for critical imports and develop robust domestic supply chains to mitigate the vulnerabilities exposed by global shocks.

For the G-77:

1. **Prioritize value addition:** Implement policies that incentivize domestic processing of raw materials (e.g., fish processing, mineral beneficiation) to retain more economic value within member countries.
2. **Build maritime infrastructure:** Prioritize investments in port infrastructure, logistics, and connectivity to reduce trade costs and better integrate into global maritime networks.
3. **Strengthen governance and capacity:** Enhance regulatory frameworks, combat IUU (Illegal, Unreported, and Unregulated) fishing, and build institutional capacity to manage marine resources sustainably and attract responsible investment.

For International Organizations (e.g., UNCTAD, World Bank):

1. **Facilitate technology transfer:** Develop programs and financing mechanisms to support the transfer of sustainable maritime technologies from developed to developing countries.
2. **Promote bloc-cooperation:** Foster dialogue and joint initiatives between blocs on issues like sustainable fisheries management, marine pollution, and maritime security.

7.3. Policy Implications

The findings of this study carry significant implications for national and international policymaking:

- **Navigating the geopolitics of the ocean economy:** The rise of BRICS and the sustained power of the EU/OECD suggest a future of increased competition for marine resources, market share, and influence over ocean governance rules. Policymakers must develop sophisticated strategies to navigate this multi-polar ocean economic landscape, balancing competition with necessary cooperation on global commons issues like climate change and biodiversity loss.
- **Integrating economic and environmental policy:** The data on sectoral growth, particularly in sea minerals and shipping, underscores the urgent need to decouple ocean economic growth from environmental degradation. Policies must be designed to incentivize green shipping, sustainable aquaculture, and renewable offshore energy from the outset, ensuring the ocean economy's long-term viability. The EU's Green Deal, for instance, serves as a potential model for integrating sustainability into core maritime economic policy.
- **Addressing inequality through targeted interventions:** The stark per capita disparities are a clear call to action. Policies cannot focus solely on aggregate GDP growth from the ocean sector. They must be explicitly designed to ensure that benefits—in the form of jobs, revenues, and improved livelihoods—are widely shared. This includes supporting small-scale fishers, promoting community-based aquaculture, and ensuring that revenues from sea minerals are transparently managed and invested in public goods.
- **Building resilience through diversification:** The differential impact of economic shocks on various blocs highlights the importance of economic diversification. For resource-dependent G-77 countries, this means developing a broader portfolio of ocean industries. For all blocs, it means building resilient supply chains that can withstand future global disruptions.
- **The critical role of data and monitoring:** This study itself demonstrates the power of disaggregated, bloc-level trade data for informed decision-making. Policymakers should invest in robust national and international systems for monitoring the ocean economy to track progress, identify emerging trends, and evaluate the effectiveness of policies.

Succinctly, future research(s) should delve deeper into the sustainability metrics of this growth, examining the environmental footprint of these expanding ocean economies. Furthermore, a more granular, country-level analysis within these blocs, particularly BRICS and G-77, would uncover leading actors and success stories, providing more nuanced policy insights. The ocean economy remains a critical frontier for global development, and understanding the competitive dynamics illuminated by this data is essential for navigating its future.

In conclusion, the future of the global ocean economy will be shaped by the policies enacted today. By embracing a vision that strategically harnesses comparative advantages, actively promotes technological upgrading and value addition, and unequivocally commits to sustainability and equity, policymakers can ensure that the ocean's economic potential is realized for the benefit of all nations and future generations.

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Appendix

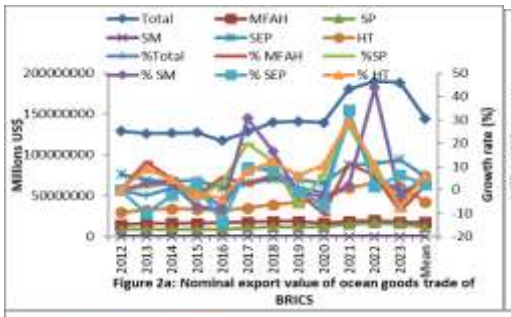


Figure 2a: Nominal export value of ocean goods trade of BRICS

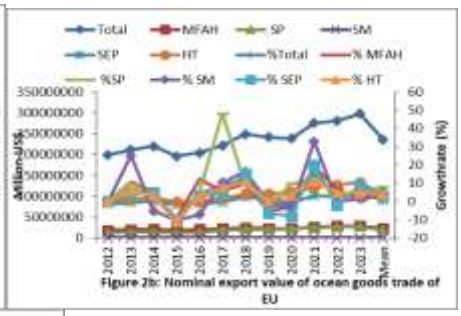


Figure 2b: Nominal export value of ocean goods trade of EU

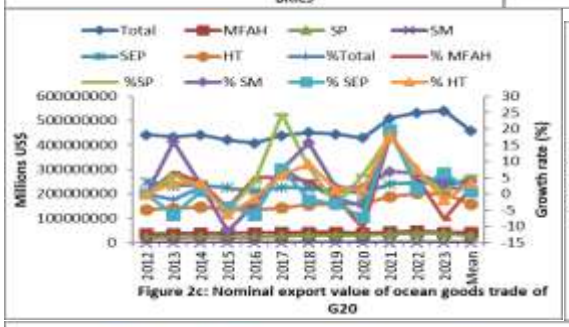


Figure 2c: Nominal export value of ocean goods trade of G20

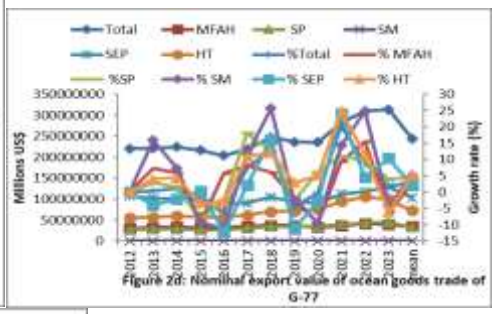


Figure 2d: Nominal export value of ocean goods trade of G-77

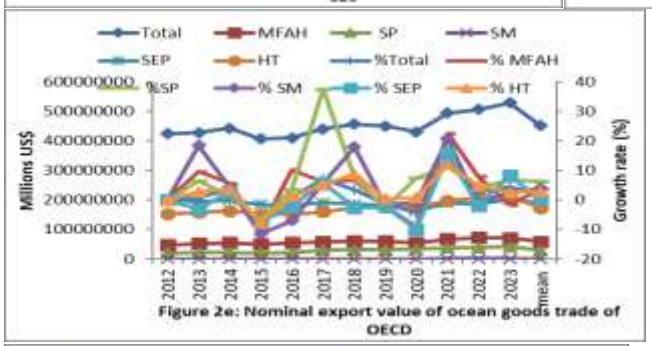


Figure 2e: Nominal export value of ocean goods trade of OECD

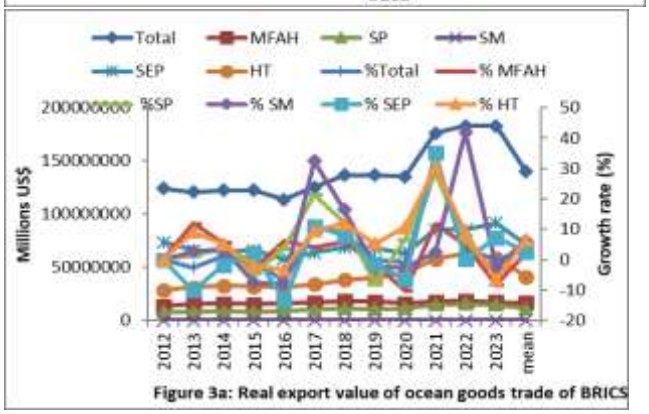


Figure 3a: Real export value of ocean goods trade of BRICS

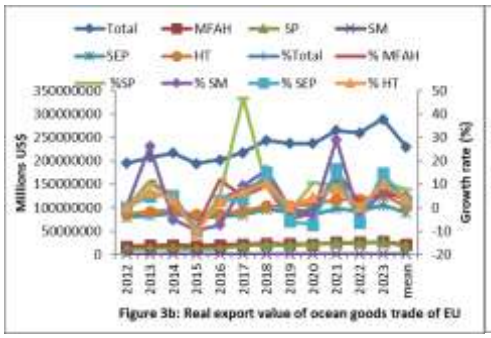


Figure 3b: Real export value of ocean goods trade of EU

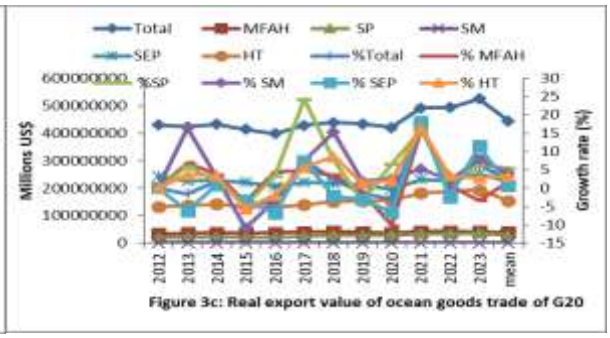


Figure 3c: Real export value of ocean goods trade of G20

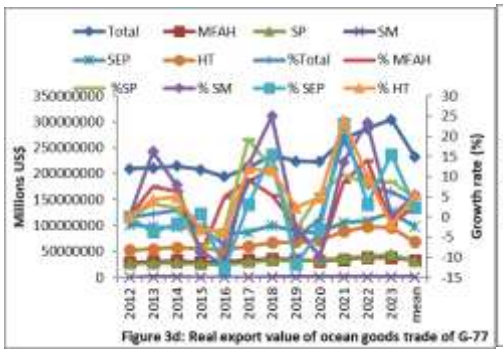


Figure 3d: Real export value of ocean goods trade of G-77

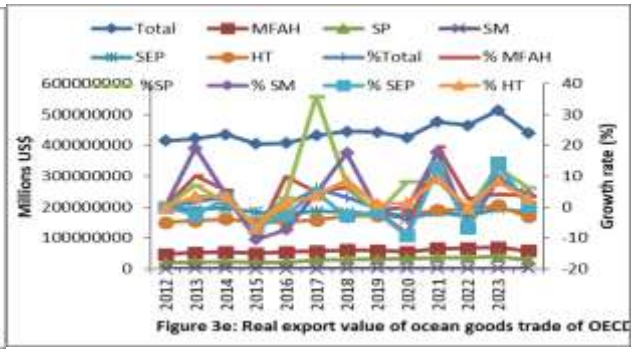


Figure 3e: Real export value of ocean goods trade of OECD

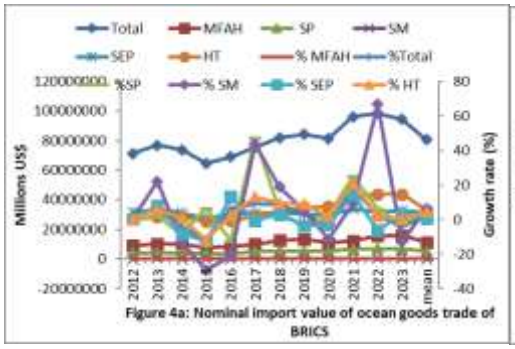


Figure 4a: Nominal import value of ocean goods trade of BRICS

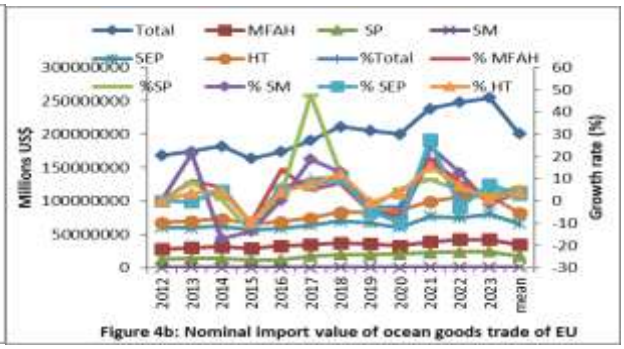


Figure 4b: Nominal import value of ocean goods trade of EU

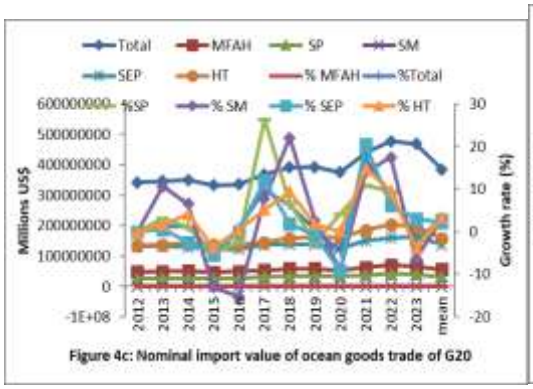


Figure 4c: Nominal import value of ocean goods trade of G20

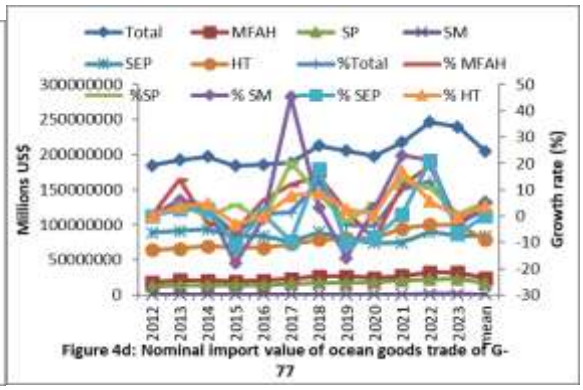


Figure 4d: Nominal import value of ocean goods trade of G-77

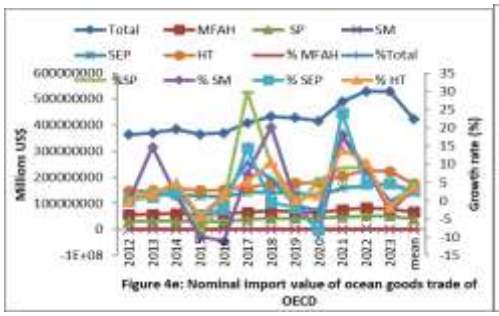


Figure 4e: Nominal import value of ocean goods trade of OECD

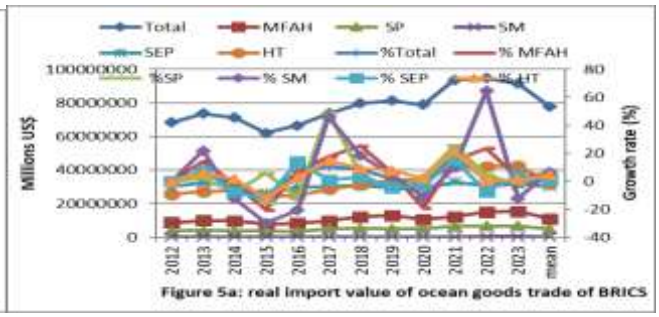


Figure 5a: real import value of ocean goods trade of BRICS

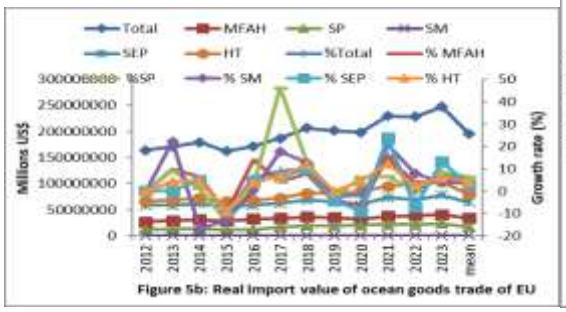


Figure 5b: Real import value of ocean goods trade of EU

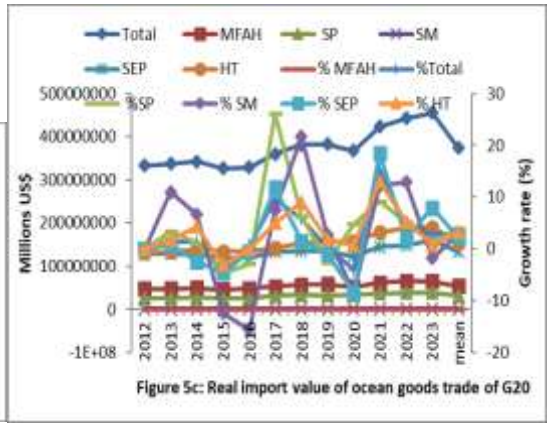


Figure 5c: Real import value of ocean goods trade of G20

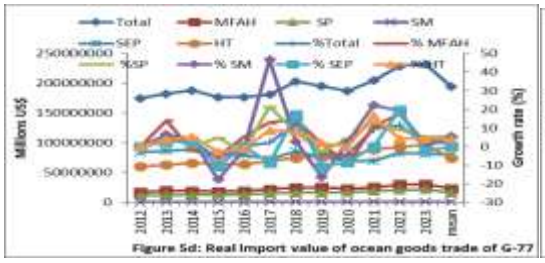


Figure 5d: Real import value of ocean goods trade of G-77

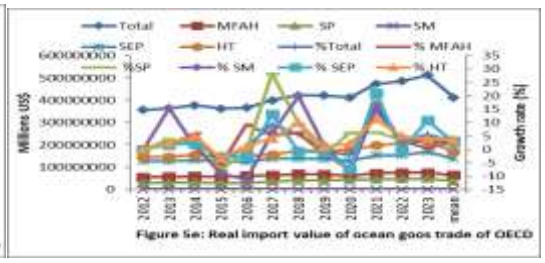


Figure 5e: Real import value of ocean goos trade of OECD

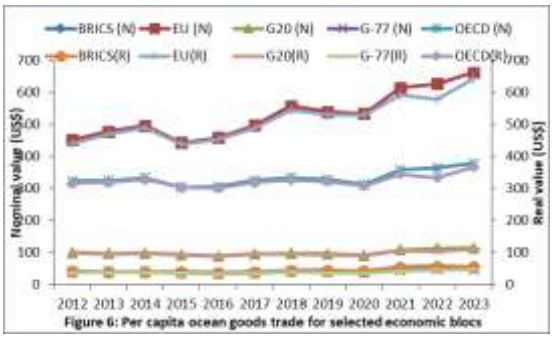


Figure 6: Per capita ocean goods trade for selected economic blocs

Note: MFAH = Marine fisheries, aquaculture and hatcheries; SP= Seafood processing; SM= Sea minerals; SEP = Ships, port equipment and parts thereof; HT = High-technology and other manufactures; N = Nominal price/value; R= Real price/value

ASEAN ÜLKELERİNDE AFET RİSK AZALTIMI VE DOĞAL AFETLER İLİŞKİSİ

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ÖZET

Günümüzde ülkelerin sosyo-ekonomik kalkınmasının artması, nüfus artışı ve hızlı kentleşme toplumların doğal afetlere karşı duyarlılığını arttırmıştır. Özellikle alt yapının zayıf, yoksul ve savunmasız nüfus tabanına sahip az gelişmiş ülkelerde doğal afetler nesiller boyu süren yıkıcı ve trajik durumlarla sonuçlanabilmektedir. Bu durum son on yıllarda afet risk azaltımı konusunu oldukça önemli hale getirmiştir. Afet risk azaltımı, Birleşmiş Milletler Afet Riskini Azaltma Ofisine (ISDR, 2009) göre, afet risklerinin azaltılması; tehlikelere maruz kalmanın azaltılması, insanların ve mülklerin kırılganlığının azaltılması, arazi ve çevrenin akılcı yönetimi ile olumsuz olaylara karşı hazırlıklı olma düzeyinin geliştirilmesi dâhil olmak üzere, afetlerin nedensel faktörlerini analiz etmeye ve yönetmeye yönelik sistematik çabalar yoluyla afet risklerini azaltma kavramı ve uygulamasıdır. Bu araştırma Güneydoğu Asya (ASEAN) grubu ülkelerde doğal afetler ve afet risk azaltımı ilişkisini incelemiştir. Bu amaçla araştırma ülkelerinin 2000-2023 arasını içeren dönemi panel veri analizi teknikleri kullanılarak analiz edilmiştir. Analizler çerçevesinde ısı (heatmap) korelasyon ve nedensellik analizleri kullanılarak doğal afetler ve afet risk azaltımı arasındaki ilişki sosyo-ekonomik göstergeler bağlamında ortaya konulmuştur.

Anahtar Kelimeler: Afet Risk Azaltımı, Sürdürülebilir Kalkınma, Doğal Afetler, ASEAN Ülkeleri.

DISASTER RISK REDUCTION AND NATURAL DISASTERS IN ASEAN COUNTRIES

ABSTRACT

Today, increased socio-economic development, population growth, and rapid urbanization have heightened societies' vulnerability to natural disasters. Particularly in underdeveloped countries with weak infrastructure and poor, defenseless populations, natural disasters can cause generations of devastating and tragic circumstances. “This situation has made disaster risk reduction a highly important issue in recent decades. According to the United Nations Office for Disaster Risk Reduction (ISDR, 2009), disaster risk reduction refers to the concept and practice

of reducing disaster risks through systematic efforts to analyse and manage the causal factors of disasters, including reduced exposure to hazards, decreased vulnerability of people and property, wise management of land and the environment, and improved preparedness for adverse events". This research examined the relationship between natural disasters and disaster risk reduction in Southeast Asian (ASEAN) group countries. This research examined the relationship between natural disasters and disaster risk reduction in Southeast Asian (ASEAN) group countries. For this purpose, the period between 2000 and 2023 of the research countries was analyzed using panel data analysis techniques. Within the framework of the analyses, the relationship between natural disasters and disaster risk reduction was revealed in the context of socio-economic indicators by using heatmap correlation and causality analyses.

Keywords: Disaster Risk Reduction, Sustainable Development, Natural Disasters, ASEAN Countries.

1. GİRİŞ

Volkanik patlamalar, depremler ve kasırgalar gibi insanların kontrol edemediği süreçler doğal nedenlerden kaynaklanan olaylar olarak tanımlanmaktadır (Shaluf, 2007). Bu süreçler, tarım, altyapı ve yerleşim yerleri gibi insan yapımı unsurlarla etkileşime girdiklerinde doğa kaynaklı afetleri meydana getirmektedirler (Chaudhary ve Piracha, 2021). Doğa kaynaklı afetler, can kaybına sebep olabilmekte, insanlara ve mallarına zarar verebilmekte ve günlük yaşamın alt üst olmasına neden olabilmektedirler (Caldera ve Wirasinghe, 2022). Doğal afetler dünyadaki ülkeler için önemli zorluklar oluştursa da Güneydoğu Asya ülkeleri, doğal afetlerin yönetiminde bazı belirgin zorluklar göstermektedir (Djalante ve Thomalla, 2012). Güney Asya, yaklaşık 1,8 milyar nüfusuyla dünyanın en kalabalık bölgelerinden biridir ve bu nüfusun %70'ten fazlası yoksulluk içinde yaşamaktadır. Bölge, su kaynakları, mineraller, ormanlar, verimli tarım arazileri ve çalışkan insan gücü gibi önemli doğal kaynaklara sahip olmasına rağmen, sık yaşanan doğal afetler nedeniyle gelişimini sürdürmekte zorlanmaktadır. Dünyadaki yoksul nüfusun üçte ikisinden fazlası Asya'da yaşamakta ve bunların neredeyse yarısı Güney Asya'da bulunmaktadır. Güney Asya, aynı zamanda doğal tehlikelere karşı oldukça savunmasızdır. Dünyada sel olaylarından en çok etkilenen bölge olan Güney Asya, siklonlara da sıkça maruz kalmaktadır. Her yıl sellerden etkilenen toplam nüfusun %64'ü bu bölgededir. Ayrıca, gelişmekte olan ülkeler arasında Güney Asya, siklonlara en fazla maruz kalan ikinci bölgedir. Bu durum, bölgenin ekonomik ve sosyal kalkınmasını önemli ölçüde engellemekte, yoksulluk ve savunmasızlık döngüsünü derinleştirmektedir (World Bank-GFDR, 2012). Güney Asya, çeşitli ve sık görülen doğal tehlikelerle karşı karşıyadır. Bu tehlikeler arasında sel, toprak kayması, kuraklık, kasırga

(siklon), deprem ve tsunami bulunmaktadır. Kuraklık, başta Afganistan, Hindistan ve Pakistan olmak üzere, Nepal ile Sri Lanka'nın bazı bölgelerini de düzenli olarak etkiler. Seller ise özellikle Bangladeş, Hindistan, Nepal, Pakistan ve Sri Lanka'da yıkıcı etkilere yol açar. Kasırgalar (siklonlar), Bangladeş, Hindistan ve Sri Lanka kıyılarını tehdit eder. Toprak kaymaları, Hindistan, Pakistan, Nepal, Bhutan ve Sri Lanka'nın dağlık alanlarında sıkça meydana gelmektedir. Ayrıca, Maldivler, Bangladeş ve Sri Lanka gibi ada ve alçak kıyı ülkeleri, kıyı erozyonu ve tuzlu su sızıntısı gibi yavaş gelişen ancak etkileri kalıcı olan tehditlerle mücadele etmektedir. Bu çok yönlü afet çeşitliliği, bölgenin kırılganlığını daha da artırmakta ve kalkınma çabalarını sekteye uğratmaktadır (Gamini, 2009). Bu araştırma ASEAN grubu beş ülke için (Endonezya, Malezya, Filipinler, Tayland ve Vietnam) afet risk azaltımı, doğal afetler ilişkisini sosyo-ekonomik göstergeler bağlamında incelemiştir. Araştırmada değişkenler arasındaki ilişki panel veri teknikleri kullanılarak analiz edilmiştir. Bu çerçevede doğal afetlerin, ekonomik büyümenin, kentleşmenin ve nüfus değişiminin bu ülkelerde uygulanan afet risk azaltımı politikaları ile olan korelasyon ve nedensellik ilişkisi ortaya konulmuştur.

2. LİTERATÜR

Güneydoğu Asya ülkeleri, hızlı sosyo-ekonomik dönüşümler yaşamakta; bu süreç, bölgedeki risk ve savunmasızlık düzeylerinin dinamik bir biçimde değişmesine neden olmaktadır. İklim değişikliği, artan nüfus yoğunluğu ve sosyo-ekonomik faaliyetlerin hassas alanlara doğru genişlemesi gibi antropojenik faktörler, mevcut tehlikeleri daha da şiddetlendirerek bir tehdit çarpanı işlevi görmektedir. Bu bağlamda afet risk azaltımı, olası tehlikeleri azaltmaya yönelik önlemler yoluyla afetlerin neden olduğu ekonomik ve çevresel boyuttaki olumsuz etkilerin hafifletilmesini amaçlamaktadır (Jayasinghe vd., 2024). Bu yaklaşım, afetlere müdahale odaklı uygulamalardan ziyade önleyici ve risk temelli politikaların geliştirilmesini esas almakta ve uluslararası düzeyde oluşturulan stratejik çerçevelerin temelini oluşturmaktadır. Güneydoğu Asya ülkelerindeki kurumlar, ulusal ve yerel düzeyde kapsamlı afet riski azaltma plan ve politikalarını yürütmekte; topluluk düzeyinde güçlü uygulamalar ile belirti sektörlerde yerelleştirme çabalarını hızlandırmaktadır. Ancak, bu çabaların iklim değişikliğinin tetiklediği ve afet savunmasızlığını derinleştiren sistemik risklerin ele alınmasıyla daha da güçlendirilmesi gerekmektedir. Güneydoğu Asya ülkelerinde doğal afetlerin giderek artan sıklığı ve şiddeti, afet yönetimi stratejilerinin etkinliğini acil bir endişe konusu haline getirmiştir. Bölgede etkin ve kapsamlı bir afet yönetimini engelleyen temel sorunlardan biri, sağlam afet hazırlık planlarının yaygın bir eksiklik olmasıdır (Heinkel vd., 2022).

Güneydoğu Asya, coğrafi konumu, iklim çeşitliliği, hızlı kentleşme ve sosyo-ekonomik dönüşümler nedeniyle dünyanın en fazla afete eğilimli bölgelerinden biridir. Sel, heyelan, tropik siklonlar, depremler ve kuraklık gibi doğal afetler, bölgedeki yaşamı, altyapıyı, ekonomiyi ve ekosistemleri derinden etkilemektedir. İklim değişikliği, bu afetlerin sıklığını ve şiddetini artırarak mevcut riskleri daha da karmaşık hale getirmektedir (UNDRR, 2024). Bölgedeki en sık görülen, en yıkıcı ve en yaygın doğal afet, hiç şüphesiz, seldir. Nepal ve Hindistan'daki Koshi Nehri'nin 2008 yılındaki taşkını ile Pakistan ve Hindistan'daki 2010 sel felaketleri bunun çarpıcı örneklerini oluşturur. Bu afetlerde binlerce kişi hayatını kaybetmiş, 3 milyondan fazla insan yerinden edilmiş ve milyarlarca dolar tutarında ekonomik zarar meydana gelmiştir. Bölgede sellerin başlıca nedeni, aşırı yağışlara bağlı nehir taşkınlarıdır. Bunun yanında, tsunami, siklon ve yüksek gelgit gibi olayların tetiklediği kıyı selleri de sahil şeridindeki alanlar için büyük bir tehdit oluşturur (Kafle, 2013).

Sel, bölgedeki doğal afetlerin yaklaşık %40'ını oluşturmakta ve milyonlarca insanın sağlığını, geçim kaynaklarını ve yaşam alanlarını tehdit etmektedir (Coker vd., 2011). Örneğin, 2011 yılında muson yağmurları ve tropik fırtınaların tetiklediği seller, yalnızca Tayland'da 5,3 milyon insanı etkilemiş ve bölge genelinde 1.300'den fazla can kaybına neden olmuştur (Bean, 2011). Bu felaketler, yalnızca anlık fiziksel yaralanma ve ölümlere değil, aynı zamanda bulaşıcı hastalıkların yayılması, ruh sağlığı sorunlarının artması, gıda güvensizliği ve sağlık altyapısına erişimin kesilmesi gibi uzun vadeli ve karmaşık halk sağlığı krizlerine yol açmaktadır (Acuin vd., 2011). Özellikle düşük gelirli topluluklar, yetersiz kaynaklar ve hazırlık kapasitesi eksikliği nedeniyle bu etkilere karşı daha savunmasız kalmaktadır (Haines vd., 2006). Bu nedenle, bölgedeki sel riskinin azaltılması, yalnızca mühendislik çözümlerini değil, aynı zamanda toplum temelli hazırlık, sağlam erken uyarı sistemleri, kurumlar arası koordinasyon ve iklim değişikliğine uyumu merkeze alan bütünleşik bir halk sağlığı yaklaşımını gerektirmektedir (Chang, 2011). Bu bağlamda, politika yapıcılar için en acil öncelik, sel öncesi risk azaltma ve toplumsal dirençlilik stratejilerine yatırım yapmak, sel sırasında etkin müdahale mekanizmalarını devreye almak ve sel sonrası uzun vadeli sağlık ve sosyal iyileşmeyi desteklemek olmalıdır.

Güneydoğu Asya ülkelerinde meydana gelen sel sıklığı ve şiddeti son yıllarda artmış, özellikle Tayland, Laos, Kamboçya, Vietnam, Filipinler ve Mekong Nehri çevresindeki bölgeleri etkileyen bir sorun haline gelmiştir (Torti, 2012). Küresel iklim değişikliğinin getirdiği etkiler gelişmekte olan bu ülkeleri, sellerin yanında şiddetli kuraklıklar ve fırtınalar nedeniyle meydana gelen kayıplarla da karşı karşıya bırakmaktadır (Dünya Bankası, 2013). Bu anlamda afet açısından en büyük riski taşıyan Güneydoğu Asya ülkesi; Filipinler'dir (Robielos vd., 2020).

Filipinler'de meteorolojik afetler, yıllık zararın %90'ını oluştururken nüfusun %74'ünü büyük risklerle karşı karşıya bırakmaktadır (Dünya Bankası, 2013). Bazı çalışmalar, Güneydoğu Asya ülkelerinde doğal afet yönetiminde karşılaşılan çok boyutlu zorlukları ortaya koymaktadır. Örneğin, Howe ve Bang (2017) çalışmasında, Filipinler hükümetinin 2008'deki Nargis Tayfunu ve 2013'teki Haiyan Tayfunu gibi büyük afetler sırasında, merkezi yönetişim sorunları ile etkin bir afet risk yönetimi arasında denge kurmakta zorlandığını belirtmiştir (Howe ve Bang, 2017). Bu bağlamda, 2008 yılında Myanmar'da meydana gelen Nargis Kasırgası, 138.000'den fazla insanın hayatını kaybetmesine neden olmuş ve ülke tarihinde yaşanan en yıkıcı doğal afet olarak kayıtlara geçmiştir (Fritz vd., 2009). 2013 yılında Filipinler'de meydana gelen Yolanda (Haiyan) Tayfunu, tarihte kaydedilen en güçlü tropikal siklonlardan biri olarak nitelendirilmiş ve 6.000'den fazla insanın hayatını kaybetmesine yol açmıştır (Lagmay vd., 2015). Benzer şekilde, 2010 yılında Endonezya'da meydana gelen Merapi Yanardağı Patlaması, 350'den fazla insanın hayatını kaybetmesine yol açmış; bununla birlikte bölgede ciddi sosyal ve ekonomik bozulmalara neden olmuştur (Mei vd., 2013). Güneydoğu Asya'nın afet odaklı tarihi incelendiğinde, yıkıcı etkiler yaratan ve büyük can ile mal kayıplarına yol açan çok sayıda afetin yaşandığı görülmektedir. Örneğin; Endonezya'nın Nias Bölgesi, 2004 yılında meydana gelen 9,0 büyüklüğündeki Hint Okyanusu Depremi ve bunu izleyen tsunami sonucunda 154 can kaybı ve 1.832 kayıp vakasıyla karşı karşıya kalmıştır. Bu tsunamiden yaklaşık üç ay sonra gerçekleşen 8,7 büyüklüğündeki Nias–Simeulue Depremi, 851 kişinin hayatını kaybetmesine ve 6.278 kişinin kayıp olarak kayıtlara geçmesine neden olmuştur (Shoji vd., 2020).

Dünya nüfusunun yaklaşık %25'ine ev sahipliği yapan Güneydoğu Asya ülkelerinde meydana gelen afetlerin büyüklüğü ve etkileri, toplumları hastalık ve ölüm açısından son derece savunmasız hale getirmektedir (Ofrin ve Salunke, 2006). Nitekim EM-DAT verileri incelendiğinde, 2024 yılında meydana gelen 393 afetin 167'sinin Asya ülkelerinde gerçekleştiği ve toplam 16.753 ölümün %58,6'sının bu bölgede meydana geldiği görülmektedir (Centre for Research on the Epidemiology of Disasters [CRED], 2025). Ancak bu verilere karşın, Güneydoğu Asya bölgesinde yer alan gelişmekte olan ülkeler üzerine yeterli sayıda kapsamlı çalışma bulunmadığından, doğa kaynaklı afetlerin yönetimine ilişkin endişeler halen devam etmektedir (Samad vd., 2025). Bu örnekler, Güneydoğu Asya ülkelerinde meydana gelen afetlerin yol açtığı kayıplar açısından çarpıcı olmakla birlikte, bölgede farklı tür ve ölçekte çok sayıda afetin yaşandığını da ortaya koymaktadır. Güneydoğu Asya ülkelerinde afet yönetimine ilişkin zorluklar bununla sınırlı değildir. Araştırmacılar, sorun alanlarını geniş bir yelpazede tanımlamaktadır. Bu zorluklar arasında; afet bilinci konusunda sınırlı kamu eğitimi, hasara karşı

savunmasız ve kötü tasarlanmış altyapı ile toplumun afetlere verdiği tepkileri şekillendiren kültürel etkenler öne çıkmaktadır (De Leon ve Pittock, 2017; Robielos vd., 2020). Tüm bu zorluklar, afet riskini azaltmak ve etkilerini hafifletmek için hükümetler, yerel yönetimler, sivil toplum ve diğer paydaşlar arasında koordineli ve bütünleşik bir eylem planı geliştirme gerekliliğine işaret etmektedir. Bu ihtiyaç, afet risk azaltımı (ARA) kavramının ortaya çıkmasına ve küresel düzeyde stratejik çerçeveler geliştirilmesine yol açmıştır. ARA, olası tehlikeleri azaltmak için alınan önlemlerle, afetlerin ekonomik ve çevresel olumsuz etkilerini hafifletmeyi amaçlamaktadır (Jayasinghe vd., 2024). Kavramın evrimi, uluslararası toplumun yaklaşımındaki değişimi yansıtan bir dizi önemli konferans ve belgeyle şekillenmiştir.

1990'larda iklim değişikliği kaygılarının artması, bu dönemin Uluslararası Doğal Afet Azaltma On Yılı (IDNDR) ilan edilmesine neden olmuş, ancak kapsamlı bir risk azaltım yaklaşımına duyulan ihtiyaç daha sonra anlaşılmıştır (Adnan ve Kreibich, 2016). Bu farkındalığın ardından, 1994'te Japonya'nın Yokohama kentinde düzenlenen Doğal Afetlerin Azaltılması Dünya Konferansı'nda, afet risklerinin azaltılmasına yönelik ilk kapsamlı rehber olan "Daha Güvenli Bir Dünya İçin Yokohama Stratejisi ve Eylem Planı" kabul edilmiştir (United Nations, 1994; Tozier de la Poterie ve Baudoin, 2015). Daha sistematik bir eylem ihtiyacı, 2005'te kabul edilen 2005-2015 Hyogo Eylem Çerçevesi (HFA) ile karşılanmaya çalışılmış ve bu çerçeve, "Ulusların ve Toplulukların Afetlere Dayanıklılığını Artırma" odağıyla savunmasız ülkeler için temel bir politika rehberi haline gelmiştir (UNISDR, 2005; Basabe, 2013). Hyogo Eylem Çerçevesi'ni takiben oluşturulan Sendai Afet Risklerini Azaltma Çerçevesi (SFDRR), afet risklerinin azaltılmasına yönelik küresel ölçekte bir kılavuz niteliği taşımaktadır (Kelman, 2015).

Ancak, Hyogo Çerçevesi kapsamında önemli ancak düzensiz ilerlemeler kaydedilmesi, daha etkili ve önleyici bir yaklaşıma duyulan ihtiyacı açıkça ortaya koymuştur (Wilkinson vd., 2017; Peters vd., 2019). Bu ihtiyaç, 2015'te düzenlenen Üçüncü Birleşmiş Milletler Dünya Afet Risklerini Azaltma Konferansı'nın temel çıktısı olan Sendai Afet Risklerini Azaltma Çerçevesi 2015–2030 (SFDRR) ile karşılanmıştır (UNDRR, 2015; Aitsi-Selmi vd., 2015). SFDRR, afet risklerinin önlenmesi ve azaltılmasına yönelik kapsamlı ve proaktif odak noktasıyla, küresel afet yönetimi paradigmasında yeni bir aşamayı temsil etmektedir. Çerçevenin, "2020 yılına kadar ulusal ve yerel afet risk azaltma stratejilerine sahip ülkelerin sayısını önemli ölçüde artırmak" şeklindeki hedefi, hem afet risk azaltımını hem de Sürdürülebilir Kalkınma Hedefleri'nin (SKH) gerçekleştirilmesini doğrudan desteklemektedir (UNDRR, 2015; Peters vd., 2019). Bu küresel çabalar, ASEAN gibi bölgesel kuruluşların ASEAN Afet Yönetimi ve Acil Durum Müdahale Anlaşması (AADMER) gibi mekanizmalarla işbirliğini güçlendirme çabalarına da zemin

hazırlamıştır. Bu veriler, Güneydoğu Asya'da doğal afet yönetiminin çok boyutlu ve karmaşık bir sorun alanı olduğu görüşünü desteklemektedir. İklim değişikliğinin etkilerinin derinleşmesi, kurumsal kapasite yetersizlikleri ve hızlı kentleşme baskıları bölgenin afetlere karşı dayanıklılığını ciddi ölçüde zayıflatmaktadır. Bu bağlamda, bölgeye özgü stratejilerin geliştirilmesi ve uygulanması kritik önem taşımaktadır.

3. ANALİZ BULGULARI

Bu araştırma ASEAN grubu beş ülke için (Endonezya, Malezya, Filipinler, Tayland ve Vietnam) afet risk azaltımı, doğal afetler ilişkisini sosyo-ekonomik göstergeler bağlamında ele almıştır. Bu amaçla değişkenlerin 2000-2023 arasını kapsayan dönemi arasındaki panel veri teknikleri kullanılarak incelenmiştir. Tablo 1'de araştırma değişkenleri tanıtılmıştır.

Tablo 1. Araştırma Değişkenleri

Değişken	Açıklama	Türü	Veri Kaynağı
LnWRISK	Ülkelerin dünya risk endeksi	Doğal logaritması alınmıştır.	Bündnis Entwicklung Hilft ve Institute for International Law of Peace and Armed Conflict (IFHV), Ruhr University Bochum
LnGDP	Kişi başına düşen reel GSYH (ABD Doları)	Doğal logaritması alınmıştır.	WDI
LnDISASTER	Doğal afetlerden etkilenen nüfus	Doğal logaritması alınmıştır.	Our world in Data
URB	Kentleşme	Kent nüfusunun toplam nüfusa oranı alınmıştır.	WDI
POP	Nüfus	Büyüme hızı alınmıştır.	WDI

Tablo 2'de araştırma serilerine ilişkin tanımlayıcı istatistikler sunulmuştur. LnWRISK serisinin ortalama değeri 3.301, maksimum ve minimum değerleri 3.859 ve 2.507 olarak hesaplanmıştır. LnGDP ve LnDISASTER serilerinin ortalama değerleri 8.193 ve 13.457, maksimum değerleri 9.345 ve 17.060, minimum değerleri ise 7.100 ve 7.272 olarak bulunmuştur. URB ve POP serilerinin ortalama değeri 48.543 ve 1.276, maksimum değerleri 76.443 ve 2.418, minimum değerleri 24.367 ve -0.045'dir.

Tablo 2. Tanımlayıcı İstatistikler

	LnWRISK	LnGDP	LnDISASTER	URB	POP
Ortalama	3.301	8.193	13.457	48.543	1.276
Ortanca	3.261	8.134	13.623	47.001	1.236
Max.	3.859	9.345	17.060	76.443	2.418
Min.	2.507	7.100	7.272	24.367	-0.045
Std. Sapma	0.432	0.564	2.199	13.898	0.554
Skewness	-0.249	0.300	-0.666	0.324	0.119
Kurtosis	1.849	2.198	2.843	2.293	2.663
Jarque-Bera	7.663	4.893	8.786	4.478	0.828
Prob.	0.021	0.086	0.012	0.106	0.660
Gözlem	117	117	117	117	117

Tablo 3'de verildiği üzere araştırma serilerinin durağanlığı yatay kesit bağımlılığı ve yapısal kırılmaların varlığında sağlam sonuçlar üreten Karavias-Tzavalis (2014) panel birim kök testi kullanılarak incelenmiştir. Analiz sonuçları bütün serilerin düzeyde durağan olduğunu göstermiştir.

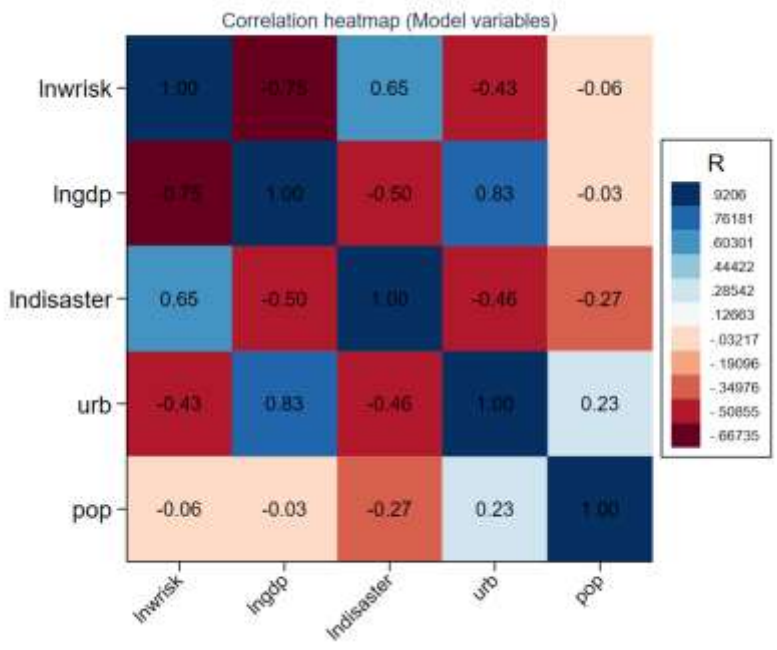
Tablo 3. Karavias-Tzavalis (2014) Birim Kök Analizi

	İstatistik	Bootstrap Kritik Değeri	Prob.	Kırılma Tarihi
LnWRISK	-6.597	3.531	0.000***	2001
LnGDP	-13.444	8.767	0.000***	2022
LnDISASTER	-12.284	-2.6601	0.000***	2022
URB	-12.729	7.738	0.000***	2022
POP	-10.628	4.856	0.000***	2001

***, ** ve * p≤0.01, p≤0.05 ve p≤0.10 düzeyinde anlamlılığı temsil etmektedir.

Araştırma çerçevesinde değişkenler arasındaki ilişki ilk olarak korelasyon heatmap analizleri kullanılarak incelenmiştir. Şekil 1'de gösterilen analiz sonuçları araştırma ülkeleri için afet risk azaltımı ile doğal afetler arasında pozitif bir korelasyon olduğunu göstermiştir. Buna karşılık afet risk azaltımı ile ekonomik büyüme, kentleşme ve nüfus değişkenleri arasında negatif bir korelasyon vardır.

Şekil 1. Korelasyon Heatmap Analizi



Araştırmanın sonraki aşamasında değişkenler arasındaki nedensellik ilişkisi Dumitrescu-Hurlin (2012) tarafından önerilen Granger temelli nedensellik testi kullanılarak incelenmiştir. Analiz sonuçları Tablo 4'de sunulmuştur. Buna göre afet risk azaltımı ile doğal afetler arasında herhangi

bir nedensellik gözlenmezken, afet risk azaltımından ekonomik büyümeye, nüfus ve kentleşmeye doğru tek yönlü Granger nedensellik olduğu tespit edilmiştir. Sonuçlar doğal afetler ile ekonomik büyüme ve nüfus arasında istatistiki açıdan önemli herhangi bir nedensellik olmadığını göstermiştir. Buna karşın kentleşme ile doğal afetler ve nüfus arasında çift yönlü Granger nedensellik vardır. Analiz sonuçları ekonomik büyüme ile kentleşme arasında çift yönlü, ekonomik büyümeden nüfusa doğru tek yönlü Granger nedensellik olduğuna işaret etmektedir.

Tablo 4. Dumitrescu-Hurlin (2012) Granger Nedensellik Analizi

Boş Hipotez	W-İstatistik	Zbar-İstatistik	Prob.
LNGDP ≠> LNWRISK	3.613	0.072	0.942
LNWRISK≠> LNGDP	9.335	3.727	0.000***
LNDISASTER≠> LNWRISK	1.818	-1.070	0.284
LNWRISK≠> LNDISASTER	2.160	-0.856	0.391
URB≠> LNWRISK	5.138	1.046	0.295
LNWRISK ≠> URB	8.200	3.002	0.002***
POP ≠> LNWRISK	2.576	-0.589	0.555
LNWRISK≠> POP	6.248	1.756	0.079*
LNDISASTER≠> LNGDP	2.551	-0.611	0.540
LNGDP≠> LNDISASTER	1.325	-1.378	0.167
URB≠> LNGDP	7.579	2.606	0.009**
LNGDP ≠> URB	7.187	2.355	0.018**
POP ≠> LNGDP	2.229	-0.811	0.416
LNGDP ≠> POP	8.682	3.311	0.000***
URB ≠> LNDISASTER	6.192	1.667	0.095*
LNDISASTER ≠> URB	6.726	2.001	0.045**
POP ≠> LNDISASTER	3.337	-0.119	0.904
LNDISASTER≠> POP	3.080	-0.281	0.778
POP≠> URB	10.994	4.788	0.000***
URB≠> POP	14.991	7.341	0.000***

***, ** ve * p≤0.01, p≤0.05 ve p≤0.10 düzeyinde anlamlılığı temsil etmektedir.

SONUÇ

Bu araştırma ASEAN grubu üyesi olan Endonezya, Malezya, Filipinler, Tayland ve Vietnam için doğal afetler ve afet risk azaltımı ilişkisini sosyo ekonomik göstergeler bağlamında incelemiştir. Küresel düzeyde doğal afetlerin artan sıklığı toplumların geleceğini tehdit etmektedir. Özellikle ASEAN bölgesinde yer alan Endonezya ve Filipinler doğal afetler açısından dünyanın en riskli ülkeleri arasında yer almaktadır. Uygulanan korelasyon analizlerinin sonuçları araştırma ülkeleri için afet risk azaltımı ile doğal afetler arasında pozitif bir korelasyon olduğunu göstermiştir. Buna karşılık afet risk azaltımı ile ekonomik büyüme, kentleşme ve nüfus değişkenleri arasında negatif bir korelasyon olduğu tespit edilmiştir. Nedensellik analizi sonuçları afet risk azaltımı ile doğal afetler arasında istatistiki açıdan herhangi bir nedensellik olmadığını, afet risk azaltımından ise ekonomik büyümeye, nüfus ve kentleşmeye doğru tek yönlü Granger nedensellik olduğunu göstermiştir. Sonuçlara göre doğal afetler ile ekonomik büyüme ve nüfus arasında istatistiki açıdan önemli herhangi bir nedensellik yoktur. Buna karşın kentleşme ile doğal afetler ve nüfus arasında çift yönlü Granger nedensellik tespit edilmiştir. Analiz sonuçları ekonomik büyüme ile

kentleşme arasında çift yönlü, ekonomik büyümeden nüfusa doğru tek yönlü Granger nedensellik olduğuna işaret etmektedir.

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G20 ÜLKELERİNDE DİJİTALLEŞME VE CİNSİYETE DAYALI ÜCRET EŞİTSİZLİĞİ İLİŞKİSİ

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ÖZET

Cinsiyete dayalı eşitsizlikler günümüzün en başta gelen küresel sorunlarından birisidir. Nitekim Birleşmiş Milletler (BM) 2030 Sürdürülebilir Kalkınma Hedefleri (SDG) kapsamında başarmayı amaçladığı 17 küresel hedeften birisi kadınlara ve kız çocuklarına yönelik her türlü ayrımcılığa sona erdirmektir. Ülkelerin farklılaşan kalkınma düzeyleri, geleneksel normlar, kültürel faktörler vd. cinsiyete dayalı eşitsizlikleri etkileyen temel faktörler arasında gösterilebilir. Diğer taraftan bilgi ve iletişim teknolojilerinin yaygınlaşması, otomasyonun ilerlemesi ve ekonomilerin dijital dönüşümü cinsiyete dayalı eşitsizliklerin azaltılması ve ülkelerin sürdürülebilir kalkınma hedeflerinin desteklenmesinde kritik bir rol üstlenebilir. Bu araştırma dünyanın en büyük yirmi ekonomisinde (G20) dijitalleşmenin cinsiyete dayalı ücret eşitsizlikler ile olan ilişkisini ele almıştır. Bu amaçla G20 ülkelerinin 1995-2023 arasını kapsayan dönemi panel veri analizi teknikleri kullanılarak incelenmiştir. Araştırmada dijitalleşmeyi temsilen Dijitalleşme endeksi (DIGII) kullanılmıştır. DIGII'nin cinsiyete dayalı ücret eşitsizlikleri ile olan ilişkisi heatmap korelasyon ve Dumitrescu-Hurlin (2012) tarafından önerilen Granger tabanlı nedensellik testi kullanılarak analiz edilmiştir. Araştırma sonuçları araştırmacılar, piyasa katılımcıları ve politika yapıcılar açısından önemli çıkarımlarda bulunmaktadır.

Anahtar Kelimeler: Cinsiyete Dayalı Ücret Eşitsizlikleri, Dijitalleşme, Sürdürülebilir Kalkınma, G20 Ülkeleri, Panel Veri Analizi.

THE RELATIONSHIP BETWEEN DIGITALIZATION AND GENDER-BASED WAGE INEQUALITY IN G20 COUNTRIES

ABSTRACT

Gender-based inequality is one of the leading global problems of our time. As a matter of fact, one of the 17 global goals that the United Nations (UN) aims to achieve within the scope of the 2030 Sustainable Development Goals (SDGs) is to end all forms of discrimination against women and girls. Different development levels of countries, traditional norms, cultural factors, etc. can be shown among the main factors affecting gender-based inequalities. On the other hand, the spread of information and communication technologies, the advancement of automation and the digital transformation of economies can play a critical role in reducing gender-based inequalities and supporting the sustainable development goals of countries. This research

examined the relationship between digitalization and gender wage inequalities in the world's twenty largest economies (G20). For this purpose, the period of G20 countries covering the period between 1995 and 2023 was examined using panel data analysis techniques. The association of DIGII with gender pay inequalities was analyzed using heatmap correlation and the Granger-based causality test proposed by Dumitrescu-Hurlin (2012). The research results have important implications for researchers, market participants, and policymakers.

Keywords: Gender Pay Inequalities, Digitalization, Sustainable Development, G20 Countries, Panel Data Analysis.

1.GİRİŞ

Cinsiyete dayalı eşitsizlikler günümüzün en başta gelen küresel sorunlarından birisidir. Nitekim Birleşmiş Milletler (BM) 2030 Sürdürülebilir Kalkınma Hedefleri (SDG) kapsamında başarmayı amaçladığı 17 küresel hedeften birisi kadınlara ve kız çocuklarına yönelik her türlü ayrımcılığa sona erdirmektir. Ülkelerin farklılaşan kalkınma düzeyleri, geleneksel normlar, kültürel faktörler vd. cinsiyete dayalı eşitsizlikleri etkileyen temel faktörler arasında gösterilebilir. Diğer taraftan bilgi ve iletişim teknolojilerinin yaygınlaşması, otomasyonun ilerlemesi ve ekonomilerin dijital dönüşümü cinsiyete dayalı eşitsizliklerin azaltılması ve ülkelerin sürdürülebilir kalkınma hedeflerinin desteklenmesinde kritik bir rol üstlenebilir. Bu araştırma dünyanın en büyük yirmi ekonomisinde (G20) dijitalleşmenin cinsiyete dayalı ücret eşitsizlikler ile olan ilişkisini ele almıştır.

Prendes-Espinosa vd (2020), dört Avrupa ülkesi cinsiyet farklılığını dijital okuryazarlık gelişimindeki cinsiyete dayalı eşitsizlikleri regresyon ve ayrıştırma yöntemlerini kullanarak inceledikleri çalışmalarında dijital okuryazarlık gelişimini etkileyen faktörlerin, cinsiyet farklılığına katkıda bulunan faktörlerden farklı olduğu bulgusuna ulaşılmıştır. Macaya vd (2021), Brezilya 2019 yılı için internet kullanıcılarının e-devlet hizmetlerini kullanımında cinsiyete dayalı farklılıkları bilişim teknolojileri hane halkları anketinden elde edilen verilerle incelemişlerdir. Elde edilen sonuçlarda erkek ve kadınların internete eşit oranlarda erişmesine rağmen, e-devlet hizmeti kullanımında cinsiyet farkı olduğu ve cinsiyete dayalı sosyo-kültürel normların dijital uçurumu nasıl etkilediği yönde bulgulara ulaşılmıştır. Reynolds (2023),114 ekonomi için yeni bir fintech veri seti kullanılarak yapılan çalışmada fintech'in benimsenmesinin kadın istihdamını iyileştirdiği ve cinsiyet eşitsizliğini azalttığı yönde kanıtlar elde edilmiştir. Yin vd (2023), G20 ülkeleri 2006-2021 dönemi için dijitalleşmenin işgücüne katılım oranındaki cinsiyet farkı üzerindeki doğrudan ve düzenleyici etkisini panel verileri ile analiz etmişlerdir. Araştırmada, artan dijitalleşme düzeyinin işgücüne katılım oranındaki cinsiyet farkını daraltıcı

etkinin yüksek gelirli ülkelerde üst orta ve alt orta gelirli ülkelere göre daha büyük olduğu sonucuna ulaşılmıştır. Shah ve Krishnan (2024), 86 ülke 2013-2016 dönemi için BİT, cinsiyet eşitsizliği ve gelir eşitsizliği arasındaki ilişkiyi panel veri analizini kullanarak inceledikleri çalışmalarında, Ayrıca, zaman içinde BİT, cinsiyet eşitliği ve gelir eşitsizliği arasındaki bağlantıları daha iyi anlamak için çapraz gecikmeli alana metodolojik katkılarda bulunuyoruz. Bulgular, BİT'in toplumsal cinsiyet eşitsizliğini azaltmaya yardımcı olabileceği ve cinsiyet eşitsizliğinin de gelir eşitsizliğini azaltmaya yardımcı olabileceği yönde kanıtlar sunmaktadır. Brice (2024), 95 gelişmekte olan ülke 2000-2021 dönemi için Bilgi ve İletişim Teknolojilerinin (BİT) istihdam ve cinsiyet farklılıkları üzerindeki etkisini inceledikleri çalışmada kısa vadede BİT'ler her iki cinsiyet için de istihdamı teşvik ediyor olmasına rağmen, uzun vadede kadınların yoğun çalıştığı sektörlerde iş kaybına yol açabileceği bulgusuna ulaşılmıştır. Asongu ve Somé (2024), 48 Afrika ülkesi 1996-2021 dönemi için Afrika ticaretinin kadın işgücüne katılımında yönetişim ve bilgi teknolojisinin etkisini önemini Bernoulli yarı maksimum ve sabit etkili regresyonlarla incelemişlerdir. Araştırmada, bilgi teknolojisi, kadın işgücüne katılımında Afrika içi ticareti önemli ölçüde düzenlenmediği bulgusuna ulaşılmıştır. Yang vd (2024), Latin Amerika ülkeleri için dijitalleşmenin COVID-19 krizi sürecinde istihdam ve iş kaybında cinsiyet eşitsizliklerini nasıl etkilediğini incelemişlerdir. Çalışmada, daha yüksek dijitalleşmenin kadın istihdamında artış yaratarak erkekler ve kadınlarda iş kaybında azalttığı bulgusuna ulaşılmıştır. Sun ve Lu (2025), 104 ülke 2014-2022 dönemi için cep telefonu erişiminin ekonomik cinsiyet eşitsizliği üzerindeki çoklu uluslararası veri setleri kullanarak panel veri analizi inceledikleri çalışmada, muhafazakâr ülkelerde cep telefonu penetrasyonunun ekonomik cinsiyet eşitsizliğini azaltırken liberal ülkelerde ise cep telefonu penetrasyonu ekonomik cinsiyet uçurumunu genişlettiği tespit edilmiştir. Singh vd (2025), 2011-2025 dönemi cinsiyet uçurumuna ilişkin mevcut literatürü sistematik olarak gözden geçirmeyi ve kadınların dijital kapsayıcılığa ulaşmada karşılaştıkları engelleri Scopus tabanından alınan verileri bibliyometrik analizler gerçekleştirmiştir. Bulgular, ekonomik kısıtlamaların erişim düzeyinde birincil engel olduğunu, dijital okuryazarlık ve beceri eksikliğinin ise kullanım düzeyinde kritik zorluk yarattığını göstermektedir. Ayrıca, sosyo-kültürel engellerin kadınların dijital teknolojinin potansiyelinden yararlanmalarını engellediği dahası Afrika ve Asya bölgelerindeki kadınlar çoğunlukla erişim ve sonuç düzeylerinde dijital uçurumla karşı karşıya kalırken, Batılı kadınlar daha çok sonuç düzeyindeki uçuruma maruz kaldığı tespit edilmiştir. Rivera-Lozada vd (2025), Sistematik bir literatür taramasına dayalı 2010 ile 2024 yılları arasında Scopus, Web of Science, EBSCO ve Sage Journals nitel ve belgesel bir yaklaşım incelenmişlerdir. Sonuçlar kadınların dijital

kapsama alanında kültürel kısıtlamalar, ekonomik eşitsizlik, dijital beceri eksikliği ve zaman darlığı gibi birçok engelle karşılaştığı gelişmekte olan ülkelerde cinsiyet dijital uçurumu, internete ve BİT'lere erişimdeki boşlukların daha geniş sosyal ve yapısal eşitsizliklerin daha fazla belirgin olduğuna dair kanıtlara ulaşılmıştır.

2.ANALİZ BULGULARI

Bu araştırma dünyanın en büyük yirmi ekonomisinde (G20) dijitalleşmenin cinsiyete dayalı ücret eşitsizlikler ile olan ilişkisini ele almıştır. Bu amaçla G20 ülkelerinin 1995-2023 arasını kapsayan dönemi panel veri analizi teknikleri kullanılarak incelenmiştir. Araştırma değişkenlerine ilişkin bilgiler Tablo 1'de sunulmuştur.

Tablo 1. Araştırma Değişkenleri

Değişken	Açıklama	Türü	Veri Kaynağı
GENINEQ	Kadınların işgücü gelir payı	Kadınların toplam emek gelirinden aldığı pay (P0-100)	WIID
LnGDP	Kişi başına düşen reel GSYH (ABD Doları)	Doğal logaritması alınmıştır.	WDI
INDIV	İnternet kullanan birey sayısı	Toplam nüfusun yüzdesi alınmıştır.	WDI
LNURB	Kentleşme (toplam nüfusunun yüzdesi alınmıştır).	Doğal logaritması alınmıştır.	WDI
POP	Nüfus	Büyüme hızı alınmıştır.	WDI

Tablo 2'de ise serilere ilişkin tanımlayıcı istatistikler gösterilmiştir. Kadınların toplam emek gelirlerinden aldığı payı gösteren GENIQ serisinin ortalama değeri G20 ülkeleri için 0.32 (%32) olarak hesaplanmıştır. Bu bakımdan istatistikler G20 ülkelerinin cinsiyete dayalı eşitsizliklerin azaltılması ve kadınların ekonomik yaşama entegrasyonu konusunda arzu edinilen seviyede olmadığını göstermektedir. Bu serinin maksimum değeri 0.425, minimum değeri ise 0.123 olarak bulunmuştur. Dijitalleşmeyi temsil eden INDIV serisinin ortalaması 44.559'dür (%44). Bu ülkelerde maksimum dijitalleşme oranı %100 iken, minimum ise %0.004 olarak hesaplanmıştır. Araştırma veri seti 484 gözlemden oluşmuştur (T=29, N=19).

Tablo 2. Tanımlayıcı İstatistikler

	GENIQ	LNGDP	INDIV	POP	LNURB
Ortalama	0.322	9.561	44.559	0.789	4.246
Ortanca	0.343	9.546	46.375	0.826	4.363
Max.	0.425	11.045	100.000	4.833	4.522
Min.	0.123	6.430	0.0049	-2.464	3.279
Std. Sapma	0.065	1.124	32.849	0.619	0.285
Skewness	-0.942	-0.704	0.002	-0.005	-1.838
Kurtosis	3.223	2.636	1.484	7.638	5.673
Jarque-Bera	72.630	42.723	46.288	433.922	416.792

Prob.	0.000	0.000	0.000	0.000	0.000
Gözlem	484	484	484	484	484

Değişkenlerinin durağanlığı yatay kesit bağımlılığı ve yapısal kırılmaların varlığında güvenilir sonuçlar veren Karavias-Tzavalis (2014) panel birim kök testi kullanılarak incelenmiştir. Test sonuçları Tablo 3'de sunulmuştur. Karavias-Tzavalis (2014) testi sonuçları bütün serilerin düzeyde durağan olduğunu göstermiştir.

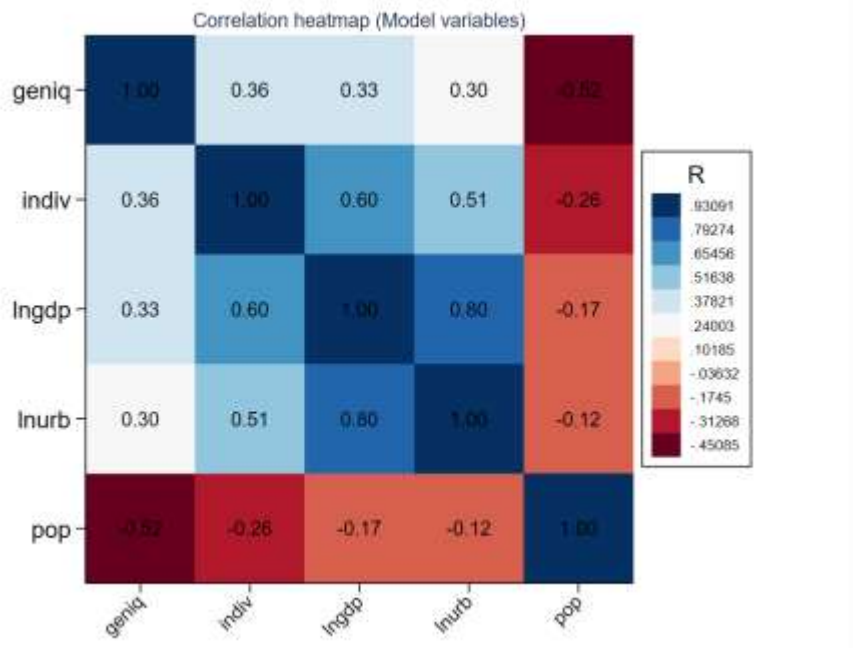
Tablo 3. Karavias-Tzavalis (2014) Birim Kök Analizi

	İstatistik	Bootstrap Kritik Değeri	Prob.	Kırılma Tarihi
GENINEQ	-20.339***	8.793	0.000***	1996
LnGDP	-16.491	8.158	0.000***	2022
INDIV	-29.780	18.543	0.000***	2022
LNURB	-10.835	5.081	0.000***	2022
POP	-26.063	1.005	0.000***	2022

***, ** ve * $p \leq 0.01$, $p \leq 0.05$ ve $p \leq 0.10$ düzeyinde anlamlılığı temsil etmektedir.

Araştırmada değişkenler arasındaki korelasyon ilişkisi, korelasyon heatmap analizleri kullanılarak incelenmiştir (Şekil 1). Korelasyon analizi sonuçları kadınların işgücü gelir payı ile ekonomik büyüme, dijitalleşme ve kentleşme arasında pozitif korelasyon olduğunu göstermiştir. Buna karşılık nüfus ile arasında negatif korelasyon olduğu tespit edilmiştir.

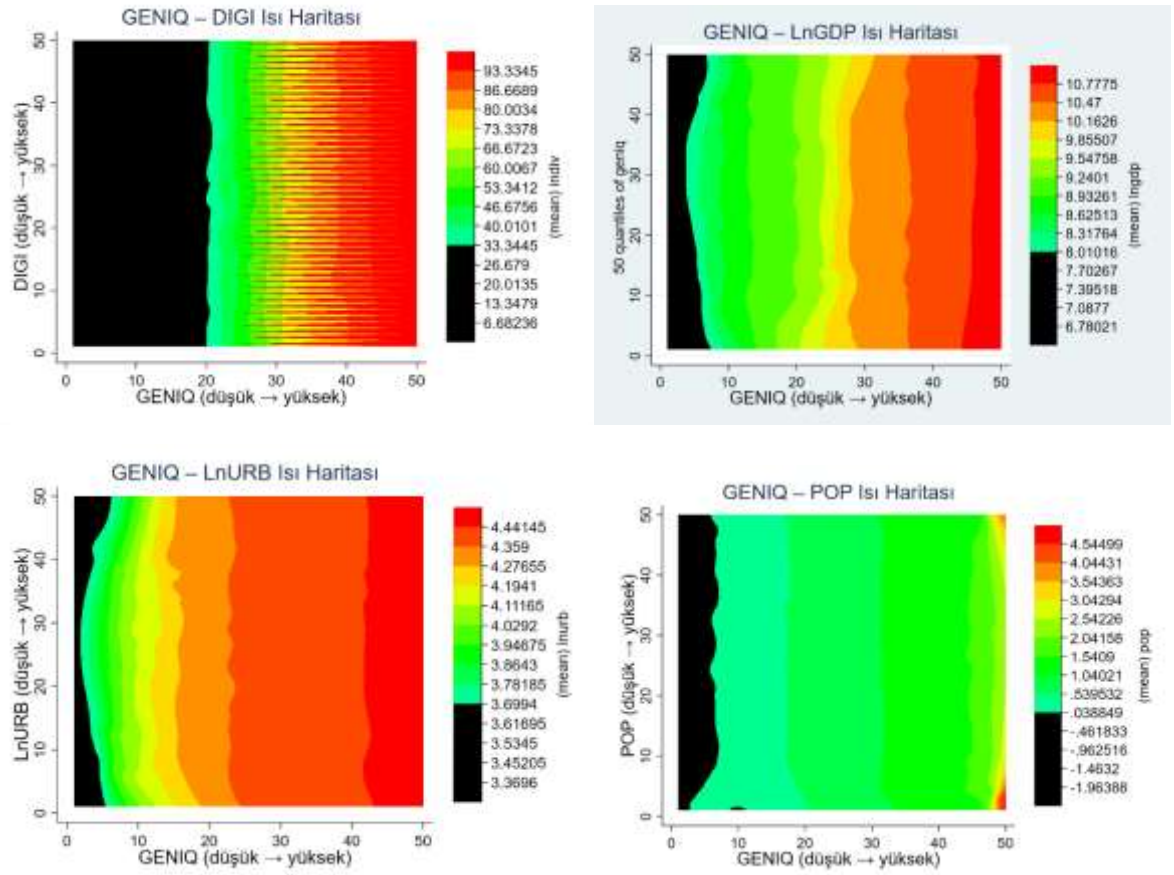
Şekil 1. Korelasyon Heatmap Analizi



Araştırmanın sonraki aşamasında GENIQ ile Açıklayıcı değişkenler arasındaki betimsel ilişki kantil tabanlı heatmap analizleri kullanılarak incelenmiştir. Analiz bulguları Şekil2'de

gösterilmiştir. GENIQ düzeyinin düşük seviyesinde dijitalleşme verilerinin yoğunlaşması son derece düşük iken, belli bir eşikten sonra GENIQ arttıkça dijitalleşme verilerinin ortalama değerlerinin yoğunluğu artmaktadır. Özellikle çok yüksek GENIQ düzeyinde dijitalleşme verileri iyic belirgenleşmektedir. Bu bulgu kadınların işgücü gelirindeki payı ile dijitalleşme arasında pozitif bir ilişkinin var olduğuna işaret etmektedir. Düşük GENIQ düzeyinde GDP verilerinin yoğunlaşması düşük iken, GENIQ arttıkça, GDP verilerinin yoğunluğu da artmaktadır. Bulgular ekonomik büyüme ile kadınların artan eşitliği arasında pozitif bir ilişki eğilimi olduğunu göstermektedir. Garfiksel görünüm düşük, orta ve yüksek GENIQ düzeyinde kentleşme verilerinin son derece yüksek yoğunlukta olduğunu, aksine yüksek GENIQ düzeyinde nüfus değişkeninin ortalama verilerinin yoğunlaşmasının çok düşük olduğunu göstermiştir.

Şekil 2. Açıklayıcı Değişkenlerin GENIQ ile Olan İlişkisinin Kantil Tabanlı Heatmap Analizi ile İncelenmesi



Araştırma çerçevesinde cinsiyete dayalı ücret eşitsizlikleri ve Açıklayıcı değişkenler arasındaki nedensellik ilişkisinin varlığı Dumitrescu-Hurlin (2012) tarafından heterojen panel verileri için önerilen Granger tabanlı nedensellik testi kullanılarak incelenmiştir. Nedensellik analizi sonuçları Tablo 4'de sunulmuştur. Sonuçlar kadınların işgücü gelir payı ile dijitalleşme,

ekonomik büyüme, kentleşme ve nufüs göstergeleri arasında çift yönlü Granger nedensellik olduğunu göstermiştir. Nüfus değişkeninden dijitelleşmeye doğru tek yönlü Granger nedensellik tespit edilirken, dijitalleşme ile diğer açıklayıcı değişkenler arasında çift yönlü Granger nedensellik olduğu ortaya konulmuştur.

Tablo 4. Dumitrescu-Hurlin (2012) Granger Nedensellik Analizi

Boş hipotez	W-İstatistik	Zbar-İstatistik	Prob.
LNGDP≠> GENIQ	5.471	5.862	0.000***
GENIQ≠> LNGDP	5.273	5.508	0.000***
INDIV≠> GENIQ	4.807	4.653	0.000***
GENIQ≠> INDIV	3.954	3.130	0.001***
LNURB≠> GENIQ	5.318	5.588	0.000***
GENIQ≠> LNURB	5.449	5.822	0.000***
POP ≠> GENIQ	3.357	2.073	0.038**
GENIQ≠> POP	5.267	5.496	0.000***
INDIV≠> LNGDP	4.749	4.549	0.000***
LNGDP≠> INDIV	4.255	3.666	0.000***
LNURB≠> LNGDP	4.816	4.688	0.000***
LNGDP≠> LNURB	5.649	6.182	0.000***
POP ≠> LNGDP	5.200	5.377	0.000***
LNGDP≠> POP	7.900	10.215	0.000***
LNURB≠> INDIV	3.867	2.973	0.002***
INDIV≠> LNURB	20.5091	32.7101	0.000***
POP ≠> INDIV	2.22384	0.03718	0.970
INDIV≠> POP	6.40605	7.51015	0.000***
POP ≠> LNURB	9.71592	13.4698	0.000***
LNURB ≠> POP	8.53609	11.3553	0.000***

***, ** ve * $p \leq 0.01$, $p \leq 0.05$ ve $p \leq 0.10$ düzeyinde anlamlılığı temsil etmektedir.

SONUÇ

Ülkelerin sürdürülebilir kalkınma hedeflerinin önündeki en önemli engellerden birisi cinsiyete dayalı eşitsizliklerdir. Birçok ülkede geleneksel ve kültürel normlar, ekonomik gelişmişlik vd. nedenlerden ötürü cinsiyete dayalı eşitsizlikler ciddi bir sorun olarak mevcudiyetini sürdürmektedir. Bu araştırma G20 grubu üyesi 19 ülke için dijitalleşmenin cinsiyete dayalı ücret eşitsizlikleri üzerindeki etkisini ele almıştır. Araştırma ülkelerinde cinsiyete dayalı ücret eşitsizliğinin göstergesi olarak kadınların toplam emek gelirinden aldığı pay verileri kullanılmıştır. Bu değişken kadınların toplam gelirden aldığı payın yanında kadınların istihdam yoğunluğunu yansıtmaktadır. İstatistiksel bulgular G20 ülkelerinde kadınların toplam emek gelirinden aldığı payın ortalama %32 olduğunu göstermiştir. Bu bakımdan G20 ülkelerinde kadınların ekonomik haklarını güçlendirecek ve kadın istihdamını teşvik edecek politikaların

uygulanması cinsiyete dayalı eşitsizlikleri azaltabilir. Nitekim korelasyon analizi sonuçları kadınların işgücü gelir payı ile ekonomik dijitalleşme, ekonomik büyüme ve kentleşme arasında pozitif korelasyon olduğunu göstermiştir. Bu bakımdan G20 ülkelerinde bilgi ve iletişim teknolojilerine yapılan yatırımlar, dijitalleşme ve sürdürülebilir ekonomik kalkınma politikaları cinsiyet eşitliğinin arttırılması açısından önemlidir. Benzer şekilde kentleşmenin artması kadınların işgücüne katılımına katkı sağlayabilir. Buna karşılık kadınların işgücü gelir payı nüfus ile arasında negatif korelasyon olduğu tespit edilmiştir. Nedensellik analizi sonuçları kadınların işgücü gelir payı ile dijitalleşme, ekonomik büyüme, kentleşme ve nufüs göstergeleri arasında çift yönlü Granger nedensellik olduğunu göstermiştir. Nüfus değişkeninden dijitelleşmeye doğru tek yönlü Granger nedensellik tespit edilirken, dijitalleşme ile diğer açıklayıcı değişkenler arasında çift yönlü Granger nedensellik olduğu ortaya konulmuştur.

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TÜRKİYE'DE E-YOKLAMA VE YAYGIN-YOĞUN VERGİ DENETİMİ UYGULAMALARI

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Öz

Vergi denetimi, beyan esasına dayalı vergilendirme sisteminin sağlıklı ve etkin biçimde işlemesini sağlayan temel idari araçlardan biridir. Türk Vergi Sisteminde idare, mükellef beyanlarının doğruluğunu ve vergilendirmeye esas fiili durumu tespit edebilmek amacıyla çeşitli denetim yöntemlerine başvurmakta; bu yöntemler arasında yoklama, uygulamadaki yaygınlığı ve pratikliği nedeniyle öne çıkmaktadır. Vergi Usul Kanunu'nun 127. maddesi ile hukuki dayanağa kavuşturulan yoklama, vergiye ilişkin olayların yerinde tespit edilmesine imkân tanıyan hızlı ve işlevsel bir denetim usulüdür. Kamu yönetiminde dijitalleşmenin hız kazanmasıyla birlikte vergi idaresi, denetim süreçlerini teknolojiyle uyumlu hâle getirmiş ve yoklama uygulaması elektronik ortama taşınmıştır. Elektronik yoklama, bilgi toplama sürecini hızlandırmayı, idari maliyetleri azaltmayı ve denetim etkinliğini artırmayı amaçlamaktadır. Bu yönüyle kayıt dışı ekonomiyle mücadele, vergi kayıp ve kaçağının önlenmesi ve mükellef haklarının korunmasına katkı sağlamaktadır. Vergi denetimi türlerinden biri olan yaygın ve yoğun vergi denetimleri ise kayıt dışı faaliyetlerin ve kayıt dışı istihdamın tespit edilmesi yoluyla kamu maliyesine önemli faydalar sunmaktadır. Bu çalışmanın amacı, yoklama, elektronik yoklama ve yaygın-yoğun vergi denetimi uygulamalarının hukuki ve idari çerçevesini incelemek ve vergi denetimindeki işlevlerini değerlendirmektir. Sonuç olarak, denetimde etkinliğin artırılması için teknolojik imkânların daha etkin kullanılması ve yaygın–yoğun denetim anlayışının mevzuatta daha kapsamlı bir yapıya kavuşturulması gerektiği değerlendirilmektedir.

Anahtar Kelimeler: Vergi Denetimi, Yoklama, Elektronik Yoklama, Yaygın Yoğun Vergi Denetimi

ELECTRONIC ON-SİTE INSPECTION AND WIDESPREAD-INTENSIVE TAX AUDITING PRACTICES IN TURKEY

Abstract

Tax audit constitutes one of the fundamental administrative instruments ensuring the effective and sound functioning of a declaration-based taxation system. In the Turkish Tax System, the tax administration employs various audit methods to verify the accuracy of taxpayers' declarations and to ascertain the factual situation underlying taxation; among these methods, on-site inspection stands out due to its widespread use and practical nature. Regulated under Article 127 of the Tax Procedure Law, on-site inspection is a rapid and functional audit technique that

enables the direct determination of tax-related facts. With the acceleration of digital transformation in public administration, the tax authority has aligned audit processes with technological developments, leading to the implementation of electronic on-site inspections. Electronic inspection aims to enhance information-gathering capacity, increase audit efficiency, and reduce administrative costs. In this respect, it contributes to combating the informal economy, preventing tax losses and evasion, and safeguarding taxpayer rights. In addition, widespread and intensive tax audits, as another audit type, play a significant role in identifying informal economic activities and undeclared employment, thereby supporting public finance. The aim of this study is to examine the legal and administrative framework of on-site inspection, electronic on-site inspection, and widespread–intensive tax audits, and to assess their functions within the tax audit system. In conclusion, it is argued that audit effectiveness can be improved through more efficient use of technological tools and by restructuring widespread-intensive audits as a more comprehensive and independent audit mechanism within the legislation.

Keywords: Tax Audit, On-Site Inspection, Electronic On-Site Inspection, Widespread–Intensive Tax Audit

1. Giriş

Vergilendirme olgusu, yalnızca kamu gelirlerinin elde edilmesine yönelik teknik bir mali işlem olarak değerlendirilmemelidir (Karakoç, 2017: 238). Özellikle dijitalleşmenin hız kazandığı günümüz koşullarında, vergilendirme süreci; veri toplama, verilerin analiz edilmesi, istatistiksel değerlendirmelerin yapılması ve bu verilerden geleceğe yönelik politika önerilerinin geliştirilmesi gibi çok boyutlu bir yapıya bürünmüştür. Sürekli ve yoğun bilgi akışının hâkim olduğu çağdaş iletişim ortamında, doğru ve isabetli kararlar alabilmek giderek güçleşmekte; bu durum vergilendirme sürecinin yalnızca mali değil, aynı zamanda yönetsel ve stratejik bir araç olarak ele alınmasını zorunlu kılmaktadır. Bu bağlamda, vergi uygulamalarının aynı zamanda karar alma süreçlerini destekleyecek nitelikte güvenilir veri üretmesi büyük önem taşımaktadır (Yıldız ve Duru, 2020: 73-74).

Vergi denetimi, beyan esasına dayanan vergi sistemlerinin doğal ve vazgeçilmez bir unsuru olarak karşımıza çıkmaktadır. Devletin, vergilendirmede mükellef beyanına güvenmesi, denetim mekanizmalarının etkin biçimde işletilmesini zorunlu kılar. Vergi denetimi yalnızca mükelleflerin yükümlülüklerini yerine getirip getirmediğini tespit etmeye yönelik olmayıp, aynı zamanda vergi idaresinin işleyişinde ortaya çıkan aksaklıkların belirlenmesine de hizmet etmektedir. Bu yönüyle denetim faaliyetleri, vergi politikalarının şekillendirilmesinde ve

mevzuatın geliştirilmesinde karar alıcılara önemli bir geri bildirim sağlamaktadır (Furtun, 2010: 302).

Türk vergi mevzuatında vergi denetimine ilişkin düzenlemeler, Vergi Usul Kanunu'nda yer almakta olup denetim faaliyetleri; yoklama, inceleme, arama ve bilgi toplama olmak üzere farklı yöntemlerle yürütülmektedir. Son yıllarda teknolojik gelişmelerin etkisiyle, geleneksel denetim yöntemlerine ek olarak elektronik araçların kullanıldığı yeni uygulamalar ön plana çıkmıştır. Bu kapsamda elektronik yoklama ile yaygın ve yoğun vergi denetimi, vergi idaresi tarafından etkin biçimde kullanılan çağdaş denetim teknikleri arasında yer almaktadır (Somuncu, 2014: 134).

Türkiye'de vergilendirme sistemi ağırlıklı olarak beyan usulüne dayanmaktadır. Bu yöntemin tercih edilmesi, vergilendirmede demokratik ilkelere uygunluk açısından önem taşımakla birlikte, mükelleflerin eksik ya da hatalı beyanda bulunabilmesi riskini de beraberinde getirmektedir. Beyan sisteminin vergi adaletini zedelemeden uygulanabilmesi, denetim mekanizmalarının düzenli ve etkin şekilde işletilmesine bağlıdır. Yapılan denetimler sonucunda matrahın eksik ya da hiç beyan edilmediğinin tespiti hâlinde, idare tarafından ikmalen veya re'sen tarh yoluna gidilmesi ve gerekli cezai yaptırımların uygulanması söz konusu olmaktadır. Denetim faaliyetlerinin yetersiz olduğu bir vergi sisteminde, yükümlülüklerini yerine getirmeyen mükelleflerin ekonomik açıdan avantajlı bir konuma gelmesi kaçınılmazdır. Bu durum, vergisel yükümlülüklerini dürüst biçimde yerine getiren mükelleflerin de zamanla sistem dışına yönelmesine neden olabilecek bir risk taşımaktadır. Daha geniş bir perspektiften bakıldığında, vergi denetiminin zayıflaması yalnızca kamu gelirlerinde azalmaya yol açmakla kalmayıp, hukuka olan güvenin sarsılmasına ve kurallara uyma kültürünün aşınmasına da zemin hazırlayabilir. Bu nedenle, özellikle yoklama faaliyetlerinin hukuki çerçevesi ve uygulama biçiminin doğru anlaşılması ve etkin şekilde hayata geçirilmesi büyük önem arz etmektedir (Yeniçeri, 2014: 15).

Bu çalışmanın amacı, Türk vergi sisteminde son yıllarda uygulama alanı giderek genişleyen elektronik yoklama ile yaygın ve yoğun vergi denetimini hukuki dayanakları çerçevesinde incelemek ve söz konusu denetim yöntemlerinin uygulama sonuçlarını değerlendirerek etkinliklerini ortaya koymaktır. Bu doğrultuda çalışmada öncelikle vergi denetimi ve denetim türleri teorik açıdan ele alınacak, ardından elektronik yoklama uygulamaları ve sonuçları analiz edilecek; son olarak yaygın ve yoğun vergi denetiminin Türkiye'deki uygulama süreci ve elde edilen bulgular değerlendirilecektir.

2. Vergi Denetiminin Kavramsal Çerçevesi ve Denetim Türleri

Denetim kavramı, vergisel yükümlülüklerin mevzuata uygun biçimde yerine getirilip getirilmediğinin belirlenmesi amacıyla yürütülen sistematik bir inceleme ve değerlendirme sürecini ifade etmektedir. Vergi denetimi özelinde bu süreç; mükelleflerin beyanlarının doğruluğunun araştırılması, defter ve belgelerin usulüne uygun tutulup tutulmadığının tespiti, kayıt düzeninin mevzuata uygunluğunun incelenmesi ve gerekli bildirimlerin zamanında yapılıp yapılmadığının değerlendirilmesini kapsayan çok yönlü bir kontrol mekanizmasıdır. Beyan esasına dayanan Türk vergi sisteminde, idarenin mükellef beyanına duyduğu güvenin sürdürülebilmesi, denetim faaliyetlerinin etkin biçimde yürütülmesine bağlıdır. Bu yönüyle vergi denetimi, yalnızca tespit ve kontrol işlevi görmekle kalmayıp, aynı zamanda raporlama ve değerlendirme boyutlarıyla vergilendirme sürecinin bütünleyici bir unsuru olarak karşımıza çıkmaktadır (Tekin ve Çelikkaya, 2018: 51).

Vergi denetimi, farklı boyutları bulunan bir amaçlar bütünü çerçevesinde şekillenmektedir. Mali amaç, kamu gelirlerinde meydana gelebilecek kayıpların önlenmesi ve kamu hizmetlerinin finansmanının güvence altına alınmasını hedeflerken; ekonomik amaç, kayıt dışı ekonomiyle mücadele edilmesi, fiyat istikrarının korunması ve ekonomik dengelerin sağlanmasına katkı sunmayı amaçlamaktadır. Hukuki amaç, denetim faaliyetlerinin kanunilik ilkesine uygun şekilde yürütülmesini sağlayarak hukuk devleti ilkesinin ve vergide eşitliğin korunmasına hizmet ederken; sosyal amaç ise mali güce göre vergilendirme anlayışı doğrultusunda adil gelir dağılımının desteklenmesini hedeflemektedir. Bu amaçlar birlikte değerlendirildiğinde, vergi denetiminin yalnızca kamu gelirlerini artırmaya yönelik bir araç olmadığı; aynı zamanda ekonomik istikrarın sağlanması, hukuki güvenliğin tesis edilmesi ve toplumsal refahın artırılması bakımından stratejik bir işlev üstlendiği görülmektedir (Öncel vd. 2020: 44-47).

Vergi denetiminin temel işlevi, mükelleflerin vergisel yükümlülüklerini mevzuata uygun biçimde yerine getirmelerini teşvik etmektir. Denetim ihtimalinin sürekli olarak varlığı, mükellef davranışları üzerinde caydırıcı bir etki yaratarak gönüllü uyum düzeyinin artmasına katkı sağlamaktadır. Vergi denetiminin mali amacının yalnızca kamuya ek gelir sağlamak olduğu yönünde yaygın bir yaklaşım bulunsa da esasen bu faaliyet, hukuken devlete ait olan ancak çeşitli nedenlerle tahsil edilemeyen vergilerin ortaya çıkarılması ve kamuya kazandırılmasını hedeflemektedir. Bu yönüyle denetim, yeni bir gelir yaratmaktan ziyade mevcut vergi potansiyelinin korunmasına hizmet eden bir mekanizma niteliği taşımaktadır (Gediz Oral vd. 2015: 129). Öte yandan vergi denetimi, ekonomik karar alma süreçleri üzerinde de belirleyici bir

role sahiptir. Serbest piyasa koşullarında faaliyet gösteren girişimciler, vergi yükümlülüklerinden kaçınma eğilimi gösterebilmekte; ancak vergi kaçakçılığının yaygınlaştığı bir ekonomik ortam, yatırım kararlarının ertelenmesine veya tamamen vazgeçilmesine yol açabilmektedir. Vergilendirme politikaları ve denetim uygulamaları, risk alma davranışlarını, kaynakların araştırma-geliştirme faaliyetlerine yönlendirilmesini ve uzun vadeli büyüme performansını doğrudan etkileyen unsurlar arasında yer almaktadır. Bu bağlamda, vergi denetiminin özellikle vergi kayıp ve kaçağının yoğunlaştığı alanlara odaklanması, kayıt dışılığın azaltılmasına katkı sağlamakta ve girişimciler açısından daha öngörülebilir bir ekonomik ortam yaratarak yatırım eğilimini güçlendirmektedir (Vergi Denetmenler Derneği, 2003: 27).

2.1. Denetim Türleri

Türk vergi hukukunda denetim faaliyetleri, farklı kapsam ve yetki düzeylerine sahip çeşitli araçlar aracılığıyla yürütülmektedir. Bu çerçevede vergi denetimi; yoklama, yaygın ve yoğun vergi denetimi, vergi incelemesi ile aramalı vergi incelemesi olmak üzere birden fazla yöntemden oluşmaktadır. Yoklama ile yaygın ve yoğun vergi denetimi, ağırlıklı olarak Gelir İdaresi Başkanlığı tarafından yerine getirilirken; daha ileri düzeyde ve kapsamlı denetim niteliği taşıyan vergi incelemesi ile aramalı vergi incelemesi ise Vergi Denetim Kurulu'nun görev alanına girmektedir. Bu yapı içerisinde yoklama, denetim sürecinin başlangıç aşamasını oluşturarak diğer denetim türlerine zemin hazırlayan temel bir araç niteliği taşımaktadır (Yurteri, 2012: 255-256). Uygulamada, yoklama kapsamında yürütülen yaygın ve yoğun vergi denetimi zamanla ayrı bir denetim yöntemi olarak gelişmiştir. Bu denetim türü, klasik yoklamadan farklı olarak daha geniş kapsamlı veri toplanmasına olanak tanımakta ve mükellef faaliyetlerinin daha ayrıntılı biçimde değerlendirilmesini mümkün kılmaktadır. Böylece yaygın ve yoğun vergi denetimi, ileri aşamada yapılacak vergi incelemelerine esas teşkil edecek bilgi ve bulguların elde edilmesinde önemli bir işlev üstlenmiştir. Bu yönüyle söz konusu denetim yöntemi, Türk vergi denetim sisteminde daha nitelikli ve etkili bir kontrol mekanizması olarak ayrı bir konuma sahip olmuştur (Yıldız ve Duru, 2020: 75).

Bu doğrultuda çalışmanın kapsamı, vergi denetim sisteminde önemli bir yere sahip olan yoklama ile yaygın ve yoğun vergi denetimi ile sınırlandırılmış; değerlendirmeler bu iki denetim türü üzerinden yürütülmüştür.

2.1.1. Yoklama

Vergi mevzuatı uyarınca mükellefler; faaliyete başlama, işyerinin taşınması, yeni şube açılması veya faaliyetin sona erdirilmesi gibi vergisel sonuç doğuran durumları ilgili vergi dairesine bildirmekle yükümlüdür. Yoklama, bu tür bildirimlere konu olan hususların vergi

idaresi tarafından yerinde incelenerek fiilî durumun tespit edilmesine yönelik bir denetim aracıdır. Bu kapsamda yoklama işlemleri, yalnızca mükellefler hakkında değil, vergisel yükümlülük doğurabilecek olaylarla bağlantısı bulunan ve henüz mükellefiyet tesis edilmemiş kişiler hakkında da gerçekleştirilebilmektedir (Yurteri, 2012: 256).

Vergisel yükümlülüğün temelini oluşturan vergiyi doğuran olay, hukuken mükellefin şahsında meydana gelmekte olup, bu olayın gerçekleşmesiyle birlikte vergi borcu doğmaktadır. Ortaya çıkan vergi borcunun ifası, kural olarak ilgili mükellefin kendi sorumluluğundadır. Bu yönüyle yoklama, vergiyi doğuran olayın gerçekleşip gerçekleşmediğinin ve mükellefiyetin fiilî duruma uygunluğunun tespit edilmesini sağlayan önemli bir idari mekanizma olarak işlev görmektedir (Gündeşli, 2005: 52).

Vergi Usul Kanunu'nun 127. maddesinde yoklama müessesesinin amacı; mükelleflerin vergisel durumuna ilişkin maddi olayların, vergilendirmeye esas alınan kayıt ve unsurların araştırılması ve fiilî durumun tespit edilmesi olarak düzenlenmiştir. Bu hüküm uyarınca yoklama, beyana dayalı vergilendirme sisteminde idarenin mükellef beyanlarının doğruluğunu yerinde kontrol edebilmesine imkân tanıyan temel denetim araçlarından biridir. Yoklama faaliyetleri, esas itibarıyla vergisel yükümlülük altında bulunan kişiler üzerinde yoğunlaşmakta olup, bu sayede yükümlülüklerini yerine getiren mükellefler aleyhine haksız rekabet doğmasının önlenmesi hedeflenmektedir (Kızılot, 2013: 37-38).

Vergi Usul Kanunu'nun 128. maddesinde ise yoklama yapmaya yetkili olan kişiler açıkça sayılmıştır. Buna göre; vergi dairesi müdürleri, yoklama memurları, yetkili makamlar tarafından bu görevle görevlendirilen kamu görevlileri, vergi incelemesine yetkili olanlar ile gelir uzmanları yoklama yapma yetkisine sahiptir. Öte yandan, VUK'ta mükellefler ve vergilendirme ile ilgili kişiler bakımından, mükellefiyetle bağlantılı maddi olayların vergi idaresine bildirilmesi zorunlu tutulmuştur. Bildirime konu edilen bu hususların gerçeğe uygunluğunun tespiti, idare tarafından yerinde yapılan incelemeler aracılığıyla sağlanmakta; bu doğrulama faaliyeti de yoklama işlemi kapsamında gerçekleştirilmektedir. Böylece yoklama, bildirime dayalı sistemin etkinliğini sağlayan ve vergi idaresinin fiilî durumu ortaya koymasına hizmet eden önemli bir denetim mekanizması niteliği taşımaktadır (Kocahanoğlu, 1983: 6-7).

Yoklama, kapsamı itibarıyla sınırlı bir denetim niteliği taşımakta olup, yalnızca gerçekleştirildiği an itibarıyla mevcut fiilî durumun tespitine yöneliktir. Bu nedenle yoklama sırasında belirlenen hususların, herhangi bir ek tespit veya inceleme yapılmaksızın yoklama sonrasındaki dönemler için de geçerli olduğu sonucuna ulaşılması mümkün değildir. Başka bir ifadeyle, yoklama yoluyla elde edilen bulgular, ileriye dönük bir hukuki durumun varlığına tek

başına delil teşkil etmez. Yoklama sürecinde ayrıntılı ve teknik bir inceleme yapılmamakta; işlem, genellikle kısa sürede ve yüzeysel tespitlerle tamamlanmaktadır. Bu özelliği sayesinde yoklama, geniş mükellef kitlelerine uygulanabilen pratik bir denetim aracı olarak öne çıkmaktadır (Öner, 2020: 99).

Öte yandan yoklama, doğrudan vergi kaybı veya kaçağının tespiti amacıyla gerçekleştirilen bir denetim yöntemi değildir. Ancak mükellefin günlük faaliyetlerine ilişkin yükümlülüklerini yerine getirip getirmediğinin yerinde incelenmesi sırasında, vergi kaybına işaret eden durumlar dolaylı olarak ortaya çıkabilmektedir. Bunun yanı sıra yoklama, mükellefin fiilen ticari bir faaliyet yürütüp yürütmediği konusunda da idareye önemli göstergeler sunmaktadır. Fiilî durumun değerlendirilmesi sonucunda, mükellefin yalnızca şekli olarak faaliyette bulunduğu ve gerçekte ekonomik bir faaliyet icra etmediği kanaatine varılması hâlinde, idare tarafından daha kapsamlı denetim araçlarına başvurulabilmektedir. Yoklama, cebri yaptırımlar içermemesi yönüyle vergi incelemesi ve aramalı incelemeden ayrılmakta olup, bu durum mükellefler üzerindeki caydırıcılığını sınırlayabilmektedir. Buna karşılık, uygulanmasının kolay olması ve sonrasında yürütülecek daha kapsamlı denetimlere veri sağlaması nedeniyle yoklama, vergi denetim sisteminde önemli ve tamamlayıcı bir işlev üstlenmektedir (Akdoğan, 2019: 117).

2.1.1.1. E-Yoklama

Teknolojik imkânların gelişmesi ve vergilendirme alanının genişlemesiyle birlikte, vergi denetiminde kullanılan yöntemlerin de çeşitlenmesi kaçınılmaz hâle gelmektedir. Özellikle kayıt dışı ekonomiyle mücadelede izlenen kararlı politikalar dikkate alındığında, yoklama işleminin giderek daha fazla uzmanlık gerektiren bir denetim aracı hâline geldiği görülmektedir. Yoklama sırasında mükellefe yöneltilecek soruların kapsamı ile talep edilecek bilgi ve belgeler, yoklamanın amacı, niteliği ve uygulanma biçimine göre farklılık gösterebilmektedir. Bu gelişmeler doğrultusunda hayata geçirilen elektronik yoklama (e-yoklama), yoklama yapmaya yetkili kişiler tarafından mobil teknolojiler kullanılarak gerçekleştirilen bir denetim uygulamasıdır. E-yoklama kapsamında yoklama fişi elektronik ortamda düzenlenmekte ve işlem sonunda oluşturulan fiş, ön izleme yöntemiyle nezdinde yoklama yapılan kişiye ya da yetkili temsilcisine sunulmaktadır. İçeriğe ilişkin herhangi bir uyuşmazlık bulunmaması hâlinde fiş, elektronik imza aracılığıyla imzalanmaktadır. Elektronik imzanın bulunmadığı durumlarda ise yoklamaya ilişkin temel bilgileri ve benzersiz kodu içeren e-yoklama imza formu düzenlenmekte ve bu form, yoklama yapanlar ile ilgili kişi tarafından ıslak imza ile imzalanmaktadır (Arslan, 2019: 271).

E-yoklama fişinin, nezdinde yoklama yapılan kişi veya temsilcisi tarafından imzalanmasının ardından, fiş yoklama yapmaya yetkili görevlilerce onaylanmakta ve bu aşamayla birlikte imzalama süreci tamamlanmaktadır. Yoklama sırasında ilgili kişinin bulunmaması ya da imzadan kaçınması hâlinde ise bu durum sistem üzerinde kayıt altına alınmakta ve fiş, yoklama yapan tarafından tek taraflı olarak onaylanmaktadır. Bu durumda ayrıca başka bir işleme gerek görülmemekte, e-yoklama imza formunun bir örneği ilgili kişiye bırakılmaktadır. Vergi Usul Kanunu'nda e-yoklama fişinin hukuki niteliği açıkça düzenlenmiş olup, elektronik ortamda düzenlenen yoklama fişinin, fiziki yoklama fişi ile aynı hukuki sonucu doğurduğu kabul edilmiştir. Bununla birlikte, e-yoklamaya ilişkin usul ve esasların belirlenmesi konusunda idareye düzenleme yetkisi verilmiş ve bu yetki çerçevesinde ilgili genel tebliğ yayımlanmıştır. Söz konusu düzenlemelerde, e-yoklama fişinin belirli durumlarda ilgililer tarafından imzalanmaksızın da geçerli olacağı öngörülmüştür. Ancak normlar hiyerarşisi dikkate alındığında, açık kanun hükümlerinin uygulanmasının hukuki açıdan daha isabetli olacağı yönünde değerlendirmeler yapılmaktadır (Alpsoy, 2021: 590).

Teknik nedenler ya da yapılan işin niteliği sebebiyle e-yoklamanın gerçekleştirilememesi durumunda, yoklama işlemi geleneksel yöntemle yürütülmekte ve yoklama fişi fiziki olarak düzenlenmektedir. Bu fişler üç nüsha hâlinde hazırlanmakta; ilgili kişinin bulunmaması veya imzadan imtina etmesi hâlinde durum fiş üzerinde belirtilmekte ve fiş, belirlenen süre içerisinde posta yoluyla tebliğ edilmektedir. Yargı kararlarına konu olan bazı uyuşmazlıklarda, yalnızca e-yoklama fişine dayanılarak cezai işlem tesis edildiği; ancak fiş içeriğinde somut ve ayrıntılı tespitlerin yer almaması nedeniyle bu işlemlerin hukuka aykırı bulunduğu görülmektedir. Özellikle belge düzenlenmediği iddiasına dayanan işlemlerde, müşteri bilgileri ve işlem tutarları gibi unsurların açıkça ortaya konulmaması, denetim sonucunun yargı mercilerince geçersiz sayılmasına yol açabilmektedir. Bu durum, e-yoklama uygulamasının hem içerik hem de usul bakımından titizlikle yürütülmesi gerektiğini açıkça ortaya koymaktadır (Kızılot ve Taş, 2013: 100).

Gelir İdaresi Başkanlığı tarafından uygulamaya alınan İnteraktif Vergi Dairesi sistemi, mükelleflerin vergisel işlemlerini elektronik ortamda gerçekleştirmelerine imkân tanımaktadır. Bu sistem aracılığıyla mükellefler işe başlama bildirimlerini dijital olarak yapabilmekte; bildirimin alınmasını takiben vergi dairesi bünyesinde yetkilendirilmiş kullanıcılar tarafından Elektronik Yoklama Sistemi (EYS) üzerinden "işe başlama yoklaması" talebi oluşturulmaktadır. Yoklama taleplerinin onay süreci, ilgili iç düzenlemelerde belirtilen yetkili yöneticiler tarafından yine elektronik ortamda gerçekleştirilmektedir (Yıldız ve Duru, 2020: 78). Onaylanan yoklama

talepleri, ilgili servisler aracılığıyla mobil cihaz kullanan yoklama memurlarına iletilmekte ve yoklama işlemleri tabletler üzerinden çalışan Elektronik Yoklama Denetim Sistemi (EYDS) vasıtasıyla sonuçlandırılmaktadır. Bu yapı, yoklama sürecinin hızlanmasını, idari işlemlerin sadeleşmesini ve denetim faaliyetlerinde etkinliğin artırılmasını amaçlamaktadır. Öte yandan Vergi Usul Kanunu'nda mükelleflerin işi bırakma bildiriminde bulunma yükümlülüğü düzenlenmiş olup, bu bildirimin yapılmaması hâlinde idare tarafından re'sen terk yoklaması yapılmaktadır. Re'sen terk yoklamaları, faaliyetine fiilen son verdiği hâlde mükellefiyet kaydı devam eden kişiler hakkında, işyeri ve yerleşim adreslerinde gerçekleştirilen tespitlere dayanmaktadır. Bu yoklama türü, vergi kayıtlarının güncelliğinin sağlanması bakımından önem taşımaktadır (Türkoğlu, 2014: 39-40). Katma Değer Vergisi sisteminde ise genel kural, indirilecek KDV'nin hesaplanan KDV'den fazla olması durumunda ortaya çıkan farkın sonraki dönemlere devredilmesi yönündedir. Bununla birlikte, mevzuatta belirtilen bazı işlemler nedeniyle indirilemeyen KDV'nin, mükellefin vergi borçlarına mahsubu veya belirli şartlar altında nakden iadesi mümkündür. KDV iadelerine ilişkin usul ve esaslar, ilgili kanuni yetkiye dayanılarak çıkarılan genel tebliğlerle düzenlenmiştir. İade hakkı doğuran işlemler arasında özellikle mal ihracatına dayalı işlemler önemli bir yer tutmaktadır. Bu kapsamda uygulanan KDV iade yoklamaları, haksız veya yersiz vergi iadesi taleplerinin önlenmesi amacıyla gerçekleştirilen özel bir yoklama türü olup iade sürecinde vergisel güvenliğin sağlanmasına hizmet etmektedir (Katma Değer Vergisi Kanunu.). Özel esaslar uygulamasının hukuki dayanağını, 26 Nisan 2014 tarihli ve 28983 sayılı Resmî Gazete'de yayımlanan Katma Değer Vergisi Genel Uygulama Tebliği oluşturmaktadır. Anılan Tebliğ'de, özel esaslar uygulamasının temel amacı; KDV iade taleplerinin gerçeğe uygunluğunun tespit edilmesi suretiyle, haksız ve yersiz vergi iadesi yapılmasının önlenmesi olarak belirlenmiştir. Bu çerçevede uygulama, kamu gelirlerinin korunmasına yönelik bir denetim mekanizması işlevi görmektedir (Tekin ve Çelikkaya, 2014: 68). Katma Değer Vergisi mevzuatında indirimli orana tabi işlemler, iade hakkı doğuran işlemler arasında yer almaktadır. Ancak uygulamada, bazı mükelleflerin sahte veya muhteviyatı itibarıyla yanıltıcı belgeler kullanmak suretiyle indirim hakkını gerçeğe aykırı şekilde elde edebildikleri ve bu durumun kamu zararına yol açabildiği görülmektedir. Bu riskin bertaraf edilmesi amacıyla geliştirilen özel esaslar yoklaması, elektronik ortamda gerçekleştirilen bir yoklama türü olarak, KDV iade sürecinde önemli bir kontrol aracı niteliği taşımaktadır (Erdal, 2014: 22-25).

2.1.1.2. E-Yoklama Uygulamasının İşleyişi

Elektronik yoklama, teknolojik gelişmelerin vergi denetimine entegre edilmesiyle klasik yoklama anlayışından ayrılan ve denetim sürecinde dijital araçlardan yoğun biçimde yararlanan

bir uygulamadır. Bu sistem sayesinde, yoklama sırasında yapılan tespitler yalnızca yazılı kayıtlarla sınırlı kalmamakta; görsel veriler ve diğer dijital unsurlar da anlık olarak Gelir İdaresi Başkanlığı'nın bilgi sistemlerine aktarılabilmektedir. Ayrıca, denetim açısından delil niteliği taşıyabileceği değerlendirilen elektronik kayıtlar ve materyaller tespit edilerek kayıt altına alınmaktadır. E-yoklama uygulaması, vergi idaresinin e-dönüşüm sürecinin bir parçası olarak denetim faaliyetlerinin daha hızlı, etkin ve bürokrasiden arındırılmış biçimde yürütülmesini amaçlamaktadır. Yoklama sırasında elde edilen bilgilerin eş zamanlı olarak merkezi veri tabanına aktarılması, denetim sürecinin sonraki aşamalarında yetkili kişilerin gerekli bilgilere gecikmeden ulaşmasına imkân tanımaktadır. Bu durum, vergi denetimlerinin etkinliğini artıran önemli bir unsur olarak değerlendirilmektedir (GİB, Yoklama Yoluyla Vergi Denetimi Rehberi, 2016: 6-7).

Yoklama sonucunda elektronik ortamda düzenlenen belge, elektronik yoklama fişi olarak adlandırılmaktadır. Bu fiş, hukuki niteliği itibarıyla klasik yoklama fişiyle aynı mahiyette olup, tutanak özelliği taşımaktadır. E-yoklama fişi, yoklama yapmaya yetkili görevliler tarafından tablet gibi mobil cihazlar aracılığıyla, Gelir İdaresi Başkanlığı'nın sistemine entegre bir yazılım üzerinden oluşturulmaktadır. Fişte yer alan tespitler, yoklama sırasında mükellefle birlikte belirlenmekte ve kayıt altına alınmaktadır (Karaboyacı, 2014: 219-221). Elektronik yoklama fişinin en önemli unsurlarından biri, her fişe özgü olarak üretilen ve değiştirilemeyen "benzersiz kod"dur. Bu kod, düzenlenen fişin bütünlüğünü ve güvenilirliğini sağlamaya yönelik bir güvenlik mekanizmasıdır. Benzersiz kod sayesinde, fiş üzerinde sonradan değişiklik yapılmasının önüne geçilmekte ve hem idare hem de mükellef açısından hukuki güvenlik sağlanmaktadır. Bu yönüyle e-yoklama uygulaması, mükelleflerin idarenin tesis ettiği işlemlere duyduğu güveni artırarak gönüllü uyumu destekleyen bir yapı sunmaktadır. E-yoklama sürecinde, yoklama yapmaya yetkili personel kendisine Elektronik Yoklama Sistemi (EYS) üzerinden atanan görevleri, mobil cihazlarda yer alan Elektronik Yoklama Denetim Sistemi (EYDS) yazılımı aracılığıyla yerine getirmektedir. Görev listesinde yer alan yoklamalar öncelik sırasına göre sistem tarafından otomatik olarak sıralanmakta ve personel ilgili mükellefi seçerek yoklama işlemini tamamlamaktadır. Tespitlerin ardından elektronik yoklama fişi düzenlenmekte ve süreç; fişin imzalanması, imzalanmadan onaylanması ya da teknik nedenlerle elektronik ortamda tamamlanamaması ihtimallerine göre sonuçlandırılmaktadır. Yoklama sırasında yapılan tespitler, mobil cihaz ekranı üzerinden mükellefe gösterilmekte ve taraflar arasında mutabakat sağlanması hâlinde elektronik imza kullanılarak fiş karşılıklı olarak imzalanmaktadır. Mükellefin elektronik imza aracının bulunmaması durumunda ise, yoklamaya ilişkin özet bilgileri ve benzersiz kodu içeren e-yoklama imza formu düzenlenmekte ve bu form taraflarca ıslak imza ile

imza altına alınmaktadır (453 Sıra No'lu Vergi Usul Kanunu Genel Tebliği; Yüce ve Yücelen, 2021: 131-132).

2.1.2. Yaygın ve Yoğun Vergi Denetimi

Yaygın ve Yoğun Vergi Denetimi, vergiye aykırı fiillerin meydana geldiği anda tespit edilmesini ve buna bağlı olarak gerekli yaptırımların gecikmeksizin uygulanmasını esas alan bir denetim yöntemidir. Bu denetim türü, uygulamada ağırlıklı olarak yoklama müessesesi kapsamında gerçekleştirilmektedir. Vergi hukuku literatüründe bazı çalışmalarda bağımsız bir denetim türü olarak ele alınmasına karşın, kimi kaynaklarda yoklama faaliyetinin bir uzantısı olarak değerlendirildiği görülmektedir. Yaygın ve yoğun denetimin temel amacı, belge düzeninin sağlanması ve mükelleflerin işlemlerini mevzuata uygun şekilde, zamanında ve doğru olarak belgelendirmelerini temin etmektir. Bu yönüyle söz konusu denetim, belgelerin günlük olarak düzenlenip kaydedilmesini esas alan ve anlık kontrol niteliği taşıyan bir uygulama olarak nitelendirilebilir (Üstün, 2013: 35). Katma Değer Vergisi'nin (KDV) yürürlüğe girmesiyle birlikte ekonomik faaliyetlerin kayıt altına alınmasına yönelik önemli adımlar atılmış; bu gelişme, vergi denetimlerinin yalnızca defter ve kayıtlarla sınırlı kalmayarak daha geniş bir inceleme alanına yayılmasına olanak sağlamıştır. Böylece vergi denetimi, kayıtlı ekonominin güçlendirilmesi ve vergiye uyumun artırılması bakımından daha etkin bir araç hâline gelmiştir (Kazıcı, 2003: 264).

Yaygın ve yoğun vergi denetimi, mükelleflerin satış ve hasılat durumlarının tespitine yönelik olarak hem nakit hem de kredi kartı işlemlerini kapsayan kapsamlı bir denetim sürecini ifade etmektedir. Bu kapsamda, işletmelere ait ödeme kaydedici cihazlardan elde edilen veriler incelenmekte; özellikle ayın başlangıcından itibaren veya son beş güne ait "Z" raporları üzerinden satış hareketleri analiz edilmektedir. Denetim faaliyetleri yalnızca satış kayıtlarıyla sınırlı kalmayıp, mükellefin en son düzenlemiş olduğu fatura, gider pusulası, yazar kasa fişi ve sevk irsaliyesi gibi belgeler de denetime tabi tutulmaktadır. Bunun yanı sıra, yeni nesil ödeme kaydedici cihazlara ilişkin bilgilerin temin edilmesi ve günlük hasılatın tespiti suretiyle kayıt düzeninin mevzuata uygunluğu değerlendirilmektedir. Yaygın ve yoğun denetim uygulamaları, işletme faaliyetlerinin dışa yansıyan unsurlarını da kapsamakta; bu çerçevede nakil vasıtalarının durdurulması yoluyla taşıma irsaliyesi, yolcu listesi ve benzeri belgeler kontrol edilmektedir. Ayrıca mükellefin ticari amaçla kullandığı araçların varlığı ile ticari ilişkide bulunduğu diğer mükelleflere ilişkin bilgilerin tespiti de denetimin unsurları arasında yer almaktadır. Bu yönüyle yaygın ve yoğun vergi denetimi, vergiye tabi faaliyetlerin bütüncül biçimde izlenmesini

amaçlayan çok boyutlu bir denetim mekanizması niteliği taşımaktadır (Yıldız ve Duru, 2020: 73-74).

Yaygın ve yoğun vergi denetiminin temel amacı, vergi ziyaına yol açabilecek fiillere ilişkin delil ve emareler ortadan kaldırılmadan önce, zamanında gerçekleştirilen denetimler aracılığıyla vergiyi doğuran olayın gerçek mahiyetini ortaya koymaktır. Bu süreçte, fiilî durum ile muhasebe kayıtları arasında bağlantı kurulmak suretiyle, vergi kaybına neden olabilecek hukuka aykırı davranışların erken aşamada tespit edilmesi ve önlenmesi hedeflenmektedir (Kaya, 1999: 75). Bu bağlamda yaygın ve yoğun vergi denetimleri; vergiye ilişkin olayların gecikmeksizin belirlenmesi, belge düzeninin yerleşmesi ve sağlıklı bir biçimde işletilmesi, vergi kayıp ve kaçağının azaltılması ve mükelleflerin bilgilendirilerek uygulamada ortaya çıkabilecek hataların önüne geçilmesi amacıyla yürütülmektedir. Denetimin önleyici niteliği, yalnızca yaptırım uygulanmasını değil, aynı zamanda mükelleflerin vergi mevzuatına uyumunun artırılmasını da kapsamaktadır (Şeker, 1994: 26).

Yaygın ve yoğun denetimin diğer hedefleri arasında; ekonomik delil sisteminin etkinliğinin artırılması, vergi incelemelerinin yalnızca mükelleflerin defter ve belgeleriyle sınırlı kalmaksızın fiilî mal, hizmet ve nakit hareketlerini de kapsayacak şekilde genişletilmesi yer almaktadır. Bu doğrultuda, tüm ticari işlemler için belge düzenlenmesinin sağlanması ve düzenlenen belgelerin yasal defterlere eksiksiz biçimde kaydedilmesi amaçlanmaktadır. Ayrıca mükellefiyetle bağlantılı olay, kayıt ve işlemlerin araştırılması suretiyle vergilendirmeye esas teşkil eden unsurların anında tespit edilmesi de denetimin önemli işlevleri arasında sayılmaktadır (Yurteri, 2012: 264). Yaygın ve yoğun vergi denetimi, mükellefleri belge düzenine uymaya sevk etmesi bakımından, vergi incelemelerinin sağlıklı ve güvenilir biçimde yürütülmesine önemli katkı sunan bir denetim yöntemidir. Özellikle belge düzeninin yeterince yerleşmediği ekonomik yapılarda, ticari işlemlerin kayıt dışı ve belgesiz olarak gerçekleştirilmesi vergi kaçakçılığının temel kaynaklarından birini oluşturmaktadır. Bu nedenle yaygın ve yoğun denetimlerin etkinliğinin artırılması, belge düzeninin yerleşmesine, vergi kaçakçılığının kapsamının daraltılmasına ve buna bağlı olarak kamu gelirlerinin kayda değer ölçüde artmasına katkı sağlayacaktır. Sonuç itibarıyla söz konusu denetimler, ekonomik yapının ve kamu maliyesinin güçlendirilmesine hizmet eden önemli bir araç niteliği taşımaktadır. Yaygın ve yoğun vergi denetimleri, hukuki dayanağını yoklama müessesesinden almakta ve bu çerçevede uygulanmaktadır (Kazıcı, 1993: 25).

Gelir İdaresi Başkanlığı tarafından yürütülen yaygın ve yoğun vergi denetimleri; işyeri hasılatı ve belge düzeni kontrolleri, nakil araçları ve bandrollü ürün denetimleri, kayıt dışı

faaliyetlerin tespiti, gayrimenkul sermaye iradına ilişkin denetimler ile akaryakıt istasyonları, günübirlik konut kiralama ve stok kontrolüne yönelik uygulamalardan oluşmaktadır. Bu denetim türlerinden bazıları, uygulamadaki yaygınlığı ve etkisi nedeniyle diğerlerine kıyasla daha fazla önem arz etmekte olup, aşağıda bu denetimlerin öne çıkan örneklerine yer verilmiştir.

2.1.2.1.Belge Düzeni Uygunluk Denetimi

Vergi hukukunda mükelleflerin temel yükümlülüklerinden biri, belge düzenine uygun hareket etmektir. Belge düzeninin temel amacı; vergilendirmeye esas teşkil eden olayların ispatlanması, yapılan beyanların doğruluğunun ortaya konulması ve idarenin denetim yetkisini etkin biçimde kullanabilmesidir. Vergi Usul Kanunu'nun (VUK) 3. maddesinde yer alan "vergiyi doğuran olay ve bu olaya ilişkin işlemlerin gerçek mahiyetinin yemin hariç her türlü delille ispatlanabileceği" yönündeki hüküm, belge düzeninin vergi hukuku bakımından taşıdığı önemi açıkça ortaya koymaktadır. Bu bağlamda, vergi hukukunda geçerli olan delil serbestisi ilkesi uyarınca, işletmeler tarafından kullanılan belgeler hem vergi incelemelerinde hem de yargı süreçlerinde ispat aracı olarak kabul edilmektedir (Erdal, 2014: 22).

VUK'un 227. maddesinde "ispat edici vesikalar" başlığı altında belge düzenine ilişkin temel esaslar belirlenmiştir. Belge kavramı yalnızca vergi incelemeleriyle sınırlı olmayıp, ikmalen vergi tarhı gibi vergisel işlemlerde de önemli bir rol oynamaktadır. Nitekim VUK'un 29. maddesine göre ikmalen vergi tarhının dayanağını defterler, kayıtlar ve belgeler oluşturmaktadır. Ayrıca, mükelleflerin düzenli ve güvenilir bir belge sistemi oluşturmalarını teşvik etmek amacıyla, belge düzenine aykırı davranışlar için çeşitli idari yaptırımlar öngörülmüştür. Vergi Usul Kanunu'nun ikinci kitabının üçüncü kısmı "vesikalar" başlığını taşımakta olup, bu kısmın ikinci bölümünde fatura ve fatura yerine geçen belgeler düzenlenmiştir. Kanunda fatura yerine geçen belgeler arasında perakende satış belgeleri, gider pusulası, müstahsil makbuzu, serbest meslek makbuzu ve ücret bordrosu gibi evraklar yer almaktadır. Teknolojik gelişmelerin etkisiyle belge düzeni elektronik ortama taşınmış ve bu kapsamda e-fatura uygulaması hayata geçirilmiştir. VUK'un 397 sıra numaralı Genel Tebliği ile faturaların elektronik ortamda düzenlenmesine ilişkin usul ve esaslar belirlenmiştir. Bunun yanı sıra, elektronik belge uygulamalarında uygulama birliğinin sağlanması ve mevzuat karmaşasının önlenmesi amacıyla 509 sıra numaralı Vergi Usul Kanunu Genel Tebliği yayımlanmıştır. Bu düzenlemeler çerçevesinde e-fatura sistemi, kâğıt ortamında düzenlenen faturaların elektronik ortamda oluşturulmasını ve Gelir İdaresi Başkanlığı'nın veri sistemlerine iletilmesini mümkün kılan bir yapı sunmaktadır. İlgili tebliğlere göre e-faturalar, hukuki sonuçları bakımından kâğıt faturalarla aynı geçerliliğe sahiptir (Yıldız ve Duru, 2020: 83).

Son yıllarda e-fatura uygulamasının yaygınlaşmasıyla birlikte, sisteme kayıtlı mükellef sayısında ve düzenlenen e-fatura sayısı ile tutarlarında önemli artışlar gözlemlenmiştir. Bu durum, elektronik belge sistemlerinin vergi idaresi ve mükellefler açısından etkinliğinin giderek arttığını göstermektedir.

2.1.2.2. Yol Denetimi ve Akaryakıt İstasyon Denetimi

Yol denetimleri, ticari, sınai ve zirai nitelikteki malların üretim ve dağıtım sürecinde belge düzeninin yerleşmesini sağlamak ve şehirlerarası yolcu taşımacılığında kayıt dışılığı önlemek amacıyla uygulanan yaygın vergi denetim yöntemlerinden biridir. Bu denetimlerde, taşımaya konu mallar ve yolcu faaliyetleri kapsamında düzenlenmesi gereken irsaliyeli fatura, sevk irsaliyesi, taşıma irsaliyesi, ambar teslim fişi ile yolcu taşıma biletleri gibi belgelerin mevzuata uygunluğu kontrol edilmektedir. Yol denetimleri, diğer yaygın ve yoğun vergi denetim türlerine kıyasla daha yüksek güvenlik önlemleri gerektirmektedir. Bu nedenle denetimlerin emniyet birimleriyle koordinasyon içinde yürütülmesi ve çoğunlukla şehir giriş ve çıkış noktalarında veya polis kontrol noktalarında gerçekleştirilmesi esas alınmaktadır. Bu uygulama hem denetim elemanlarının güvenliğini sağlamakta hem de denetimin etkinliğini artırmaktadır (GİB, Yol Denetim Rehberi, 2016d: 7-8).

Vergi gelirleri içerisinde önemli bir paya sahip olan akaryakıt sektörü, denetim faaliyetlerinin yoğunlaştığı alanlardan biridir. Akaryakıt ve benzeri ürünlerden elde edilen vergi gelirlerinin toplam vergi gelirleri içindeki yüksek oranı, bu sektörde yapılacak denetimlerin kamu maliyesi açısından stratejik önem taşımasına neden olmaktadır. Bu çerçevede akaryakıt istasyonlarına yönelik denetimler, vergi kayıp ve kaçağının önlenmesi ile sektörde adil rekabet ortamının korunması açısından kritik bir işleve sahiptir. Akaryakıt istasyonu denetimleri, klasik yoklama faaliyetlerinden farklı olarak teknik bilgi ve uzmanlık gerektiren bir denetim türüdür. Bu denetimler ağırlıklı olarak, istasyonlardaki pompalarla entegre çalışan ödeme kaydedici cihazların kontrolü üzerinden yürütülmektedir. İlgili mevzuat uyarınca, akaryakıt istasyonu işletmecilerine pompalarını ödeme kaydedici cihazlara bağlama ve bu sistemleri aktif şekilde kullanma yükümlülüğü getirilmiştir. Akaryakıt satışlarının belgelendirilmesi ise satış işlemi tamamlandığında cihazlardan otomatik olarak üretilen fişler aracılığıyla sağlanmaktadır (GİB, Yol Denetim Rehberi, 2016c: 4-5).

Ayrıca, Vergi Usul Kanunu kapsamında yayımlanan ilgili genel tebliğlerle akaryakıt istasyonlarında yeni nesil ödeme kaydedici cihaz uygulamasına geçilmiş ve pompa bazlı satışların elektronik ortamda izlenmesi hedeflenmiştir. Bu düzenlemeler, akaryakıt sektöründe denetim kapasitesinin artırılmasına ve vergisel şeffaflığın güçlendirilmesine katkı sağlamaktadır.

Belirli dönemlerde gerçekleştirilen denetimler sonucunda kesilen idari para cezaları da bu denetimlerin caydırıcılık boyutunu ortaya koymaktadır.

2.1.2.3.Bandrollü Ürünler ile Kısa Süreli Konut Kiralama Faaliyetlerinin Denetimi

Gelir İdaresi Başkanlığı tarafından, tütün mamulleri ile alkollü içki sektörlerinde faaliyet gösteren üretici ve ithalatçı firmaların etkin biçimde izlenmesi amacıyla 2007 yılından itibaren Bandrollü Ürün İzleme Sistemi uygulamaya konulmuştur. Bu sistem, vergi kayıp ve kaçağının önlenmesi ve vergilendirmede adaletin sağlanması hedefleri doğrultusunda, teknolojik imkânlardan yararlanarak mükelleflerin gerçek vergi matrahlarının tespit edilmesini amaçlamaktadır. Bu kapsamda, yurt içinde üretilen veya ithal edilen tütün mamulleri ile alkollü içki ürünleri, bandrol, kod ve kodlanmış etiketler aracılığıyla izlenmektedir (GİB, Bandrol Denetim Rehberi, 2016e: 4). Bandrollü Ürün İzleme Sistemi çerçevesinde yürütülen denetimlerin konusunu; tütün mamulleri ve bira dâhil olmak üzere alkollü içki ürünleri oluşturmaktadır. Denetim faaliyetleri, ülke genelinde bu ürünlerin üretim, ithalat, toptan ve perakende satış aşamalarında faaliyet gösteren tüm gerçek ve tüzel kişileri kapsamakta; ayrıca açık alkollü içki satış noktaları da denetim alanına dâhil edilmektedir. Sistem kapsamında gerçekleştirilen denetimlerin yıllar itibarıyla sonuçları, denetlenen mükellef sayıları üzerinden değerlendirilmektedir. Öte yandan, apart, pansiyon ve günübirlik kiralama faaliyetlerine konu olan gayrimenkullere yönelik denetimler de kayıt dışı ekonomiyle mücadelede önemli bir araç olarak öne çıkmaktadır. Bu denetimler yalnızca vergisel uyumun sağlanması açısından değil; aynı zamanda kamu güvenliği, toplum sağlığı, hukuka aykırı faaliyetlerin önlenmesi ve suçla mücadele bakımından da önem taşımaktadır. Günlük veya haftalık konut kiralama faaliyetlerinin sunduğu ekonomik avantajlar, bu alanın vergilendirilmesini ve idari denetimini zorunlu kılmaktadır (Yıldız ve Duru, 2020: 87).

Bulgular

Çalışma bulguları, yoklama müessesesinin Türk vergi denetim sisteminde temel ve tamamlayıcı bir araç olduğunu ortaya koymaktadır. Yoklama, vergiyi doğuran olayın ve fiilî durumun yerinde tespit edilmesini sağlayarak beyan esasına dayalı vergilendirme sisteminin işlerliğini desteklemekte; özellikle mükellefiyetin tesisine, terkine ve faaliyetin fiilen sürdürülüp sürdürülmediğinin belirlenmesinde idare açısından hızlı ve pratik sonuçlar üretmektedir. Bununla birlikte yoklamanın kapsam itibarıyla sınırlı olması ve doğrudan tarh veya yaptırım süreci doğurmaması, vergi kayıp ve kaçağının tespitinde tek başına yeterli bir denetim aracı olmasını engellemektedir. Elektronik yoklama uygulamaları ise denetim süreçlerini hızlandırarak idari maliyetleri azaltmakta ve bilgi paylaşımını güçlendirmektedir; ancak bu

uygulamaların etkinliği, tespitlerin içeriğine bağlı olup, yüzeysel kayıtların ileri denetim aşamalarına yeterli veri sağlamadığı görülmektedir. Bu nedenle e-yoklamanın yalnızca teknik değil, yöntem ve içerik bakımından da geliştirilmesi gerekmektedir.

Yaygın ve yoğun vergi denetimleri, belge düzeni, yol kontrolleri ve sektörel denetimler yoluyla kayıt dışı ekonomiyle mücadelede önemli bir işlev üstlenmekte; sahada ve anlık olarak yürütülmesi sayesinde caydırıcı etki yaratmaktadır. Ancak bu denetim türünün mevzuatta açık ve bağımsız bir denetim yöntemi olarak düzenlenmemiş olması, hukuki dayanağın yoklama kapsamında değerlendirilmesine ve yetki sınırlarının belirsizleşmesine yol açmaktadır. Ayrıca denetimlerin ağırlıklı olarak kayıtlı mükellefler üzerinde yoğunlaşması, denetim etkinliğini sınırlamaktadır. Bu çerçevede, yoklama ve elektronik yoklama uygulamalarının risk temelli denetim anlayışıyla bütünleştirilmesi ve yaygın-yoğun vergi denetiminin mevzuatta açık biçimde düzenlenmesi hâlinde, vergi adaletinin sağlanması ve kayıt dışı ekonominin azaltılması yönünde daha etkili sonuçlar elde edilebileceği değerlendirilmektedir.

Sonuç

Beyan esasına dayanan vergilendirme sistemlerinde vergi denetimi, mükellef beyanlarının doğruluğunu sağlamak ve vergilendirmeye esas fiilî durumun tespitini mümkün kılmak açısından vazgeçilmez bir idari araçtır. Türk Vergi Sisteminde bu amaca hizmet eden denetim yöntemleri arasında yoklama, uygulamadaki pratikliği ve hızlı sonuç üretme kapasitesi nedeniyle önemli bir yere sahiptir. Vergi Usul Kanunu'nda hukuki dayanağı bulunan yoklama, vergisel olayların yerinde tespiti suretiyle idarenin bilgi edinme ve denetim fonksiyonunu yerine getirmesine imkân tanımaktadır.

Bu çalışmanın amacı; yoklama, elektronik yoklama ve yaygın-yoğun vergi denetimi uygulamalarını hukuki ve idari boyutlarıyla ele alarak, bu denetim türlerinin vergi sistemindeki işlevlerini ve kamu gelirlerinin kalitesine olan etkilerini değerlendirmektir. Çalışma kapsamında yapılan incelemeler, yoklamanın denetim sürecinin başlangıç noktasını oluşturduğunu, ancak mevcut mevzuat ve uygulama çerçevesiyle denetim kapasitesinin sınırlı kaldığını ortaya koymaktadır. Özellikle yoklama işlemlerine ilişkin yetki kullanımı, elkoyma uygulamaları ve hukuki güvenceler bakımından normatif belirsizliklerin bulunduğu tespit edilmiştir. Dijitalleşme süreciyle birlikte uygulamaya alınan elektronik yoklama, denetim süreçlerinin hızlandırılması, idari maliyetlerin azaltılması ve bilgi akışının etkinleştirilmesi açısından önemli bir gelişme olarak değerlendirilmektedir. Ancak bu uygulamanın beklenen faydayı sağlayabilmesi, risk analizi temelli bir yaklaşımla yürütülmesine ve diğer denetim türleriyle bütüncül bir yapı içerisinde ele alınmasına bağlıdır. Bununla birlikte yaygın ve yoğun vergi denetimlerinin, kayıt

dışı ekonomiyle mücadelede ve özellikle vergi kaydı bulunmayan ya da gelirlerini eksik beyan eden mükelleflerin tespitinde kritik bir rol üstlendiği görülmektedir.

Çalışmanın bulguları, yaygın ve yoğun vergi denetiminin mevcut mevzuatta yoklama başlığı altında değerlendirilmesinin, bu denetim türünün kapsam ve etkinliğini sınırladığını göstermektedir. Bu nedenle söz konusu denetimlerin, yoklamadan bağımsız ve daha geniş yetkilerle donatılmış bir vergi denetim türü olarak yeniden yapılandırılması gerektiği sonucuna ulaşılmıştır. Ayrıca denetim faaliyetlerinin yalnızca kayıtlı mükellefler üzerinde yoğunlaşmasının, kamu gelirlerinin niteliğini artırmada yetersiz kaldığı; denetim odağının kayıt dışı alanlara yöneltilmesinin zorunlu olduğu değerlendirilmektedir.

Sonuç olarak, Vergi denetiminde etkinliğin artırılabilmesi için teknolojik imkânların daha sistematik ve yaygın biçimde kullanılması, yoklama müessesesinin hukuki çerçevesinin güçlendirilmesi ve yaygın-yoğun vergi denetiminin kurumsal bir yapı altında, bağımsız bir denetim modeli olarak mevzuatta açık ve net şekilde düzenlenmesi gerekmektedir. Bu yönde atılacak adımların, vergi adaletinin sağlanmasına, kayıt dışı ekonominin azaltılmasına ve sürdürülebilir kamu gelirlerinin elde edilmesine önemli katkılar sunacağı değerlendirilmektedir. Her ne kadar yoklama müessesesi, vergi incelemesine kıyasla hukuki bağlayıcılığı ve yaptırım gücü bakımından sınırlı bir nitelik taşısa da sistematik takip mekanizmaları ve elektronik uygulamalarla desteklenmesi hâlinde vergi güvenliğinin sağlanmasına kayda değer ölçüde katkı sağlayacağı açıktır. Bu yönde atılacak adımların, vergi adaletinin sağlanmasına, kayıt dışı ekonominin azaltılmasına ve sürdürülebilir kamu gelirlerinin elde edilmesine önemli katkılar sunacağı değerlendirilmektedir.

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KONUŞUYORUZ ÖYLEYSE VARIZ…
BEYAZ YAKALILARDA İŞYERİNDE KÜÇÜK SOHBETLER

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ÖZET

Günlük yaşam akışında oluşan ve sıradan, anlamsız ve havadan sudan konuşma olarak ifade edilen küçük sohbetler hem özel yaşamda hem de işyerinde gerçekleşmektedir. İşyerinde gerçekleşen bu tür küçük sohbetler bireylerin örgütsel anlamda sosyalleşmesine de katkı sunabilmektedir. Bu çalışma, günlük iş hayatındaki kısa süreli diyalogların diğer bir deyişle sosyal konuşma ve fiili iletişim olarak iki alt kategoriye ayrılan küçük sohbetlerin (small talk) çalışanlar açısından anlamını ve etkisini anlamak için gerçekleştirilmiştir. Bunun için nitel yöntemle gerçekleştirilen araştırmada beyaz yakalı araştırma grubuyla yarı-yapılandırılmış görüşme gerçekleştirilerek bulgular elde edilmiştir. Araştırmanın sonuç ve önerileri gelecek araştırmalara ışık tutmaya yönelik anlam bulabilir.

Anahtar Kelimeler: İşyerinde küçük sohbetler, beyaz yakalılar, nitel yöntem.

WE SPEAK, THEREFORE WE EXIST… SMALL TALKS AMONG WHITE-COLLAR WORKERS AT THE WORKPLACE.

ABSTRACT

Small talks, described as mundane, meaningless, and trivial conversations that occur in the flow of daily life, takes place both in private life and in the workplace. These types of small talks in the workplace can also contribute to the organizational socialization of individuals. This study was conducted to understand the meaning and impact of short-term dialogues in daily work life, in other words, small talks, which is divided into two subcategories: social conversation and actual communication, on employees. For this purpose, in the research conducted using a qualitative method, findings were obtained through semi-structured interviews with a white-collar research group. The results and recommendations of the research may be meaningful in shedding light on future research.

Keywords: Small talks in the workplace, white-collar workers, qualitative method.

1. GİRİŞ

Küçük sohbetlerin ilk tanımı ya da bir iletişim biçimi olarak en erken ve prototipik formülasyonu, Malinowski (1923/1999) tarafından "son derece açık bir durum" hakkında "sadece kelime

alışverişiyle birlik bağlarının kurulduğu bir konuşma türü" olarak tanımlanmasıyla ortaya çıkmıştır (Malinowski, 1923/1999: 303-304). Aslında bu noktada küçük sohbetlerin insanlar arasında bilgilendirme, eylemsel anlamda bir araya getirme veya herhangi bir düşünceyi ifade etme gibi bir görevi bulunmadığı söylenebilir. Küçük sohbetler "sadece arkadaşlık ihtiyacıyla bir araya gelen insanlar arasında kişisel birlik bağları kurmaya" hizmet etmektedir (Malinowski, 1923/1999: 303-304).

İşyerinde küçük sohbetlere yönelik yazın çalışmalarında, küçük sohbetlerin işlevleri üç yön içerecek şekilde geliştirilmiştir. İlk olarak küçük sohbetler işyeri etkileşimlerinin sınırını belirleyen bir *söylem işlevi* görmektedir. İkinci olarak meslektaş ilişkilerini kuran ve sürdüren bir *sosyal işlevi* ortaya koymaktadır. Son olarak ise *güç ilişkisini kuran bir işlevdir* (Holmes, 2000a; Holmes ve Stubbe, 2003). Küçük sohbetler, kişinin iş ekibine 'ait olduğunu' göstermek için gerekli olabilmektedir (Holmes, 2000a, 2000b). Küçük sohbetlerde ne çıkan ya da yetenekli olmak, 'çekici ve dışa dönük bir sosyal tavır sergilemek' anlamına gelir ki bu da iş arkadaşlarını olumlu yönde etkilemede büyük bir etkiye sahip olabilir ve hatta görevler en üst verimlilikle yapılmadığında ortaya çıkan rahatsızlığı bile bastırabilir (Holmes ve Fillary, 2000: 288; Cui, 2015: 3-23). Method vd. (2021) ise çalışmalarında küçük sohbetleri ofis içinde sosyal bir ritüel olarak ele almış hem cesaretlendirici etkisi olduğunu hem de zaman zaman dikkat dağıtıcılığı olduğunu vurgulamışlardır.

İşte günlük yaşam akışında oluşan ve sıradan, anlamsız ve havadan sudan konuşma olarak da ifade edilebilen küçük sohbetler hem özel yaşamda hem de işyerinde gerçekleşmektedir (Jaworski, 2000). İşyerinde gerçekleşen bu tür küçük sohbetler bireylerin örgütsel anlamda sosyalleşmesine de katkı sunabilmektedir. Bu çalışma, günlük iş hayatındaki kısa süreli diyalogların diğer bir deyişle sosyal konuşma ve fiili iletişim olarak iki alt kategoriye ayrılan küçük sohbetlerin çalışanlar açısından anlamını ve etkisini anlamak için gerçekleştirilmiştir. Bunun için nitel yöntemle gerçekleştirilen araştırmada beyaz yakalı araştırma grubuyla yarı-yapılandırılmış görüşme gerçekleştirilerek bulgular elde edilmiştir.

2. ARAŞTIRMA VE BULGULAR

Araştırmada beyaz yakalı çalışanlar açısından küçük sohbetlerin anlamını ve etkisini değerlendirmek amacıyla “amaçlı örnekleme yöntemine” bağlı olarak araştırma grubu oluşturulmuştur. Cresswell (2003) nitel bir araştırma için katılımcı sayısının 8 ile 30 kişi arasında değişebileceğinin ifadesiyle hareket edilmiştir. Araştırmada katılımcı sayısının belirlenmesi kapsamında veri doygunluğu ve veri yeterliliği gibi iki temel faktörün dikkate alınması gerektiği görüşü ile hareket edilmiştir. Veri doygunluğu yeni verilerin mevcut bilgilere düşük düzeyde

katkı sağlaması veya herhangi bir etki oluşturmaması iken veri yeterliliği elde edilen verilerin araştırma probleminin cevaplanmasına fayda sağlayacak düzeyde olmasıdır (Kanten vd. 2018: 943). Bu noktada görüşlerini açık, net ve nesnel olarak ifade edebilecek 12 beyaz yakalı katılımcı ile yarı-yapılandırılmış görüşmeler gerçekleştirilmiştir.

Çalışmada veriler yarı-yapılandırılmış görüşme tekniği kullanılarak yüz yüze görüşmeler yapılarak elde edilmiştir. Görüşme formunun hazırlanması aşamasında yazın incelemesi yapılmış ve incelemeye bağlı olarak sorular oluşturulmuştur. Oluşturulan sorular form haline getirilmiş ve geçerliliği için uzman görüşüne başvurulmuştur. Belirlenen alanında 3 uzman soru formunu değerlendirmiştir. Görüşme formunda açık uçlu sorular ile demografik betimleme için sorular sorulmuştur. Araştırma katılımcılar ile yapılan görüşmeler 01 Haziran 2025 ile 01 Temmuz 2025 tarihleri arasında ortalama 20-30 dakika arasında süreler ile tamamlanmıştır. Görüşmeler esnasında ses kayıt cihazı kullanılmamış, görüşmeler not tutma yöntemiyle yazılı olarak kayıt altına alınmıştır.

Araştırma grubunda yer alan beyaz yakalıların demografik bilgilerinin yer aldığı Tablo 1'de toplam çalışma süresi, mevcut işletmede çalışma süresi, yaş, eğitim düzeyi, beyaz yakalı iş deneyimi ve medeni durum kapalı uçlu soru ile katılımcı yengelere sorulmuştur. Yanıtlar tabloda betimlenmiştir.

Tablo 1: Demografik Bilgiler

Toplam Çalışma Süresi (Yıl)	Mevcut İşletmede Çalışma Süresi	Yaş	Eğitim Düzeyi	Beyaz Yakalı İş Deneyimi (Yıl)	Medeni Durum
10	7	32	Lisans	5	Evli
12	8	38	Lisans	2	Evli
10	8	29	Lisans	4	Bekar
11	7	32	Lisans	4	Evli
8	4	29	Lisans	2	Bekar
7	6	37	Yüksek Lisans	3	Evli
12	6	48	Yüksek Lisans	6	Evli
14	8	41	Ön-Lisans	4	Evli
8	7	39	Lisans	5	Evli
9	6	31	Lisans	4	Evli
8	4	32	Lisans	4	Evli
9	4	34	Lisans	4	Evli

Demografik veriler incelendiğinde toplam çalışma süresinin 7 yıl ile 14 yıl arasında değiştiği, mevcut işletmede çalışma süresinin 4 yıl ile 8 yıl arasında olduğu, katılımcıların 29 yaş ile 48 yaş arasında değiştiği görülmüştür. Ayrıca katılımcıların ağırlıklı olarak lisans mezunu olduğu, beyaz yakalı olarak iş deneyimlerinin olduğu ve ağırlıklı olarak evli olduğu tespit edilmiştir.

Araştırma grubunda yer alan beyaz yakalı kişilere ilk olarak işyerinde küçük sohbetlerin onlar açısından önemini belirlemek için "küçük sohbetlerin ne olduğuna ilişkin fikirleri sorulmuştur."

Bu sorudaki amaç araştırma grubunda yer alan kişilerin öncelikle ilgili kavramı anlamlandırmalarını sağlamaktır. Küçük sohbetlere araştırma grubunda yer alan kişilerce yüklenen anlamlar aşağıdaki tabloda özetlenmiştir.

Tablo 2: Küçük Sohbetleri Anlamlandırma

Katılımcıların Anlamlandırmaları	Frekans	Yüzde
Kısa ve öz	5	% 41.66
Öylesine	2	% 16.66
Dedikodu	2	% 16.66
Pozitif konuşma	2	% 16.66
Kahve arkası	1	% 8.33

Tablo 2'de yer alan ifadeler değerlendirildiğinde bazı katılımcıların bu anlamlandırmayı destekleyen ifadeler bulunmaktadır. Aşağıdaki örnekler bu yönde ifadelerdir.

> *"...Katılımcı 7...Küçük sohbetler kısa fikir alışverişidir. Bizi bir arada tutar ve işe ısındıran kısa süreli sohbetlerdir...Katılımcı 9...Küçük sohbetler iş arasında, öncesinde birer dedikodudur. Bize hemen ve ayaküstü bilgi üretir..."*

İkinci olarak araştırma grubunda yer alan beyaz yakalılara küçük sohbetlerin çalışmanıza pozitif katkısına ilişkin bir soru yöneltilmiştir. Katılımcıların bu soruya yönelik yanıtları kısa süren sohbetlerin çalışmamıza pozitif yönde etki ettiğine yönelik gerçekleşmiştir. Aşağıdaki katılımcı ifadeleri bu durumu destekler niteliktedir.

> *"...Katılımcı 4...Küçük sohbetler işletme içinde kaynaşma sağlamaktadır. İşe yeni girenler bu sayede bir kaynaşma yaşamakta ve alışma süresi hızlanmaktadır...Katılımcı 6...Bu sayede rutin bir iş temposu çözülmekte ve keyif veren bir mutluluk üretmektedir..."*

Üçüncü olarak araştırma grubunda yer alan katılımcılara küçük sohbetlerin çalışmanıza negatif etkisi olup olmadığı sorulmuştur. Bu soruya yanıt veren katılımcıların bir kısmı zaman zaman negatif durumlar da oluşturabileceğini vurgulamışlardır. Aşağıdaki katılımcı ifadeleri bu durumu destekler niteliktedir.

> *"Katılımcı 1...Zaman zaman sohbetler uzamakta ya da başka bir şekilde mesleki hastalık yaratmaktadır...Katılımcı 11...Küçük sohbetler sosyalleşme sağlarken aynı zamanda iş akışını engelleyebilmektedir..."*

3. SONUÇ

Yazında küçük sohbetlerin çalışanların işte günlük olumlu sosyal duygularını güçlendirdiğini, örgütsel vatandaşlık davranışlarını artırdığını ve iş günü sonunda iyi oluşu beslediğini göstermektedir (Method vd., 2021: 1445-1471). Dahası verimliliği artırdığı (Hessing, 1991), örgüt içi grup çalışmalarında başarıyı artırdığı ve işbirliğini güçlendirdiği (Holmes, 2000a; Holmes ve Fillary, 2000), çatışmaların çözümünü kolaylaştırdığı (Sotirin, 2000), rutin, kısa ve

sık etkileşimlerin mutluluk ve keyif verdiği (Roy, 1959) ifade edilmektedir. Bu çalışmalar yazında küçük sohbetlerle ilgili pozitif sonuç üreten çalışmalardır. Ancak yazında negatif sonuç üreten çalışmalar da bulunmaktadır. Method vd. (2021) dikkat dağıttığını ifade ederken; Jett ve George (2003) bireylerin iş sonuçlarını olumsuz engelleme yaparak performanslarını düşürdüğünü belirlemişlerdir. Genel anlamda değerlendirildiğinde küçük sohbetlerin kibar, ritüelvari ve formüle dayalı doğasının hem moral verici hem de dikkat dağıtıcı olduğunu göstermektedir (Method vd., 2021: 1445-1471; Yıldırım vd., 2023: 186-197).

Yazında yer alan bu sonuçlar bu çalışmayı da destekler niteliktedir. Nitekim bu çalışma sonucunda da küçük sohbetlerin pozitif yönleri ve negatif yönleri vurgulanmıştır. Bu çalışmanın özgünlük üretecek kısmı ise katılımcıların iş akışını bozacağını vurgulamış olmalarıdır. Pozitif anlamda ise katılımcılar küçük sohbetlerin sosyal bir yapıştırıcı özelliği olacağını ifade etmiş olmalarıdır.

Sonuç olarak denilebilir ki, küçük sohbetler bazı işletmelerde/çalışanlarda faydalı olabilirken bazıları için zararlı olabilmektedir. Bu nedenle işletmeler küçük sohbetleri pozitif bir araç olarak kullanmadan önce çalışanlarının kişilik özelliklerine dair mutlak bilgi sahibi olmalıdırlar. Bu araştırmanın bir sınırlaması, sadece katılımcı sayısı ile sınırlı olmasıdır. Gelecekteki araştırmalar, daha farklı ortamlarda ya da farklı yöntemler kullanarak küçük sohbetlerin olası etkilerini anlamayı amaçlamalıdır.

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PAYLAŞIMLI OFİSTE ÇALIŞMAK: BEKLENTİLER VE SORUNLAR

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ÖZET

Esnek çalışma, uzaktan çalışma ve/veya hibrit çalışma gibi kavramlar özellikle bilgi ve iletişim teknolojilerindeki gelişmelerin ardından yaşanan değişimlerin ürünleri olarak ifade edilmektedir. Bu ürünler beraberinde örgütten bağımsız bir mekan kavramını ön plana çıkarmaya başlamıştır. Sürekli bulanık hale gelen iş ve yaşam alanlarının ayrıştırılmasında yeni bir gerçek olarak karşımıza paylaşımlı ofis kavramı çıkmaktadır. Bu çalışmanın amacı paylaşımlı ofiste çalışan bireylerin çalışma esnasındaki beklentilerine ve sorunlarına odaklanmaktadır. Bu amaçla nitel bir yöntem kullanılarak paylaşımlı ofiste çalışan bireylerle yarı-yapılandırılmış görüşme gerçekleştirilmiştir. Elde edilen bulgular gelecek araştırmalara yön verici nitelikte olabilir.

Anahtar Kelimeler: Esnek çalışma, paylaşımlı ofis, nitel yöntem.

WORKING IN A SHARED OFFICE: EXPECTATIONS AND CHALLENGES

ABSTRACT

Concepts such as flexible work, remote work, and/or hybrid work are expressed as products of the changes that have occurred, especially following developments in information and communication technologies. These products have brought to the forefront the concept of a space independent of the organization. In the constantly blurring lines between work and life, the concept of shared offices emerges as a new reality. The aim of this study is to focus on the expectations and problems of individuals working in shared offices. For this purpose, a semi-structured interview was conducted with individuals working in shared offices using a qualitative method. The findings obtained may guide future research.

Keywords: Flexible work, shared office, qualitative method.

1. GİRİŞ

Ofis mimarisinin gelişimi paylaşımlı ofisi ön plana çıkarmaktadır. Özellikle yeşil odaklı çalışmalar ve anlayışın oluşması, ekonomiklik ve verimlilik temaları insan bakış açısını etkinleştirmektedir (Yao, 2025: 3-13; Valitabar vd., 2025). Dahası özellikle esnek çalışma ve esnek çalışma sistemlerinin ön plana çıkması insanların artık birlikte kullanabilecekleri bir mimari tasarıma ihtiyacı doğurmuştur. Örgütten/işletmeden bağımsız bir mekanın değerli olması

ile karşımıza paylaşımlı ofis çıkmaktadır. Bu çalışmanın amacı paylaşımlı ofiste çalışan bireylerin çalışma esnasındaki beklentilerine ve sorunlarına odaklanmaktadır. Bu amaçla nitel bir yöntem kullanılarak paylaşımlı ofiste çalışan bireylerle yarı-yapılandırılmış görüşme gerçekleştirilmiştir.

2. KAVRAMSAL ÇERÇEVE

Paylaşımlı ofise yönelik ilk uygulamaların Anglo-Sakson ülkelerinde küçük ve orta büyüklükteki işletmelerde yerel ekonomiyi canlandırma projesi olarak ortaya çıktığı ifade edilmektedir (Hartog vd., 2018). Birden fazla kişinin kullanabildiği ofisler birden fazla işletmenin kullandığı, ortak hizmetlerin sunulduğu ve gerçekleştiği mekanlar olarak gelişmeye başlamıştır (Calder ve Courtney, 1992; Weijs-Perrée vd., 2016). Bu gelişme o kadar ilerlemiş ve farklı sektörlerde faaliyette bulunan işletmelerin birlikte çalışabildiği ortak, yaratıcı, yeni, açık bir çalışma ortamı sunarak son yıllarda dünya çapındaki ofis sayısının ellibine ulaştığı tahmin edilmektedir (Statistica Research Department, 2023).

Paylaşımlı ofis kavramı "küçük ölçekli işletmeler, start-up'lar ya da serbest çalışanlar için işbirliğini, yaratıcılığı, fikir paylaşımını, ağ oluşturmayı, sosyalleşmeyi ve yeni iş fırsatlarını yakalama adına farklı sektörlerden profesyonellerin bir araya gelerek kullandığı esnek, paylaşıma açık, kiralanabilir ve topluluk odaklı yapılar" olarak tanımlanmaktadır (Füzi, 2015: 462). Başka bir ifade tarzıyla paylaşımlı ofis çalışanların arasında etkileşim deneyimi sunan ekosistemler olarak değerlendirilmektedir (Hutter ve Fariıas, 2017). Paylaşımlı ofis aslında paylaşım ekonomisinin ilham verici itici gücü olarak ifade bulmaktadır (Belk, 2014).

3. ARAŞTIRMA VE BULGULAR

Araştırmada örneklem belirlenirken yazından yararlanılmıştır. Van de Koevering (2017) tarafından yapılan çalışmada paylaşımlı ofisi kullananlar girişimciler, serbest çalışanlar, kendi işinin sahipleri ve öğrenciler olarak betimlenmektedir. Bu betimlemeye bağlı olarak araştırmada amaçlı örnekleme yöntemine bağlı olarak start-up girişimcilerden katılımcılar oluşturulmuştur. Cresswell (2003) nitel bir araştırma için katılımcı sayısının 10 ile 30 kişi arasında değişebileceğini ifade etmektedir. Ancak araştırmada katılımcı sayısının belirlenmesi kapsamında "veri doygunluğu ve veri yeterliliği" gibi iki temel faktörün dikkate alınması gerektiği görüşü ile hareket edilmiştir. Veri doygunluğu yeni verilerin mevcut bilgilere düşük düzeyde katkı sağlaması veya herhangi bir etki oluşturmaması iken veri yeterliliği elde edilen verilerin araştırma probleminin cevaplanmasına fayda sağlayacak düzeyde olmasıdır (Kanten vd. 2018: 943). Bu noktada görüşlerini açık, net ve nesnel olarak ifade edebilecek 18 çalışan ile yarı-yapılandırılmış görüşmeler gerçekleştirilmiştir.

Araştırma kapsamında veriler yarı-yapılandırılmış görüşme tekniği kullanılarak online platformlarda görüşmeler yapılarak elde edilmiştir. Görüşme formunun hazırlanması aşamasında yazın incelemesi yapılmış ve incelemeye bağlı olarak sorular oluşturulmuştur. Oluşturulan sorular form haline getirilmiş ve geçerliliği için uzman görüşüne başvurulmuştur. Belirlenen 3 uzman soru formunu değerlendirmiştir. Görüşme formunda açık uçlu 2 temel soru ile demografik betimleme için 6 soru sorulmuştur. Araştırma katılımcılar ile yapılan görüşmeler 15 Ekim 2025 ile 01 Kasım 2025 tarihleri arasında gerçekleştirilmiştir. Araştırmaya yönelik demografik betimleme aşağıdaki tabloda gösterilmiştir.

Tablo 1: Demografik Betimleme

Cinsiyet	Medeni Durum	Yaş	Eğitim Durumu	Start-up Faaliyeti	Paylaşımlı Ofis Kullanımı
Kadın (5)	Evli (8)	20-30 Yaş (6)	Lise (1)	Satış (6)	1-3 Yıl (14)
Erkek (13)	Bekar (10)	31-40 Yaş (7)	Önlisans (4)	Çözüm ortaklığı (4)	3-5 Yıl (2)
		40-50 Yaş (5)	Lisans (13)	Destek (4)	5-10 Yıl (2)
				Yönetici (4)	

Demografik betimlemede görüldüğü gibi katılımcıların ağırlığı erkeklerden oluşmakta, medeni durumları bekar olarak görülmekte ve yaş ağırlığı (31-40 yaş) arasında yer almaktadır. Eğitim durumları ağırlıklı olarak lisans iken, start-up faaliyeti satış odaklı ve paylaşımlı ofis kullanımı 1 yıl ile 3 yıl arasındadır.

Araştırmada katılımcılara iki ana eksende sorular yöneltilmiştir. İlk eksende paylaşımlı ofiste çalışmanın beklentilerini belirlemeye yönelik motivasyon soruları sorulurken; ikinci eksende paylaşımlı ofisteki sorunları keşfetmeye yönelik sorular sorulmuştur. İlk eksendeki sorularda paylaşımlı ofis vurgusuna bağlı olarak katılımcıların beklentileri keşfedilmeye çalışılmıştır. Beklentilere yönelik 5 ana kavramın betimlendiği görülmektedir. Aşağıdaki tablo beklentileri özetlemektedir.

Tablo 2: Paylaşımlı Ofisten Beklentiler

Beklentiler	Frekans	Yüzde
İşbirliği	7	% 38.89
Ekoloji	5	% 27.78
Yalnızlık	3	% 16.67
Sosyal Sermaye	2	% 11.11
Estetik	1	% 5.55

Tablo 2 incelendiğinde paylaşımlı ofisten beklentilerin ağırlıklı olarak işbirliği bağlamında olduğu ifade edilebilir. Yazında da bu yönde çalışmaların olduğu görülmektedir (Fuzi, 2015; Ferguson, 2013). İşbirliği girişimcilerin en önemli beklentisi iken onu ekoloji, yalnızlık, sosyal sermaye ve estetik takip etmektedir.

İkinci eksendeki sorularda ise katılımcılara paylaşımlı ofisle ilgili olarak sorunlarına yönelik sorular sorulmuştur. Katılımcılar paylaşımlı ofis ile ilgili olarak sorunlarını 3 ana başlık altında vurgulamışlardır. Aşağıda yer alan Tablo 3 sorunları betimlemektedir.

Tablo 3: Paylaşımlı Ofis Sorunları

Sorunlar	Frekans	Yüzde
Lokasyon	8	% 44.44
Mimari	6	% 33.33
Zaman Geçirme Alanları	4	% 22.23

Tablo 3 incelendiğinde paylaşımlı ofise yönelik katlımcıların en büyük sorunlarının lokasyon sorunu olduğu ifade edilebilir. Katılımcılar daha uygun ve kendilerinin daha kolay ulaşabilecekleri lokasyonları tercih etme eğilimine bağlı olarak byle bir beklentiye girmektedirler. Lokasyon sorununu mimari ve zaman geçirme alanları sorunları takip etmektedir.

4. SONUÇ

Yazında paylaşımlı ofiste çalışanların rol geçişlerinin ardındaki motivasyonları ve bu motivasyonların paylaşımlı ofislerde bağımsız çalışanlar arasındaki rol iletişimini nasıl şekillendirdiğini anlamaya yönelik çalışmada kendilerini motivasyonel anlamda daha özgür hissettiklerini ve mesleki kimliklerini daha iyi gerçekleştirdiklerini vurgulamaktadırlar (Walden, 2019: 316-330). Ayrıca çalışanların yaratıcılığını artırdığı ifade edilmektedir (Wu ve Zhang, 2024: 173-191).

Bu çalışmada da paylaşımlı ofisleri kullananların beklentilerinin ve sorunlarının yazınla benzer sonuçlar ürettiği görülmektedir. Yazındaki beklentilere benzer beklentiler ortaya çıkmakla birlikte sorunlar bakımından lokasyon sorunun ön planda olduğu görülmektedir. Gelecek araştırmalarda bu çalışmada uygulanan yöntem ve teknikten bağımsız bir şekilde farklı örneklemlere daha geniş çapta çalışmalar yapılabilir. Farklı coğrafyalardan oluşan kişilerden oluşan katılımcı gruplarının beklenti ve sorunları karşılaştırılabilir.

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THE ROLE OF AS SUNNAH FOUNDATİON İN COMBATİNG POVERTY AND UNEMPLOYMENT İN BANGLADESH :A REVİEW FROM THE PERSPECTİVE OF SOCİAL JUSTİCE

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ABSTRACT

Poverty and unemployment remain two of the most persistent socioeconomic challenges in Bangladesh, disproportionately affecting vulnerable populations and hindering the attainment of social justice. Within this context, faith-based civil society organizations play a significant complementary role alongside state-led initiatives. The As-Sunnah Foundation represents one such institution of Bangladesh that mobilizes Islamic social finance, particularly zakat, sadaqah, and community donations to provide structured poverty alleviation, employment generation, and skill-development interventions. This study lies in examining how an Islamic nonprofit organization translates religious obligations into sustainable development practices and measurable socioeconomic outcomes.

The existing literature on zakat institutionalization, Islamic social justice, and faith-based welfare activities highlights the potential of organized zakat distribution in reducing structural poverty. Building upon this literature, the present study reviews the As-Sunnah Foundation as a case that operation lies these theoretical principles at the grassroots level.

This research employs a mixed method approach, where document analysis used as part of qualitative research and field observation used to collect quantitative data. Organizational reports, case-based evidence, various books, journal articles, institutional publications, and publicly available statistical sources also used in this research. The study also examines project-specific information regarding beneficiary selection processes, financial policies, training programs, and development initiatives.

The results indicate that the As-Sunnah Foundation plays a significant role in reducing poverty and unemployment by focusing on sustainable, skill-oriented, and productivity-based interventions. The “Individual Self-Sufficiency (Shabolombi) Project” alone has provided income-generating tools to 5,129 beneficiaries, enabling many to transition from dependency to stable income generation. Skill development programs have trained nearly 2,500 youths, many of whom secured employment or began entrepreneurial activities. Seasonal relief, disaster

response programs, and student housing initiatives further contribute to social protection and equal opportunity. Overall, the findings demonstrate that an institutional and transparent zakat-based model can serve as an effective mechanism for promoting social justice, economic empowerment, and community resilience in Bangladesh.

Key word: Poverty elevation, Unemployment, Social Justice, Sustainable development.

Introduction

Poverty stands out as one of the most fundamental and chronic problems of the contemporary world. As one of the major structural issues faced by individuals and societies throughout human history, poverty constitutes a multi-layered problem area not only in economic terms but also in its social, cultural, and moral dimensions. Islam, as a system of life compatible with human nature, prioritizes the material and spiritual well-being of the individual and defines combating poverty as a religious responsibility. In this context, zakat is one of the five pillars of Islam. It is regarded not only as an individual act of worship but also as an effective economic instrument for establishing social justice.

Bangladesh, the eighth most populous country in the world, struggles with poverty and unemployment. Although the Bangladeshi government has taken various measures to address these issues, these efforts are often insufficient. Therefore, in addition to state-supported initiatives, civil society organizations and private initiatives also play significant roles. In this regard, the As-Sunnah Foundation stands out as an institutional structure that serves as a model in reducing poverty and unemployment through modern and scientific methods. The strategic distribution mechanisms developed by the organization for those in need across the country demonstrate the potential of zakat to generate the intended social benefits.

In this study, the practices of the As-Sunnah Foundation operating in Bangladesh are analyzed, and the issue of reducing poverty and unemployment is discussed within the framework of social justice.

Research Method

This study is a qualitative research presented in the light of various data and information. As sources, newspapers, journals, and various scholarly works were used to provide the necessary information on the topic.

Literature Review

In our study, many works written in English, Turkish, Arabic, and Bengali on the subject of zakat have been utilized. In addition, some Arabic and Urdu books translated into Bengali were also consulted. In his work “Zakat–Tax Relationship in the Context of Negative Income Tax”, Dr.

İsmail Yılmaz emphasizes the importance of institutionalizing zakat and discusses issues such as reducing the income gap between the rich and the poor and increasing its effectiveness in combating poverty.

Mervan Selçuk and Şakir Görmüş, in their book "Institutionalization of Zakat: Global Practices and Model Proposal for Türkiye", examine zakat as an institutional structure and discuss both historical and contemporary applications in different countries.

In Öznur Özdemir's work "Conquest, Kharaj, Economics: Social Justice in the Era of Caliph 'Umar", the implementation of the kharaj tax during the period of Caliph 'Umar is evaluated from a social justice perspective. In our study, sections related to justice and social justice from this work were used.

Muhammad Akram Khan's "Issues in Islamic Economics: Current Condition and Future Analysis" contributes to the evaluation of social justice through his thoughts on zakat.

In "Zakat and Ushr" written by Prof. Dr. A. S. M. Tarikul Islam, the rewards of giving zakat and the factors related to achieving social justice are discussed.

In "Selected Articles in Islamic Economics", written by Prof. Shah Muhammad Habibur Rahman of Rajshahi University's Department of Economics, there is an article focusing on the role of zakat in poverty reduction and social welfare.

Additionally, Dr. Javed Muhammad, in his book "Zakat in the Islamic Economic System", discusses the penalty for not giving zakat, the nisab threshold, ushr, zakat-eligible individuals, and sadaqat al-fitr.

Author Farishta J. D. Jayas, in "The Law and Philosophy of Zakat", addresses the fundamental principles of zakat law, tax and zakat administration, and related topics. Dr. Javed Muhammad's aforementioned book "Zakat in the Islamic Economic System" once again thoroughly covers fundamental issues related to zakat.

Researchers Muhammad Hamidur Rahman and Abul Kalam Muhammad Obaidullah, in their joint article "Zakat Management in Bangladesh: An Evaluation" (Bangladesh Economic Association, 2021), present a comprehensive analysis of the definition, evidences, management methods, and institutions of zakat.

Dr. Meraj Ahmad Meraj, in his article "Zakat: Islamic Device for Social Justice", examines zakat as an Islamic tool for ensuring social justice.

This article aims to evaluate the activities of the As-Sunnah Foundation from different perspectives, focusing on its role in reducing poverty and unemployment within the context of social justice.

Poverty and Unemployment in Bangladesh: Current Situation

Despite demonstrating economic growth in recent years, Bangladesh continues to struggle with fundamental socioeconomic problems such as poverty and unemployment. As of 2022, the national poverty rate stands at 18.7%, and this rate is considerably higher in rural areas (Bangladesh Bureau of Statistics [BBS], 2024).[i] In contrast, the proportion of the population living in extreme poverty, defined as living on less than USD 2.15 (PPP) per day is around 5% (World Bank, 2024a).[ii] According to the expanded poverty threshold of USD 3.65 (PPP), approximately 30% of the population lives below this line (World Bank, 2024a). [iii] Despite the post-COVID-19 economic recovery in 2022, the World Bank projects that the extreme poverty rate may rise from 6.1% to 7.0% during the 2024–2025 period. This trend raises concerns about the sustainability of Bangladesh's previous achievements in poverty reduction (World Bank, 2024b).[iv]

The unemployment rate appears relatively low. As of 2024, the overall unemployment rate was recorded at approximately 4.68% (Statista, 2024). However, unemployment is significantly higher among the youth population. Among individuals aged 15–24, the unemployment rate reached 11.46% in 2024 (World Bank, 2024c). This figure indicates structural challenges in integrating young people into the labor market.

For sustainable social development, Bangladesh needs to focus not only on economic growth but also on social policies addressing income inequality and labor market reforms. In particular, reducing rural poverty, tackling youth unemployment, and investing in skill-based education and training play a critical role in establishing long-term social justice.

1.1 Introduction to the As-Sunnah Foundation

In the modern era, Islamic civil society organizations do not limit themselves solely to religious education and preaching activities; they also play active roles in social welfare, moral rehabilitation, and individual development (Esposito, 2003; Mandaville, 2007).[v] In this context, the As-Sunnah Foundation stands out in Bangladesh as a civil society model shaped by Islamic principles. Founded in 2017 under the leadership of Sheikh Ahmadullah, the foundation carries out its work in three main fields: education, religious outreach (da'wah), and humanitarian assistance supported by zakat funds, charitable donations, and contributions from its permanent and periodic members.[vi]

The As-Sunnah Foundation, headquartered at Aftabnagar, Road No. 3, Block C, House 70, Dhaka 1212, was established in 2017 and officially registered in 2019 under the registration number S-13111/2019 with the Joint Stock Companies and Firms office of the Government of

Bangladesh. The founder of the foundation, Sheikh Ahmadullah, is widely known in the country for his Islamic scholarship and his balanced, moderate approach to religious outreach (Sheikh Ahmadullah, 2024; Rahman, 2021).[vii]

1.2 Principles of the As-Sunnah Foundation:

The fundamental references of the As-Sunnah Foundation are the Qur'an and the authentic Sunnah of Prophet Muhammad (peace be upon him). The foundation bases its understanding and practice of these two primary sources on the interpretations of the *Salaf al-Salih* (the pious predecessors). It adopts and aims to promote the essential principles and worldview of *Ahl al-Sunnah wa'l-Jama'ah*. It encourages a religious lifestyle free from shirk (associating partners with Allah) in belief and free from bid'ah (innovation) in practice.

Furthermore, it considers the unity and solidarity of the Muslim ummah as a primary principle. By adopting a moderate and balanced stance in divisive matters, the foundation aims to prevent social polarization. The foundation refrains from political involvement and avoids forming direct ties with any political party. Instead, it adheres to the principle of working for the common good and public benefit, encompassing all segments of society.

1.3 Mission of the As-Sunnah Foundation:

The core mission of the foundation is to build a life and society based on the Qur'an and the authentic Sunnah. In this direction, it conducts religious and vocational technical training programs, moral awareness seminars for society and humanity, youth-oriented camp activities, and humanitarian aid programs for the poor. In its activities, the foundation aims to use methodological tools that remain faithful to the primary sources of Islam while also being appropriate for contemporary needs (Nasr, 2006; Roy, 2004).[viii]

The foundation's approach is shaped by the methods of the early scholars of the Islamic tradition, known as the *Salaf al-Salihīn*. In this respect, the foundation adopts a text-based, academic, and superstition-free language in the transmission of religious knowledge.

1.4 Financial Resources and Revenue Models of the As-Sunnah Foundation:

The sustainability of civil society organizations largely depends on their financial capacity and the effective management of that capacity. In this context, the As-Sunnah Foundation has developed a noteworthy financial structure in terms of resource diversification. The foundation's revenue sources are shaped within a multidimensional system consisting of founding donations, community-supported funding mechanisms, and project-based income models.

The financial journey of the foundation began with the in-kind and monetary contributions made by its founding members during its establishment phase. This initial capital made it possible to build the foundation's first organizational structure and initiate its core service activities.

A significant portion of the foundation's income consists of one-time or periodic donations made by members, volunteers, and charitable supporters. These donations not only cover the foundation's basic operational expenses but also allow the diversification of community-oriented service areas.

Additionally, the As-Sunnah Foundation generates direct revenue through various social, educational, and technical projects conducted internally. The financial resources obtained from these projects not only ensure their sustainability but also contribute to the foundation's overall budget. Another financing model based on public awareness and participation is conditional donations, which are allocated for specific purposes. Donations targeted toward sectors such as education, food aid, and healthcare ensure the targeted and effective use of funds.

Moreover, in accordance with Islamic law, zakat and fitrah contributions collected from affluent Muslim individuals are administered directly by the foundation for distribution to the needy. These types of donations not only fulfill religious obligations but also function as significant tools for establishing social justice.

Seasonal and religious campaigns, such as Ramadan iftar programs and Eid al-Adha (Qurbani) initiatives, also constitute an important part of the foundation's income sources. These periodic contributions encourage broader community participation in the foundation's activities. In addition to these, the As-Sunnah Foundation occasionally receives resources through grants, sponsorships, and in-kind support from government institutions or private sector entities. Such external funding enables the foundation's project-based growth and expansion of its impact.

In the management of all these financial resources, the principles of transparency and accountability are prioritized. Additionally, to ensure the administrative sustainability of the foundation's projects, an administrative expense allocation of 5% to 10% is deducted from various projects. This allocation is intended to cover essential services such as project management, auditing, reporting, and operational coordination.

The As-Sunnah Foundation adopts a multi-layered and principled financing model, enabling it to maintain both its financial independence and its effectiveness in service areas.

1.5 Expenditure Policy of the As-Sunnah Foundation:

For civil society organizations, it is not only financial sustainability but also the transparent, auditable, and purpose-driven management of resources that is crucial for institutional credibility.

In this context, the As-Sunnah Foundation, through its expenditure policy, establishes donor confidence while demonstrating a financial structure that prioritizes Islamic sensitivities. The fundamental principle adopted by the foundation is that donations are used solely for the purposes for which they were allocated. In other words, contributions made for a specific project or sector are never diverted to other activities, ensuring strict adherence to the principle of purpose alignment.

In particular, revenues collected under the Zakat fund are distributed entirely to eligible recipients in full compliance with Islamic law. No administrative deductions are made from zakat income; these funds are directed entirely toward the intended assistance. This approach not only fulfills religious obligations but also contributes to the construction of economic justice at the societal level.

Following each project, detailed income and expenditure reports are prepared and recorded. This practice ensures the effectiveness of internal audit processes and institutionalizes accountability to the public. By reinforcing donor confidence, this practice represents a concrete example of "financial transparency" in the civil society management literature (Ebrahim, 2003; Anheier, 2005).[ix]

The foundation's accounts are audited annually by an independent and certified financial auditor. This audit process goes beyond mere technical compliance and evaluates the conformity of all financial transactions with national regulations and international accounting standards.

All financial operations are continuously monitored by an independent audit and oversight board composed of accounting experts. This structure demonstrates that the As-Sunnah Foundation adheres not only to Islamic principles but also to institutional governance standards.

The expenditure policy of the As-Sunnah Foundation serves as a model not only for financial control but also for ethical responsibility, donor satisfaction, and the safeguarding of religious sensitivities.

1.6 Activities of the As-Sunnah Foundation

The As-Sunnah Foundation is an active Bangladesh-based civil society organization shaped by religious references and prioritizing social benefit. Its activities are carried out along three main axes: Education, Social Services, and Da'wah (Religious Outreach). Through its work in these areas, the organization aims both to enhance the religious and social competencies of individuals and to foster social solidarity.

i. Educational Activities

The foundation's work in education seeks to integrate the core teachings of the Qur'an and Sunnah with modern pedagogy. Key initiatives include:

- Developing religion-based, contemporary curricula and establishing madrasas based on these curricula.
- Organizing competitions in education, culture, and life skills for different segments of society.
- Establishing a Higher Research Center to support academic competence.
- Offering periodic religious education programs for working individuals.
- Establishing educational institutions (schools, colleges, universities, technical schools) in accordance with the As-Sunnah approach.
- Expanding preschool religious education through the Sabahi Mektep model.
- Providing educational support to students at risk of dropping out due to financial difficulties.

ii. Social Assistance Activities

Social assistance initiatives, aimed at enhancing societal welfare and individual self-sufficiency, can be classified as follows:

- Vocational training (craftsmanship, technical skills, agriculture, etc.) and support with income-generating equipment.
- Aid distribution during natural disasters and emergencies.
- Iftar programs during Ramadan, and fitrah and clothing assistance during Eid festivals.
- Organizing Qurbani (sacrificial) programs on behalf of affluent individuals.
- Distribution of livelihood tools (rickshaws, sewing machines, etc.) to those in need.
- Construction of wells and water storage facilities in areas with limited access to clean water.
- Planting productive trees to promote environmental protection and food security.
- Vocational and personal development support for students.
- Care and education for widows and orphans.

iii. Da'wah (Religious Outreach) Activities

The As-Sunnah Foundation conducts Da'wah activities with a focus on the spiritual development of society under the following initiatives:

- Construction and management of mosques centered on peace and spirituality.
- Conferences, sermons, and open sessions in mosques, madrasas, and public spaces.
- Publication of books based on authentic religious knowledge.
- Awareness campaigns against shirk, bid‘ah, and social polarization.
- Thematic videos and documentaries shared via social media.
- Distribution of introductory books and brochures for non-Muslims.
- Strategies to combat religious and social prejudices.
- Family counseling, open helplines, and Youth Club activities.
- Da’wah methodology training for imams and preachers.
- Establishment of Islamic cultural centers for children.
- Creation of library and Shari‘ah advisory units.

These activities demonstrate that the As-Sunnah Foundation is not only a religious institution but also provides an effective and structured model in the areas of social development, mutual aid, and the enhancement of individual capabilities.

1.7 Activities and Role of the As-Sunnah Foundation in Reducing Poverty and Unemployment

i. Individual Self-Sufficiency (Shabolombikoron) Project:

The primary aim of the self-sufficiency project carried out by the As-Sunnah Foundation is to economically support poor, needy, and zakat-eligible individuals across Bangladesh, enabling them to become capable of sustaining their own livelihoods.

Provided Livelihood Tools:

The materials and equipment provided to participants in the project are determined according to local economic conditions and vary based on individual needs. These include large and small livestock (cows, goats), rickshaws (three-wheeled vehicles), three-wheeled cargo vehicles (vans), grocery shop materials, poultry farming equipment, sewing machines, and fishing equipment.

Funding Source

The project is entirely funded through zakat contributions collected from the public. These zakat revenues are directly provided as economic support to the eligible beneficiaries identified within the project. In this way, the project practically demonstrates the potential of zakat to promote social justice and economic equality.

Beneficiary Selection Process

The identification of beneficiaries is carried out through a systematic process with local participation. Imams, preachers, and school and college teachers across the country recommend poor individuals in their communities for the project via Google Forms. Based on these recommendations, the foundation's field officers conduct on-site assessments, evaluating candidates' homes, property, livestock, and family circumstances. Final decisions are made in light of these evaluations.

Training Process and Delivery of Materials

Before receiving livelihood tools, individuals selected for support undergo two months of religious education. Those who successfully complete this training become eligible to receive the livelihood materials. This approach demonstrates that the assistance provided has not only a material dimension but also a spiritual one.

Results and Impacts

Within the scope of this project, various livelihood support materials were provided to 1,077 individuals in 2022, 2,000 rickshaws were distributed in 2023, and different types of livelihood assistance were delivered to 2,052 individuals in 2024. Since the inception of the project, a total of 5,129 people have received economic support. A significant proportion of the participants have started earning their own income through the provided livelihood tools, and noticeable improvements in their living standards have been observed. In particular, most individuals supported through livestock assistance have increased their income as a result of animal reproduction. Those who received rickshaws and handcarts now sustain their livelihoods using these tools. Beneficiaries who received small business support are successfully operating their own enterprises. These outcomes demonstrate that the project has generated a substantial transformation at the societal level.

As-Sunnah Foundation's "Shabolombi" project presents an exemplary model for reducing poverty by ensuring social justice and economic equity through the effective and sustainable use of zakat. The project aims at development at both individual and community levels and stands out for its high success rate. The expansion of such initiatives can be considered an effective strategy for combating poverty not only in Bangladesh but also in other countries with similar socioeconomic structures.

i. Basic Needs Provision Project:

Under this project, essential assistance is provided to people in need across the country, including the distribution of food packages (containing dry food items such as rice, lentils, salt, sugar, and cooking oil), iftar packages (including local iftar items, dates, sugar, and salt), winter relief items

(such as blankets, jackets, and sweaters), and red meat distribution. The project is financed through seasonal and special religious campaign funds, such as sadaqah funds, iftar funds collected during Ramadan, and qurbani (sacrificial) funds. **Support Provided (Up to June 2025)**

Support Type	Recipient Type	2025	2024	2023	2022	2021	2020	2019	Total
Iftar Package Distribution (10 kg supplies)	Family	30,000[x]	10,300	9,270	15,000	14,670	1,369	–	50,609
Food Package Distribution (10 kg supplies)	Family	–	–	170	2,000	1,050	–	–	3,220
Winter Relief Distribution[xi]	Person	–	58,045	15,651	7,620	11,450	605	5,785	104,601
Red Meat Distribution – Large Livestock	Head	208	147	120	105	48	55	13	696
Red Meat Distribution – Small Livestock	Head	820	624	305	334	304	176	33	2,596

Support provided up to June 2025.

ii. Flood Relief Assistance Project

Bangladesh faces severe flooding every year during the monsoon season, which has devastating impacts particularly on populations living in the northern regions. Approximately 26,000 square kilometers of land are submerged, posing serious threats to agriculture, housing, and food security (Ahmed & Rahman, 2012).[xii] In response, As-Sunnah Foundation implements not only emergency relief for flood victims but also long-term support and reconstruction projects.

During flood periods, the Foundation actively operates in the field by distributing essential food and relief packages consisting of rice, lentils, cooking oil, potatoes, clothing, candles, matches, gas stoves, water purification tablets, and other urgent necessities. The major assistance items distributed to flood victims to date are outlined below.

Support Type	Recipient Type	2025	2024	2023	2022	2021	2020	2019	Total
Food Package Distribution	Family	–	120,000	7,552	75,000	–	–	–	202,552
Rice Distribution (25 kg sacks)	Sack	–	100,000	–	–	–	–	–	100,000
Cash Assistance for House Construction	Family	–	8,970	350	959	–	–	–	10,279
New House Donation	Family	–	1,500	–	–	–	–	–	1,500
Distribution of Agricultural Inputs to Farmers	Person	–	–	–	996	–	–	–	996
Distribution of Large Livestock	Person	–	–	–	105	–	–	–	105

During the major flood disaster of 2022, the Foundation distributed 1,032 metric tons of food aid. In addition, during Eid al-Adha, 105 cows were distributed to flood-affected families along with milk and animal feed. Beyond emergency relief, reconstruction- and development-oriented interventions were also implemented. In total, 959 families received housing support, and 996 flood-affected farmers were provided with financial assistance amounting to 5,000 BDT per

person. This initiative represented not only short-term relief but also a critical step toward reactivating the productive sector.

The flood relief model developed by As-Sunnah Foundation in Bangladesh represents a holistic humanitarian assistance approach shaped by religious values. Its comprehensive support packages not only meet the immediate needs of victims but also contribute to the resumption of productive activities such as agriculture and livestock farming.

iii. As-Sunnah Skill Development Project

The As-Sunnah Skill Development Project is conducted to promote personal development and skill acquisition among the youth in the country. It is a long-term educational initiative aimed at enhancing self-sufficiency, addressing youth unemployment, and facilitating employment opportunities.

So far, the foundation has implemented various modern skill development programs, including computer training, web design and coding courses, language education, shoe-making training, culinary courses, rebar tying in construction, plumbing, and driving. Among these, sewing and fashion design training for women has been one of the most successful activities. To date, every student who has completed the sewing course has received a cash grant of 70,000 Taka for capital and a sewing machine.

Through this project, approximately 2,500 individuals have received training across various programs. Many of these participants, Alhamdulillah, have either secured employment or successfully established their own businesses as entrepreneurs. Based on these results, the project aims to train 100,000 individuals annually. Within the scope of this initiative, the foundation also plans to establish its own dedicated training facility. Below are some figures illustrating the impact of these programs on beneficiaries. Training programs overview given below:

Program Name	Number of Courses	Ongoing	Completed	Total Students	Graduated Students	Ongoing Students	Employed	Started Own Business
Tailoring and Fashion Design Training	5	1	4	252	205	47	–	205
SME (Small & Medium Enterprise) Business Training	21	3	18	931	802	129	485	–
Marketing Training	2	1	1	82	43	39	16	27
English Language Training	1	1	0	139	0	139	–	–
Footwear Design and Production Training	1	1	0	23	–	–	–	–

Program Name	Number of Courses	Ongoing	Completed	Total Students	Graduated Students	Ongoing Students	Employed	Started Own Business
Driving Training	3	1	2	180	120	60	–	–
Chef Training	2	1	1	36	14	22	–	–
Web Design and Coding Training	1	–	1	50	50	–	15	–

iv. Successful Student (Medhabi) Support Project

The As-Sunnah Foundation provides temporary accommodation for students of Jagannath University, a public university located in Old Dhaka. A ten-story building in the Hasnabad area of South Keraniganj has been allocated for the students. This accommodation is part of the "Medhabi" (Successful Student) project. In the initial phase, housing for 700 male students is planned for the 2023–2024 academic year. This project already healped more than 1500 students. [xiii] Over time, the foundation aims to expand this accommodation support to reach 5,000 students. The project provides targeted financial assistance for educational expenses along with capacity-building support, enabling students to continue their studies with dignity and focus. Beyond financial aid, the project emphasizes skill development, ethical leadership, and career preparedness through mentoring and training initiatives. This integrated approach contributes to improved academic performance, reduced dropout rates, and enhanced employability among beneficiaries. By investing in human capital at the university level, the Medhabi Project promotes inclusive education and sustainable socioeconomic development in Bangladesh.

Evaluation of As-Sunnah Foundation's Activities in the Context of Social Justice

1. Social Justice and the Institutionalization of Zakat

The As-Sunnah Foundation's "Individual Self-Sufficiency Project" (Shabolombikoron) transforms the classical understanding of zakat into an institutionalized and sustainable development model. In Islam, zakat is not merely an act of worship but also a social institution aimed at ensuring income justice. In this project, zakat is converted directly into tools and capital that enhance individual productivity, aiming not just to alleviate poverty but to reduce it structurally. In this context, the project aligns with the principles of social justice, particularly "equal opportunity" and "social participation" (Rawls, 1971; Sen, 1999).[xiv]

2. Community-Based Approach and Beneficiary Selection

The process of selecting beneficiaries is not a top-down aid model; it incorporates local participation through recommendations from community leaders such as imams, teachers, and preachers. In this way, the project strengthens targeting systems based on local knowledge and

contributes to the fair distribution of social assistance. The use of digital tools such as Google Forms exemplifies the integration of modern methods with traditional values.

3. Integrated Social Assistance Through Education

The project includes not only economic but also spiritual and moral dimensions. The two-month religious training provided before receiving support positions the individual as both a productive and responsible member of society. This approach illustrates that social assistance can be value-based, not merely material.

4. Nature of Assistance and Sustainability

Livelihood tools such as rickshaws, sewing machines, and livestock are direct income-generating resources, making the impact of assistance sustainable in the medium and long term. These efforts contribute to Sustainable Development Goals (SDG 1 – No Poverty, SDG 8 – Decent Work and Economic Growth). The support provided to 5,129 individuals facilitates micro-level economic development, enhancing individual welfare and reducing social inequalities.

5. Basic Needs and Emergency Aid from a Social Equity Perspective

Although activities such as food, winter, and meat distribution are consumption-based aid, they relate to social justice by ensuring a minimum standard of living. The As-Sunnah Foundation's initiatives aim to protect marginalized populations from temporary crises and prevent social exclusion. Winter aid reaching over 104,000 people demonstrates a highly inclusive social protection mechanism.

6. Disaster Relief: Solidarity and Reconstruction in Crisis Periods

Flood relief efforts go beyond classical aid models by including reconstruction and economic recovery components. For instance, the distribution of 105 large livestock, direct cash support for home construction, and equipment provided to farmers illustrate that these projects are not merely humanitarian but also agricultural economy-based development initiatives. This demonstrates that the project plays a dual role: not only as a provider of aid but also as a builder of resilient communities.

7. As-Sunnah Skill Development Project: Capacity Building for Fair Employment

In Bangladesh, where youth unemployment is high, vocational skill development projects are valuable in terms of the social justice principle of "fair employment." Providing training to over 2,500 individuals and enabling them to gain employment as entrepreneurs or workers contributes not only to individual development but also to the productivity of society. Supporting women, particularly in sewing and fashion, further strengthens a social justice approach based on gender equality.

8. "Medhabi" Project and Equal Opportunity in Education

Providing accommodation support for higher education students facing economic difficulties is crucial for ensuring equal opportunities in education. Supporting students who are educated but face housing challenges contributes to long-term societal development. This initiative serves the social justice principle of "developing potential."

Conclusion

The projects carried out by the As-Sunnah Foundation directly align with various principles of social justice: equal opportunity, fair distribution of resources, local participation, structural poverty reduction, increased employment, and the promotion of productivity. This holistic approach provides a model that can serve as an example not only for Bangladesh but also for other developing countries with similar socioeconomic structures. The impact of these projects demonstrates how powerful transformation can be when social policies are integrated with local beliefs and values.

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SENİL OSTEOPOROZDA DEXA VE KEMİK MİNERAL YOĞUNLUĞU İLİŞKİSİ

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ÖZET

Senil osteoporoz, kemik kütlesinde azalma ve kemik mikro yapısında çeşitli derecelerde yıkım riskinin artması ile karakterize biyolojik bir süreçtir. Bu süreç kemik dayanıklılığının azalmasına ve çeşitli derecelerde kırık riskinin artmasına neden olmaktadır. Osteoporoz, genellikle ilk kırığın oluşumuna kadar sessizce devam etmektedir. WHO, osteoporozu, kemik mineral yoğunluğu (KMY) ve T skoru kullanılarak görüntüleme yöntemleri ile belirlenmektedir. Osteoporoz, T skoru< -2,5 iken hastada kırık görülmesi olarak tanımlanmaktadır. Araştırmamızın amacı yaşlı hastalarda osteoporozun önlemesi amacıyla yapılan araştırmalarda, kontrol tarama yöntemlerinden yararlanılırken görüntüleme tekniklerinden DEXA'nın avantajından bahsetmektir. Yöntem olarak DEXA ile ilgili literatür taraması yapılmıştır. Senil osteoporozda zaman içerisinde hücrede sürekli olarak birikerek moleküler yaşlanmaya sebep olan ileri glikasyon son ürünlerinin kemik mikro yapısına verebileceği zararın net olarak görüntüleme ile tespit edileceği bilinmektedir. Enerji hemostazı, DNA onarımı gibi uzamış yaşam süresine katkı sağlayacak tüm uygulamalarda çalışmalar yapılması için son yıllarda çaba sarf edilmektedir. Özellikle mitekondriyal aktivitenin arttırılması, hücresel yaşlanmanın baskılanması, telomer yıpranmasının önlenmesi ve DNA onarımı ile genom bütünlüğünün sürdürülmesine katkı sağladığı düşünülen uygulamaların test edildiği araştırmalar yapılmaktadır. Bu araştırmalarda tarama ve görüntüleme yöntemleri ile sonuca ulaşmaya çalışılmaktadır. Sağlıklı yaşlanma sürecinin öneminin vurgulanması için yaşlı grupla araştırma planlandığında, kemik yoğunluğu heterojenitesi hakkında bilgi vererek taramaya destek olan bu yöntem ile kantitatif ölçüm yapılabilmektedir. Bu alanda yapılacak yeni araştırmalarda, osteoporozu önleyici uygulamaların test edilmesinde DEXA ile kemik mineral yoğunluğuna bakılması araştırmanın etkinliğinin test edilmesinde yol gösterici olacaktır.

Anahtar Kelimeler: Yaşlanma, Senil Osteoporoz, DEXA, Kemik Mineral Yoğunluğu (KMY)

THE RELATİONSHİP BETWEEN DEXA AND BONE MİNERAL DENSİTY İN SENİLE OSTEOPOROSİS

ABSTRACT

Senile osteoporosis is a biological process characterized by a decrease in bone mass and an increased risk of various degrees of bone microstructural destruction. This process leads to a decrease in bone strength and an increased risk of various degrees of fracture. Osteoporosis generally persists silently until the first fracture occurs. The WHO defines osteoporosis using imaging methods using bone mineral density (BMD) and T-score. Osteoporosis is defined as the occurrence of a fracture in a patient with a T-score < -2.5. The aim of our research is to highlight the advantage of DEXA among imaging techniques when using control screening methods in studies aimed at preventing osteoporosis in elderly patients. A literature review of DEXA was conducted as a method. It is known that the damage to bone microstructure caused by advanced glycation end products, which continuously accumulate in cells over time and cause molecular aging in senile osteoporosis, can be clearly detected through imaging. In recent years, efforts have been made to conduct studies on all applications that will contribute to extended lifespan, such as energy homeostasis and DNA repair. Studies are being conducted specifically to test applications thought to contribute to increasing mitochondrial activity, suppressing cellular aging, preventing telomere deterioration, and maintaining genome integrity through DNA repair. These studies attempt to reach conclusions using screening and imaging methods. When research is planned with older adults to emphasize the importance of healthy aging, this method can provide quantitative measurement by providing information about bone density heterogeneity and supporting screening. In new research in this field, measuring bone mineral density with DEXA will be a guide to testing the effectiveness of osteoporosis-preventive applications.

Keywords: Aging, Senile Osteoporosis, DEXA, Bone Mineral Density (BMD)

GİRİŞ

Dünya nüfusunun yaşlanmasıyla birlikte giderek yaygınlaşan Osteoporoz, önemli bir halk sağlığı sorunu olmuştur. Senil osteoporoz, kemik gücünün azalmasıyla karakterize, bireyi kalça, vertebra ve diğer iskelet bölgelerinde kırık riskine daha yatkın hale getiren bir iskelet hastalığıdır. Bu hastalığın klinik sonuçları ve ekonomik yükü, uygun müdahale için önlem alınması gerektiğinin belirtisidir. Yüksek risk altındaki bireyleri değerlendirmeye yönelik önlemler gerektirmektedir (Lane, 2006; Atik vd., 2006).

1.Senil Osteoporoz, Kemik Mineral Yoğunluğu ve T Skoru

1.1. Senil Osteoporoz

1997 yılında ilk olarak Avrupa Osteoporoz ve Kemik Hastalıkları Vakfı ve sonrasında Uluslararası Osteoporoz Vakfı, osteoporozun tanı ve yönetimi için kılavuzlar yayınlamıştır. Bu kılavuzlar daha sonra 2008 yılında Uluslar Arası Osteoporoz Vakfı ve Avrupa Osteoporoz ve Osteoartrit Klinik ve Ekonomik Değerlendirme Derneği tarafından güncellenmiştir. O zamandan beri osteoporoz alanında önemli ilerlemeler kaydedilmiş ve kemik mineral yoğunluğunun ölçülmesi için yeni tekniklerin geliştirilmesi öngörülmüştür. Ayrıca, osteoporozda kırık riskini değerlendirmek için yeni yöntemlerin araştırılması da gerekli görülmüştür. Bu rehberlerin hazırlığında tanımı düzenlenen senil osteoporoz, şöyle tanımlanmıştır (Kanis vd., 2013): Senil osteoporoz; kemik kütlesinde azalma ve kemik mikro yapısında çeşitli derecelerde yıkım riskinin artması ile karakterize biyolojik bir süreçtir (Fujita, 1997). Bu süreç kemik dayanıklılığının azalmasına ve çeşitli derecelerde kırık riskinin artmasına neden olmaktadır (Gazzotti vd., 2023).

Osteoporoz, genellikle ilk kırığın oluşumuna kadar sessizce devam etmektedir. WHO, osteoporozu, kemik mineral yoğunluğu (KMY) ve T skoru kullanılarak görüntüleme yöntemleri ile belirlemektedir. Osteoporoz, T skoru<-2,5 iken hastada kırık görülmesi olarak tanımlanmaktadır (Gazzotti vd., 2023; Fujita, 1997). Senil osteoporozda, sadece kemiğin fiziksel özelliklerine ve gücüne yoğunlaşılmamalı, aynı zamanda kalsiyum depolama fonksiyonuna da odaklanılmalıdır (Fujita, 1997). Osteoporoz kontrol altına alınarak ve kemiğin uygun kalsiyum depolama fonksiyonunu geri kazandırarak, yaşlı hastada aynı zamanda hipertansiyon, arterioskleroz ve yaşlılık bunaması gibi kalsiyum eksikliğinden ve vücuttaki bozulmuş kalsiyum dağılımından kaynaklanan veya bu durumla şiddetlenen birçok yaşlılık hastalığı da başarıyla kontrol altına alınabilmektedir (Fujita, 1997).

Yaşlılıkta segmental kemik defektlerinin yönetimi için iyileşme aşamasında osteoporoz ile ilgili bilgi sahibi olunması gerekmektedir. Senil osteoporozda DEXA ile kemik mineral yoğunluğu (KMY) ölçümü yapmak, tanı ve tedaviyi destekleyici bir uygulamadır (Stokovic vd., 2021; Jain & Vokes, 2017).

1.2. Kemik Mineral Yoğunluğu

Kemik Mineral yoğunluğu, osteoporoz ve kırık görülmesi arasında güçlü bir ilişki bulunmaktadır. Düşük kemik mineral yoğunluğuna sahip bir bireyde osteoporozun gelişmesi

ve kırık görülmesi kaçınılmaz olabilmektedir. Osteoporozlu kişilerde diğer gruptaki bireylere oranla daha fazla kırık riski vardır. Bu risk öncesinde tayin edilebildiğinde sağlığı arttırıcı önlemler alınabilmektedir. Kemik mineral yoğunluğu ile ilgili tanılamaya destek olacak T skoru ölçümü, hastalarda osteoporozun ilerlemesi konusuda önlem alınmasına fayda sağlayacaktır (Tihud, 2025; Andersen vd., 2022; Gazzotti vd., 2023, (Kanis vd., 2013).

1.3. T skoru

Çift enerjili X-ışını absorbsiyometrisi (DEXA, DXA) ile kemik mineral yoğunluğu ölçümü, kırık riskini değerlendirmek için en yaygın kullanılan yöntemdir. DEXA, KMY'nu hesaplamak için iki farklı enerji X-ışını kullanır ve bir normatif veri tabanıyla karşılaştırılarak T-skoru belirlenmektedir. 1994 yılında Dünya Sağlık Örgütü, Osteoporozu T-skorunu kullanarak tanımlamış ve Osteoporozun tanılanmasında kolaylık sağlamıştır (Jain & Vokes, 2017; Andersen vd., 2022).

WHO, DEXA ölçümlerini osteoporozu teşhis ederken öncelikli işlem olarak görmüş ve günümüzde yapılan son çalışmalar, DEXA ile ölçülen kemik mineral yoğunluğunun tahmin edici değeri ile kıyaslama yapılmasına olanak sağlamıştır. T skorunda görülen standart sapmalar hastalığın derecesi için yol gösterici olmuştur. Kemik Mineral Yoğunluğundaki her bir standart sapma düşüşü için, kırık riskinin 1,5-2,5 kat daha yüksek olduğu bildirilmiştir.1994 yılında Dünya Sağlık Örgütü, genç Kafkas kadınların ortalamasının üstünde veya altında kalan standart sapma sayısı olan T-skorlarını kullanarak osteoporoz, osteopeni ve normal KMY'nu tanımlamıştır. T-skorunun -2,5'ten az olması, Osteoporoz, T-skorunun -1,0 ile -2,5 arasında olması Osteopeni ve T-skorunun -1,0'dan büyük olması ise normal KMY olarak tanımlanmıştır (Tablo 1) (Jain & Vokes, 2017; Andersen vd., 2022; Akpolat, 2008; Kanis vd., 2013).

Tablo 1. WHO'nun KMY'ye Göre Tanı Sınıflaması (Akpolat, 2008)

Tanım	T-skoru	Kırık Riski
Normal	T-skor >-1	Düşük risk
Osteopeni	-1 > T-skor >-2.5	Ortalamanın üstünde risk
Osteoporoz	T-skor <-2.5	Yüksek risk
Yerleşik Osteoporoz	T-skor <-2.5 ve kırık varlığı	Çok yüksek risk

2. Senil Osteoporozun Epidemiyolojisi, Etiyolojisi, Patofizyolojisi

2.1. Senil Osteoporozun Epidemiyolojisi

Yaşlı nüfus, dünyada en hızlı büyüyen nüfus grubunu oluşturmaktadır ve insanlar yaşlandıkça kemik mimarisi bozulmakta ve rejenerasyon aktivitesi gerileyerek kemik kütlesi ve kemik mineral yoğunluğu azalmaktadır. Dünya nüfusunun yaşlanması nedeniyle osteoporozun sosyal ve ekonomik yükü sürekli olarak artmaktadır. Dünya çapında yaklaşık 200 milyon kadında osteoporoz bulunmaktadır. Osteoporoz prevelansı Kuzey Amerika ve Avrupa'da en yüksek oranda ölçülmüş olsa da, bu ülkelerde nüfusun yaşam süresinin diğer ülkelerden daha uzun olması ölçümdeki yüksek oranı açıklamaktadır. Çünkü osteoporoz, yaşın artmasıyla prevelansı arttıran geriatrik bir sendromdur (Lane, 2006; Atik vd., 2006).

Osteoporoz, ilk kez kemik gözenek oranını (poroziteyi) tanımlamak için 19. yüzyılda Alman ve Fransız hekimleri tarafından kullanılan bir tıp terimi olmuştur. Osteoporoz sebepli kırık ise ilk kez 1842 yılında bildirilmiştir. Osteoporoz yaşlanan dünyamızda her iki cinsi ve tüm ırkları etkileyen aynı zamanda sıklığı her geçen gün artarak devam eden, özellikle yaşlıların yaşam kalitesini düşüren bir sağlık sorunudur. Osteoporoz ilk kırığın oluşmasına kadar fark edilemediği için sessizce devam etmektedir. Bu sessizlik aşamasında KMY oldukça düşmekte ve tedavi zorlaşmaktadır (Tihud, 2025; Kanis vd., 2013).

2.2. Senil Osteoporozun Etiyolojisi ve Patofizyolojisi

2.2.1. Senil Osteoporozun Patogenezi: Normal kemik mimari yapısının devamı osteoklastların proteolitik aktiviteler ile rezorpsiyon boşluğuna osteoid (kemiklerin organik matriksi) salgıladığı kemik rezorpsiyonu ve kemik oluşumu süreçleri arasındaki hassas bir dengeyi içermektedir. Özellikle yaşlılarda, kemik döngüsü bozulmakta ve bu durum ilerleyici kemik kaybına yol açmaktadır (Lane, 2006).

Kemik, sürekli yeniden şekillenmeye uğrayan dinamik bir süreci olan vücudun en sert dokusudur. Kemik metabolizması, bir çok faktör tarafından kontrol edilmektedir. Kemik oluşum döngüsü ve eski kemik atıklarının rezorpsiyonunu dengeleyen, düzenlenmiş bir süreci olan kemik dokusunda anabolik ve katabolik süreçler arasındaki denge korunmuştur. Osteoblast (OB) ve osteoklast (OC) aktivitesinin hassas dengesi ile devam eden süreçte, kemik homeostazı sağlanmış olmaktadır. Bununla birlikte, bu dengenin çeşitli sebeplerle bozulması kemik dokusunda metabolik bozukluklara ve hastalıklara sebep olabilmektedir (Liang vd., 2024; Qin vd., 2025; Kim vd., 2020).

Gelişmiş bir mitokondriyal kalite kontrol sistemi ile devam etmekte olan mitekondriler zararlı etkileri azaltmak ve mitokondriyal işlevselliği sürdürmek için, içsel ve dışsal stres faktörlerine uyum sağlayabilmektedirler. Bu sistemde mitekondriler, moleküler, organel ve hücresel düzenleme mekanizmalarını içeren görevlerini yerine getirmektedirler. Düzenleyici mekanizmalar arasında mitokondriyal dinamikler, mitofaji, mitokondriyal biyogenez ve mitokondriyal redoks homeostazı bulunmaktadır. Bu süreçler birbirleri ile sinerjik bir etkileşim halinde olarak, entegre bir kalite kontrol mekanizması ile devam etmektedir (Qin vd., 2025).

2.2.2. Senil Osteoporozun Etiyolojisi:

Osteoporoz ve osteoporotik kırıklar için risk faktörlerine katkıda bulunan çeşitli durumlar mevcuttur. Bu faktörler arasında klinik, tıbbi, davranışsal, beslenme, genetik değişkenler gibi durumlar bireysel farklılıklar oluşturarak Osteoporozun derecesinin her bireyde farklı olmasına sebep olmaktadır (Liang vd., 2024; Lane, 2006).

2.2.2.1. Klinik Faktörler

Yaşlı bir bireyde Osteoporozun en önemli belirleyicilerinden biri, kemik kütlesinin yoğunluğudur. Kemik kütlesine ulaşma süreci anne karnında başlayan ve ortalama olarak 40 yaşına kadar tamamlanacağı düşünülen bir süreçtir. Bu sürece en büyük katkıyı ergenlik döneminde kazanılan kemik miktarı sağlamaktadır. Özellikle kadınlarda menopozda yumurtalık fonksiyonlarının sona ermesinden sonraki ilk yıllarda kemik kaybı hızlanmakta ve kemik kütlesi yaşla birlikte azalmaya devam etmektedir. Bu nedenle, yaşlanma süreci de kemik kaybı için bir risk faktörü olmaktadır (Fujita, 1997).

Herhangi bir bölgede önceki kırık öyküsü ile gelecekteki vertebra ve kalça kırığı riski arasında bir ilişki olduğunu varsayan yazılar mevcuttur. Kemik mikro mimarisindeki ve kemik hemostazındaki dengesizliğin kırık riskini arttırabileceği bilinmektedir. Kemik hemostazının olumsuz etkilenmesine sebep olabilecek herhangi bir durum ve etken KMY'nun değişmesine sebep olabilmekte ve kemik mikro yapısının bozulmasına sebep olmaktadır (Jain & Vokes, 2017; Lane, 2006).

2.2.2.2. Tıbbi Faktörler

Primer ve Sekonder osteoporoz diye adlandırılan ayırıcı farklılıklar bulunmaktadır. Bu süreçte bilinmesi gereken yandaş hastalıkların diğer hastalıkları tetikleyebileceğidir. Bedendeki tüm süreçlerde sinerjik etkileşim olduğu bilinmekte ve bazı hastalıklar ve durumlar Osteoporozu tetikleyebilmektedir. Gastrointestinal hastalıklar, hematolojik bozukluklar ve hipogonadal

durumlar dahil olmak üzere bir dizi tıbbi bozukluğun Osteoporoz sürecini hızlandırabileceği bilinmektedir (Lane, 2006). Ayrıca, kullanılan bazı ilaçlar osteoporoza katkıda bulunabilmekte ve şiddetlendirebilmektedir. Glukokortikoidler, Alüminyum Lityum, Antikonvülsanlar, Heparin, Benzodiazepinler, Progesteron, Sitotoksik ilaçlar, Suprafizyolojik tiroksin, Tamoksifen (menopoz öncesi kullanım), Gonadotropin salgılatıcı hormon agonistleri, Total parenteral beslenme, İmmünosupresanlar gibi ve etkisi test edilebilecek bir çok ilaç Osteoporozu tetikleyebilmektedir. Bu durumda bu ilaçların uzun süre kullanımı ile kemik mimarisinin bozulmasına sebep olacak etkiler, kemik mineral yoğunluğunun azalmasına sebep olmaktadır (Gazzotti vd., 2023; Lane, 2006).

2.2.2.3. Davranışsal faktörler

Çeşitli davranışsal risk faktörleri, osteoporoz ve travma dışı kırıkların gelişme olasılığını artırmaktadır. Bu davranışsal seçimlerde sedanter yaşamın etkileri ile bedende görülen hastalıklar arasında ilişki vardır ve sağlıklı yaşam hareketlerinin önemi anlaşılmaktadır. (Sigara tüketilmesi, Alkol kullanılması, Düşük fiziksel aktivite, Kafein alımı, D vitamini eksikliği vb. Hemostazı bozabilecek tıbbi durumlar) (Lane, 2006).

2.2.2.4. Beslenme faktörleri

Diyetle alınan kalsiyum miktarı, kemik mineral yoğunluğu ile orta derecede ilişkilidir. D vitamini eksikliği, daha yüksek kemik döngüsü, azalmış kalsiyum emilimi ve ikincil hiperparatiroidizmden kaynaklanan kemik kütlesi kaybı durumlar kırıklar için bilinen bir risk faktörüdür. Ayrıca, diüretikler, kortikosteroidler, antikonvülsanlar, immünosupresif ilaçlar, nonsteroid antiinflamatuar ilaçlar, kortikosteroid içeren astım ilaçları ve bir dizi antibiyotik de dahil olmak üzere bir dizi reçeteli ilacın kalsiyum emilimini etkilediği gösterilmiştir (Lane, 2006).

2.2.2.5. Genetik faktörler

Irk, ve cinsiyet kemik mineral yoğunluğunun ve kırık riskinin temel belirleyicisi olmasa da belirleyicilerinden biridir. Farklı ırk, etnik gruplar ve cinsiyet arasında yapılan çalışmalardan elde edilen insidans oranları, kadınların genel olarak erkeklere göre daha yüksek kırık oranlarına sahip olduklarını bildirilmiştir (Stokovic vd., 2021; Lane, 2006).

3. Senil Osteoporoz'da Tanı Kriterleri

Osteoporoz sessizce devam edebilen ve genellikle ilk kırık oluştuğunda tespit edilebilen bir hastalıktır. Ancak ortalama 40 yaşından sonra ayırıcı belirtilerinin takip edilmesi gereken önemli bir halk sağlığı sorunudur (Kanis vd., 2013).

3.1. Radyografik İnceleme

Radyografik İnceleme, normalde 3 boyutlu olan kemik yapısında kemiğin mikro mimarisi için tam bir görüntü vermese de tek açıdan 2 boyutu göstererek bazı durumlarda hızlı erişilebilir olmasıyla avantajlıdır. Dokuların ve organların şekil bozukluğunu ve dokudaki anormal görüntüleri tespit etmede yeterli olabilmektedir. Osteoporozda kırık görülmesi bu duruma bir örnektir (Kazakia & Majumdar, 2006; Tihud, 2025).

3.2. Manyetik Rezonans

Manyetik rezonans (MR)'da görüntülemede üç boyutlu görüntüler üretilmektedir. MR, güçlü bir manyetik alan ve bir dizi radyo frekans dalgaları kullanan iyonlaştırıcı olmayan bir yöntemdir. Protonlar, gradyan alanları ve radyo frekansı dalgaları arasındaki etkileşimler, uzamsal frekans kodlamasına dayalı bir görüntü oluşturulmasına olanak tanır (Kazakia & Majumdar, 2006). Kas-iskelet dokusunda bulunan hidrojen, biyolojik MR görüntülemede en sık incelenen bileşendir. Kemik dokusunun su içeriği çok düşüktür. Ek olarak, kemik dokusu matrisindeki protonların T2 gevşeme süresi çok kısadır. Bu durum, protonların kimyasal ortamını yansıtan bir MR ölçütüdür. Sonuç olarak, kemik standart MR'da sinyal vermez. Bunun yerine trabeküler ağ, kemik iliği görüntülemesi yoluyla dolaylı olarak ortaya çıkarılır. Yüksek çözünürlüklü T2 ağırlıklı MR görüntülerinde, kemik dokusundan yeterli sinyal alınmadığı için siyah görünürken, kemik iliği yeterli miktarda su ve yağ içerdiği durumlarda trabeküler boşluklarda yüksek yoğunluklu bir sinyal üretir. Üretilen bu sinyal ile beyaz görüntü alınmış olur (Kazakia & Majumdar, 2006; Glüer vd., 1997).

3.3. Kemik Mineral Yoğunluğu Ölçüm Yöntemleri

Kemik mineral yoğunluğunun ölçümü, osteoporoz tanısının temelini oluşturmaktadır (Tablo 2) (Lewiecki, 2010).

Tablo 2. Kemik mineral yoğunluğu için ölçüm endikasyonları

65 yaş ve üzeri kadınlar
Kırık riski taşıyan 65 yaş altı menopoz sonrası kadınlar
Menopoz geçiş döneminde olan ve düşük vücut ağırlığı, daha önce geçirilmiş kırık veya yüksek riskli ilaç kullanımı gibi kırık için klinik risk faktörlerine sahip kadınlar
70 yaş ve üzeri erkekler
Kırık riski taşıyan klinik risk faktörlerine sahip 70 yaş altı erkekler
Kırılganlık kırığı olan yetişkinler
Kemik kütlesinin düşük olması veya kemik kaybıyla ilişkili bir hastalığı veya durumu olan yetişkinler
Kemik kütlesinde azalmaya veya kemik kaybına neden olan ilaçlar kullanan yetişkinler
Farmakolojik tedavi için değerlendirilen herkes
Tedavi gören herkes için, tedavi etkisinin izlenmesi amacıyla.
Kemik kaybı belirtileri gösteren ve tedavi gerektirecek durumda olan ancak tedavi görmeyen herkes

Kemik mineral yoğunluğu, çeşitli tekniklerle ölçülebilmektedir. DEXA, günümüzde en yaygın kullanılan tekniktir. Ancak, yapılan çalışmalarda, tüm kemik dansitometri ölçüm tekniklerinde ve sağladıkları verilerin yorumlanmasında minimal doğruluk hataları bulunduğu ifade edilmiştir (Kröger & Reeve, 1998; Rossini vd., 1998; Kanis vd., 2013).

İskeletin değerlendirilmesine yönelik yöntemlerin geliştirilmesinde kaydedilen önemli ilerlemeler, osteoporozun non-invaziv yöntemlerle ve erken dönemde tespit edilmesini mümkün kılmaktadır. Günümüzde kullanılan çeşitli teknikler mevcuttur: Bu teknikler; tek fotonlu (SPA) ve tek X-ışını absorbsiyometrisi (SXA), çift fotonlu (DPA) ve DEXA, kantitatif bilgisayarlı tomografi (QCT), Periferal kantitative komputerize tomografi (pQCT), radyografik absorbsiyometri (RA), MR ve kantitatif ultrason (QUS)'dur. Bu tekniklerin geliştirilmesi, düz radyografinin bu amaç için sahip olduğu eksikliklerin üstesinden gelme ihtiyacından kaynaklanmıştır. Hem SPA hem de SXA yöntemleri, iskeletin periferik bölgelerinde kemik mineral yoğunluğunun kantitatif değerlendirmesini mümkün kılmaktadır. Ancak değişken doku kalınlığı olan alanlarda ölçümde kısıtlılık görülmektedir ve bu amaçlar için DPA ve DEXA teknikleri geliştirilmiştir. Görüntüleme tekniklerinden X-ışını sistemlerinin radyonüklid (Anatomik bilgiler veren görüntüleme yöntemleri) sistemlerine göre başlıca avantajları, daha kısa muayene süresi, daha yüksek çözünürlükte görüntü vermesidir. Düşük radyasyon dozu, erişilebilirlilik, birden fazla bölgeyi değerlendirme kapasitesi ve kullanım kolaylığı, kemik mineral yoğunluğunu ölçmek için DEXA'yı en yaygın kullanılan teknik haline getirmiştir (Rossini vd., 1998; Kröger & Reeve, 1998; Glüer vd., 1997; Cheng vd., 1997; Lewiecki, 2010).

3.3.1. Tek foton ve tek X- ışın absorbsiyometrisi (SPA ve SXA): 1895 yılında, Röntgen tarafından keşfedilen X-ışınları, kemik yapılarının değerlendirilmesinde günümüzde de geçerli bir yöntemdir. Direkt radyografik incelemelerin, kemik yoğunluğu açısından yeterli olmadığı göz önüne alınarak, 1930 yılından itibaren bu konudaki araştırmalar ivme kazanmış ve 1963'de kemik mineral içeriğini değerlendirmeye yönelik ilk yöntem geliştirilmiştir. Bu teknik, SPA yöntemi olarak bilinmektedir. Daha sonra aynı amaca yönelik pek çok yöntem geliştirilerek kullanılmaya devam edilmiştir. Aslında elde edilen değer taranan alandaki kemik mineral içeriğidir ve gr/cm² olarak ifade edilir. KMY, "kemiğin içeriği" değerinin, "kemik alanı" değerine bölünmesiyle elde edilmektedir (Borg vd., 1995; Rossini vd., 1998; Glüer vd., 1997; Akpolat, 2008).

I. Single Photon Absorbtiometry (SPA): Bu metod; I-125 kaynağından yapılan düzenli monoenerjetik foton demetinin, bir ekstremiteden radyasyon ile geçisinin, Na iodid içeren ve radyoaktif cisim parıltılarını saptayan bir dedektör ile ölçülmesidir. Bu teknik, sadece yumuşak doku kalınlığının sabit olduğu vücut bölgelerinde kullanılabilmektedir ki bu da, distal radius ve ulna ile sınırlı kalmaktadır (Borg vd., 1995; Rossini vd., 1998; Glüer vd., 1997; Akpolat, 2008).

II. Single Energy X-Ray Absorbtiometry (SEXA): Yumuşak dokuların kalınlığı, ölçüm sonuçlarını etkilediği için, dokuların az olduğu kalkaneus ve ön kol gibi bölgelerde ölçüm yapılabilmektedir. X-ışını kaynağı ile yaklaşık 5 dk süren bu işlem ucuz, hızlı ve taşınabilir bir tekniktir. Alınan radyasyon dozu 1µSv'dir (Borg vd., 1995; Rossini vd., 1998; Glüer vd., 1997; Akpolat, 2008).

3.3.2. Dual Photon Absorbtiometry (DPA): İki foton demetinin, iki farklı enerji ile ölçülmesidir ve kaynak Gadalinium'dur. Tüm vücut, lumbal vertebra veya femur ölçülebilmektedir. Radyasyon dozu, 10 milirem (mrem) kadardır (100 mrem = 1 mSv). KMY ve kemik mineral içeriği konusunda kantitatif değerler verebilen bu teknik, duyarlı ve özgül bir yöntem olmakla birlikte, her yaş grubunda kırık riski sınırının ayrılarak araştırılması gerektiği göz önünde bulundurulduğunda kısıtlı kalmaktadır. Bu aşamada yalancı negatif sonuç verebilmesi, radyoizotop madde maliyetinin yüksek olması, yılda bir kez kaynağın değiştirilme zorunluluğu ve buna bağlı olarak hata payının artması gibi olumsuzluklar görülebilmektedir (Akpolat, 2008).

3.3.3. Dual Enerji X-ray Absorbsiyometri (DEXA): DEXA, projeksiyon görüntüsünü oluşturmak için iki farklı enerjiye sahip X-ışınları kullanır. Bu projeksiyon görüntülerinden iki

ölçüm hesaplanır ve kemik kütlesini belirlemek için kullanılır. Bu ölçümler, alansal kemik mineral yoğunluğu (g/cm²) ve kemik mineral içeriğidir (Kazakia & Majumdar, 2006; Andersen vd., 2022). Günümüzde halen altın standart olarak tanımlanan bu teknikte, enerji spektrumundaki değişikliklerin yaratacağı problemler, otomatik iç referans sistemi ile çözümlenmiştir. Işın, önce absorbsiyon materyali içeren bir ayarlama diskinden, sonra hastanın dokusundan geçer ve hastadan elde edilen değer, absorbsiyon materyalinden alınan değere oranlanarak ölçülmektedir. En küçük farklılıkları ayırt edebilme yeteneği olan yüksek rezolüsyon ile elde edilen görüntüler, ard arda incelemeler sırasında aynı bölgenin ölçümünü sağladığı için, netliğe önemli ölçüde katkı sağlamaktadır. Duyarlılık oranı yüksek olan DEXA, tüm vücut, ön-arka ve lateral lumbal vertebra ve femurbaşı ölçümü yapabilmektedir. Tarama iki boyutludur (gr/cm²) ve alansal yoğunluğu vermektedir. Aynı zamanda periferik ölçüm de yapılabilmektedir. Alınan radyasyon dozu 15 mrem'dir ve DPA gibi düşük bir radyasyon dozu ile çalışmasına rağmen DPA'dan daha yüksek rezolüsyon yeteneği ile daha küçük farklılıkları ayırt edebilmektedir (Akpolat, 2008; Kanis vd., 2013).

DEXA'nın avantajları arasında düşük radyasyon dozu, düşük maliyet, kullanım kolaylığı ve hızlı ölçüm gibi kolaylıklar yer almaktadır. Ek olarak, DEXA, KMY ölçümü, T skoru değerlendirmesi için "altın standart olarak kabul edilmektedir. Ancak, DEXA ölçümlerinin kısıtlı olduğu alanlar vardır. Bu iki boyutlu teknik, kemiğin sert tabakası olan kortikal kemik ve süngerimsi tabakası olan trabeküler kemik arasında ayrım yapamaz ve kemik geometrisinden kaynaklanan değişiklikleri yalnızca artan kemik yoğunluğundan kaynaklanan değişikliklerden ayırt edemez. Değişken yumuşak doku yoğunluğu ve vertebra osteoartriti durumlarında hatalar meydana gelebilmektedir. Ancak yine de diğer yöntemlerden üstünlükleri fazladır (Kazakia & Majumdar, 2006; Andersen vd., 2022; Jain & Vokes, 2017; Kröger & Reeve, 1998; Rossini vd., 1998; Lewiecki, 2010**)**.

3.3.4. Kantitatif Ultrasonografi (QUS): Son zamanlarda, kemik özelliklerini değerlendirmek için alternatif bir yöntem olarak kantitatif ultrason (QUS) tanıtılmıştır. QUS'nun X-ışını tekniklerine göre avantajları arasında düşük maliyet, taşınabilirlik ve iyonlaştırıcı olmayan radyasyon yer almaktadır. QUS avantajlarından bahsederken, bu teknolojinin sadece yoğunluk hakkında değil, aynı zamanda kemiğin yapısı ve mekanik özellikleri hakkında da bilgi sağlayabileceği iddia edilmektedir (Cheng vd., 1997). Ancak, Osteoporozun uzun süreli

takibinde ve ilaç tedavisinin etkinliğinin kontrolünde uygun bir yöntem olarak kabul edilmemektedir (Tihud, 2025; Akpolat, 2008).

Düşük maliyeti, taşınabilir olması, non-iyonizan radyasyona maruziyet ve kemik yapısı konusunda fikir vermesi açısından, epidemiyolojik araştırmalarda önerilen bir yöntemdir. Kalkaneus ve patellada, trabeküler kemiği, tibiada, kortikal kemiği ve el-ayak falankslarında integral kemiği yani tüm flanksı değerlendiren teknikleri içermektedir. Ultrason dalgasının yayılım hızı veya ses hızı, ölçülen vücut kısım genişliğinin geçiş süresine oranı (m/sn) ile hesaplanır. Dalgada zayıflama, dalgada disfonksiyon, dağılma, absorbsiyon ve konversiyon ile enerjinin uzaklaşması, ultrason sinyalini zayıflatabilmektedir. Trabeküler kemikte baskın olan zayıflama mekanizması, dağılma iken, kortikal kemikte, absorbsiyon zayıflamaktadır (Akpolat, 2008; Rossini vd., 1998).

3.4.Kemik Mikro Mimari Görüntüleme Yöntemleri

3.4.1. Kantitative komputorize tomografi (QCT: Hacimsel (gr/cm³) mineral yoğunluk ölçümü yapan bir tekniktir. 8-10 mm kalınlıktaki kesitler, vertebraların orta hattından geçirilir. Radyasyon dozu, 200-900 mrem arasında değişmektedir. Yani radyasyon dozu 2 mSv ile 9mSv arasında değişmektedir. Bu doz, diğer tekniklerden (SPA, SXA, DPA, DEXA, Periferal kantitative komputerize tomografi-pQCT, radyografik absorbsiyometri-RA), non-iyonize radyasyonlu MR ve QUS dahil tüm yöntemlerde kullanılan dozlardan yüksektir (Rossini vd., 1998; Kröger & Reeve, 1998).

Trabeküler kemiğin, kortikal kemikten ayırt edilebildiği bir tetkiktir. Kemiğin iki farklı yapısının ayırt edilebilmesi, tekniğin çözünürlülüğünün yüksek olduğunun göstergesidir. Vertebra gibi derin ve anatomik olarak çeşitli dokuların yan yana olduğu alanlar haricinde görüntüde kalsifikasyonlar net görülebilmektedir. Diğer tüm alanlarda kalsifikasyonlar dahil tüm yapılar görüntüde net bir şekilde incelenebilmektedir. Bu yöntemde, en küçük yapıların ayırt edilebildiği yüksek rezolüsyonlu görüntüler elde edilmektedir. Kullanım amacı, kemik yoğunluğundan ziyade kemiğin süngerimsi yapısının, trabeküllerin durumunun değerlendirilmesidir. İnce kesitler, trabeküler ağı göstermede başarılıdır. Ancak, oldukça pahalı bir yöntemdir (Akpolat, 2008; Gazzotti vd., 2023; Lewiecki, 2010).

Bu görüntüleme yönteminde görüntüdeki kesitlerde trabeküler fragmantasyon indeksi (trabeküler ağ uzunluğunun trabekül devamsızlıklarına oranı) bakılarak osteporozlu hastaları, normal sağlıklı kişilerden ayırt etmek amaçlanmıştır. Fakat trabeküler fragmantasyon indexi

kırıkları çok iyi ayırt etmesine rağmen, vertebra dayanıklılığını değerlendirmede tek başına yeterli olamamaktadır. Alanın genişliğine ve çekimin uzunluğuna göre alınan radyasyon dozu 60 mSv'e kadar çıkabilmektedir (Akpolat, 2008; Gazzotti vd., 2023; Lewiecki, 2010).

3.4.2. Periferal kantitative komputerize tomografi (pQCT): Apendiküler kemikte distal Radius ve distal Tibiada mineralizasyon hakkında 3 boyutlu bilgi vermektedir. Kullanımı kolay ve ucuzdur. Tüm vücuda göre, periferal apendiküler kemikte görüntüleme yapılacağı için daha düşük doz iyonizan ışın vardır. Trabeküler kemik hakkında yeterli bilgi vermesi bir avantajdır. Ancak periferde çalışılması, vertebra ve proksimal femurda çalışılamaması dezavantajdır. KMY ölçümünde tek başına yeterli değildir. Kemik mimari yapısının görüntülemesinde apendiküler kemiklerde, periferik olarak kullanılan bir tekniktir. *pQCT,* epidemiyolojik çalışmalarda kullanılabilir, ancak çok sayıda kesitler alındığında doğru sonuçlar elde edilebildiği için derin dokularda QCT'nin kullanımı daha yaygın olmaktadır. *(*Tihud, 2025; Gazzotti vd., 2023; Lewiecki, 2010).

SONUÇ VE ÖNERİLER

Senil osteoporoz ile ilgili yapılan araştırmalarda tarama ve görüntüleme yöntemleri ile sonuca ulaşılmaya çalışılmaktadır. Tekniklerin kendileri arasında avantaj-dezavantaj dengelerinin literatürde incelenmesi göstermiştir ki DEXA, osteoporozun tanı, prognoz ölçümü, hastalık takibi ve tedaviye yanıtta kullanılacak en iyi yöntemdir. DEXA, pahalı bir uygulama olduğu için toplum taraması çalışmalarında önerilmemektedir. Ancak, bireysel hasta takibinde kullanılacak en avantajlı yöntem olarak görülmektedir.

Tüm teknolojilerin karşılaştırılmalı özelliklerinin bilinmesi ile hastaya göre en ideal yöntemin seçilmesi amaçlanmıştır. Özellikleri bakımından avantajlı olduğu bulunanan DEXA ile KMY ölçümü takibi literatürde de avantajları ile açıklanmıştır (Tablo 3) (Lewiecki, 2010).

Tablo 3. Kemik mineral yoğunluğu ölçmek için kullanılan teknolojilerin karşılaştırılmalı özellikleri

Özellik	**DEXA**	**DPA**	**QUS**	**QCT**	**pQCT**	**SPA**	**SXA**	**MR**	**RA**
Teşhis (DSÖ)	Evet	Sınırlı	HAYIR	HAYIR	HAYIR	Sınırlı	Sınırlı	Sınırlı	Sınırlı
Kırık riski tahmini	Evet	Evet	Evet	Evet	Evet	Evet	Evet	Evet	Evet
İzlem	Evet	HAYIR	HAYIR	Evet	HAYIR	Kısmen	Kısmen	Kısmen	Kısmen
İyonize radyasyon	Evet	Evet	HAYIR	Evet	Evet	Evet	Evet	Hayır	Evet
Testin yaklaşık maliyeti	Orta	Düşük	Düşük	Yüksek	Orta	Düşük	Orta	Orta	Orta
Yorumlar	En çok yönlü teknoloji	Taşınabilir, Sınırlı uygulama	Taşınabilir, radyasyon içermez.	En yüksek radyasyon seviyesi	Sınırlı uygulama				

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SENİL OSTEOPOROZA KARŞI MOLEKÜLER GÜÇ: SIRT-3

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ÖZET

Senil osteoporoz, kemik kütlesinde azalma ve kemik mikro yapısında çeşitli derecelerde yıkım riskinin artması ile kırık oluşumunun arttığı geriatrik bir sendromdur. Osteoporoz, kemik mineral yoğunluğu (KMY) ve T skoru kullanılarak tanımlanmaktadır. Osteoporozda -2,5'den daha düşük bir standart sapma ile ölçülen T skoruna ek olarak hastada kırık görülmesi tanı kriteri sayılmaktadır. Senil osteoporozda mitekondride metabolik düzenleyici enzimlerden Sirtüin-3'ün (SIRT-3), kemik mineral yoğunluğuna direkt etkisi olmasa dahi, kemik iliği mezenkimal kök hücrelerinin yaşlanmasını yavaşlatabileceği düşünülmektedir. SIRT-3, hücre senesensinde ve osteoporozda koruma sağlayabilmektedir. Araştırmanın amacı, yaşlılık ve osteoporoz ile ilgili yapılan araştırmalarda, SIRT-3 aktivasyonunun arttırıldığı uygulamalarda osteoporoz gelişimine engel olma durumundan bahsetmektir. Yöntem olarak SIRT-3 aktivasyonu ile ilgili literatür taraması yapılmıştır. Bir dizi karmaşık dengenin etkin olduğu kemik hemostazında çeşitli düzenleyici mekanizmaların varlığı bilinmektedir. Kemik kütlesinde azalma ve kemik mikro yapısında yıkımın azaltılabilmesi için moleküler düzeyde önlemlerin önemi yapılan araştırmalarda ifade edilmektedir. Zaman içerisinde ileri glikasyon son ürünlerinin kesintisiz birikiminin moleküler yaşlanmaya sebep olduğu bilinmektedir. Bu bileşiklerin birikimi protein yapısına zarar vererek hücresel yaşlanmayı hızlandırmaktadır. Bu aşamada dikkati çeken ayrıntılardan biri sirtüin proteinlerinin aktif olması durumunda hücresel yıkımın azalacağı konusudur. Sirtüinler uzamış yaşam süresine katkı sağlayacak proteinler olarak dikkati çekmektedir. Özellikle SIRT-3'ün mitekondriyal aktiviteyi arttırdığı, hücresel yaşlanmaya engel olduğu, telomer kısalmasını önlediği ve DNA onarımına katkı sağladığı görülmüştür. SİRT-3 transkripsiyonel seviyede sessiz bilgi düzenleyici olarak görev almaktadır. Bu sebeplerle SIRT-3 gibi sirtüinlerin aktivasyonunun sağlanması amaçlanmaktadır. Bu aşamada epigenetik değişikliklerin senesensinin engellemesi gerekmektedir. Bu alanda yapılacak araştırmalarda SİRT-3'ün hücre senesensine doğrudan ve dolaylı etkisinin öğrenilmesi, yol gösterici olacaktır.

Anahtar Kelimeler: Yaşlanma, Sirtüinler, Senil Osteoporoz, SIRT-3

MOLECULAR POWER AGAİNST SENİLE OSTEOPOROZİS: SIRT-3

ABSTRACT

Senile osteoporosis is a geriatric syndrome characterized by decreased bone mass and increased risk of various degrees of bone microstructural destruction, leading to increased fracture risk. Osteoporosis is defined using bone mineral density (BMD) and T-score. In osteoporosis, a T-score measured with a standard deviation of less than -2.5, in addition to the presence of a fracture, is considered a diagnostic criterion. In senile osteoporosis, Sirtuin-3 (SIRT-3), a metabolic regulatory enzyme in mitochondria, is thought to slow the aging of bone marrow mesenchymal stem cells, even though it has no direct effect on bone mineral density. SIRT-3 may protect against cell senescence and osteoporosis. The aim of this study was to investigate the role of SIRT-3 activation in preventing osteoporosis in studies on aging and osteoporosis. A literature review was conducted regarding SIRT-3 activation. The existence of various regulatory mechanisms in bone homeostasis, where a series of complex balances are at play, is known. Studies have highlighted the importance of molecular-level measures to reduce the decrease in bone mass and the destruction of bone microstructure. It is known that the continuous accumulation of advanced glycation end products over time causes molecular aging. The accumulation of these compounds accelerates cellular aging by damaging protein structure. One notable detail at this stage is that cellular destruction is reduced when sirtuin proteins are active. Sirtuins are noteworthy as proteins that contribute to extended lifespan. SIRT-3, in particular, has been shown to increase mitochondrial activity, prevent cellular aging, prevent telomere shortening, and contribute to DNA repair. SIRT-3 functions as a silent signal regulator at the transcriptional level. For these reasons, the activation of sirtuins like SIRT-3 is aimed at preventing senescence at this stage. At this stage, epigenetic changes should prevent senescence. Understanding the direct and indirect effects of SIRT-3 on cell senescence will be guiding in future research in this area.

Keywords: Aging, Sirtuins, Senile Osteoporosis, SIRT-3

1. GİRİŞ

1.1. Senil Osteoporoz

Senil Osteoporoz, yaşlının kemik kütlesinde azalma ve kemik mikro yapısında çeşitli derecelerde yıkım riskinin artması ile karakterize biyolojik bir süreçtir. Bu süreç kemik dayanıklılığının azalmasına ve çeşitli derecelerde kırık riskinin artmasına neden olmaktadır

(Resnick & Greenspan, 1989). Osteoporoz, osteoblastlar ve osteoklastlar arasındaki dengesizlikten kaynaklandığı varsayılan, yaşa bağlı olarak artan kemik mikro mimari yapının bozulmasıdır. Yaşlanma ile birlikte tüm organ ve sistemler etkilenmekte ve KMY'nun değişmesine sebep olacak hücre senesensi başlamaktadır (You & Wang, 2025). Senil Osteoporoz, kemik mineral yoğunluğu (KMY) ve T skoru kullanılarak tanımlanmaktadır. Osteoporozda -2,5'den daha düşük bir standart sapma ile ölçülen T skoruna ek olarak hastada kırık görülmesi tanı kriteri sayılmaktadır. Yaşlılar için ortalama KMY'nun üstündeki ve altındaki standart sapmalar dikkatle takip edilmelidir. (t skoru> -1.0 olmalı). Osteopeni durumunda T skoru-1.0 ile -2.5 arasında, osteoporoz durumunda T skoru <-2.5, yerleşmiş osteoporoz durumunda ise T skoru< -2,5 ve +kırık görülmesi olarak tanımlanmaktadır (Deshpande et al., 2023; (Resnick & Greenspan, 1989).

Osteoporozun gelişiminde kemik hemostazı ile mezenkimal kökenli osteoblastlar tarafından oluşturulan kemik matriksi oluşumu arasındaki hassas dengenin bozulmasından bahsedilmektedir. Bir dizi karmaşık dengenin etkin olduğu kemik hemostazında çeşitli düzenleyici mekanizmaların varlığı bilinmektedir. Senil osteoporozda mitekondride metabolik düzenleyici enzim olarak görev yapan Sirtüin-3'ün (SIRT-3), kemik mineral yoğunluğuna direkt etkisi olmasa dahi, kemik iliği mezenkimal kök hücrelerinin yaşlanmasını yavaşlatabileceği düşünülmektedir (Brown et al., 2013). Sirtuin 3 (SIRT3), ökaryotik yaşam için hayati öneme sahip ve birçok organın metabolizmasıyla ayrılmaz bir şekilde bağlantılı olan mitokondrilerdeki asetilasyon seviyelerini düzenleyebilen en önemli deasetilazlardan biridir. Bugüne kadar, SIRT3'ün mitokondriyal metabolizma ve homeostazın neredeyse tüm yönlerinde rol oynadığı ve mitokondrileri çeşitli hasarlardan koruduğu kanıtlanmıştır. Son zamanlarda, SIRT-3'ün yaşa bağlı hastalıklar, kanser, kalp hastalığı ve metabolik hastalıklar da dahil olmak üzere birçok insan hastalığı türüyle ilişkili olduğuna dair artan kanıtlar vardır. SIRT-3'ün potansiyel bir terapötik hedef olabileceğini göstermektedir (Zhang et al., 2020). Sirtuinler, hücresel senesense direk etki eden mekanizmalara yön vererek bu dengeyi düzenleyen enzimlerdir. Bu enzimler, DNA hasar onarımı, mitokondriyal biyogenez, genomik stabilite, inflamatuar yanıt ve metabolik homeostaz dahil olmak üzere hücresel ve sistemik homeostaza katkıda bulunan çok çeşitli fizyolojik mekanizmaları düzenlemektedirler (You & Wang, 2025; Brown et al., 2013).

Hücrenin karmaşık ve çok faktörlü bir ortam olması sebebiyle SIRT-3 gibi sirtüinlerin oranının artmış olması mitekondrilerde ATP üretimindeki süreçte, reaktif oksijen türlerinin detoksifiye olmasına fayda sağlayacaktır. Yaşlanma sürecinde solunum zinciri kapasitesinde, substrat tedarikinde, glutatyon seviyelerinde, sitoplazmik kalsiyumda ve membran potansiyelinde ince değişiklikler meydana gelmesi ile yaşlılık süreci hızlanmaktadır (Nicholls, 2002). Yapılan incelemelerde mitokondrilerin ve içinde bulundukları hücrelerin sağlığını ve hayatta kalmasını etkileyen birçok biyoenerjetik faktörden yalnızca bazılarına değinilebilinmiştir. Neredeyse tüm bu faktörler birbirleriyle etkileşim halindedir. Biyoenerjetik fizyolojinin zor olduğunun bilindiği durumda, yaşlanma veya hastalıkla birlikte ortaya çıkan biyoenerjetik değişikliklerin sonuçlarını anlamak ve hücrelere verilen zararı en aza indirecek stratejileri önermek gerekmektedir. Bu sebeple hücre içi etkileşimlerin doğası ve kapsamı hakkında daha fazla bilgi edinilmesi gerekmektedir (Nicholls, 2002; Lombard et al., 2007).

1.2. Kemik İle İlgili Mitekodriyal Aktivitelerin Senil Osteoporoz İle İİşkisi

Kemik, oluşum ve rezorpsiyon süreçlerini içeren sürekli yeniden şekillenmeye uğrayan dinamik bir organdır. Kemik metabolizması, çok sayıda faktör tarafından kontrol edilen, yeni kemik oluşumu ve eski kemik rezorpsiyonunu dengeleyen, düzenlenmiş bir süreçtir. (Liang et al., 2024) Sağlıklı kemikte, anabolik ve katabolik süreçler arasındaki denge korunmuştur. Osteoblast (OB) ve osteoklast (OC) aktivitesinin hassas düzenlenmesi yoluyla devam eden süreçte kemik homeostazı sağlanmış olmaktadır. Bununla birlikte, bu dengenin bozulması kemik dokusunda metabolik bozukluklara ve hastalıklara sebep olabilmektedir. (Liang et al., 2024; Qin et al., 2025; Kim et al., 2020)

Zararlı etkileri azaltmak ve mitokondriyal işlevselliği sürdürmek için mitokondriler, hem içsel hem de dışsal stres faktörlerine uyum sağlayabilen gelişmiş bir mitokondriyal kalite kontrol sistemi ile devam etmektedirler. Üç düzeyde çalışan bu sistem moleküler, organel ve hücresel düzenleme mekanizmalarını içermektedir. Temel düzenleyici mekanizmalar arasında mitokondriyal dinamikler, mitofaji, mitokondriyal biyogenez ve mitokondriyal redoks homeostazı bulunur. Bu süreçler sinerjik olarak etkileşime girerek entegre bir kalite kontrol ağı oluştururlar. (Qin et al., 2025)

Mitokondriler, ökaryotik hücrelerde dinamik süreçleri olan, çift zarlı organellerdir. Enerji dönüşüm istasyonları olarak adlandırılan mitokondriler, çok çeşitli hücresel aktivitede yaşamsal döngüye destek olmaktadır. Bunlar arasında reaktif oksijen türlerinin (ROS) üretimi ve

temizlenmesi, katabolik ve anabolik reaksiyona katılım, hücre sinyalizasyonuna destek vermesi, kalsiyum iyon homeostazının korunması, ayrıca apoptoz ve otofajinin düzenlenmesi gibi bir çok aktivite yer almaktadır. Mitokondriyal işlevlerden herhangi birindeki bozulma, temel rollerini yerine getirme yeteneklerini engelleyebilir ve hücresel biyolojik aktivitelerde irreversbl hasarlar ve hücre ölümüne yol açabilir (Yang et al., 2023; Kim et al., 2020; Nicholls, 2002).

Bu aşamada hücresel düzeyde endojen mekanizmaların aktivitelerini tanımak osteoporoz ve Sirt-3 aktivitesindeki dengeyi anlatmak açısından iyi olacaktır: Yapılan çalışmalar ile osteoporoz gibi kemik metabolizma hastalıklarının patogenezinde mitokondriyal kalite kontrolünün kritik rolünü vurgulamaktadır. Bu durum, kemikte osteoblast ve osteoklast farklılaşmasını ve aktivitesini modüle etme ve böylece kemik oluşumu ve rezorpsiyonu arasındaki dengeyi etkileme yeteneğiyle açıklanmaktadır. Aynı zamanda SIRT3, oksidatif stresi hafifleterek kemik oluşumunu destekler ve kemik yıkımını engeller. (Kim et al., 2020; Du et al., 2025).

SIRT3, mitokondriyal morfoloji ve fonksiyonu düzenleme konusunda geniş bir yelpazeye sahip olan, NAD+-bağımlı bir deasetilazdır. Yayınlanan bilimsel bilgiler SIRT3'ün osteoblastların, osteoklastların ve Mezenkimal Kök Hücrelerinin (BMSC)'lerin osteojenik farklılaşma kapasitesi üzerindeki etkisinin oksidatif stres seviyesiyle ilişkili olduğunu göstermiştir. SIRT3, deasetilasyon görevi ile ATP üretimini ve osteoblast farklılaşmasını teşvik edebilmektedir. Sedanter yaşam koşulların da ise tam tersine SIRT3 seviyesi düştüğü için kemik mineral yoğunluğu azalarak Osteoporoz'a yol açabilmektedir (Hirschey et al., 2010).

SIRT3'ün baskılandığı araştırmalarda lizin 68'i deasetile edememesi durumunda osteoklast farklılaşması engellenmiş olur. Aynı zamada Sirt-3 azaldığında hücre içi ROS seviyelerinin düşürülmesinde de aksaklık yaşanacaktır. Yapılan fare deneylerinde doğal fizyolojik osteoklast farklılaşmasının bozulması, hücre içi ROS seviyelerinin artması ile kemik kaybının artırdığı gözlemlenmiştir. Osteoklastlar, kemik metabolizması ve dönüşümünde hayati bir rol oynar ve kemik rezorpsiyonundan sorumlu hücrelerdir. Güçlü ve sağlıklı kemik mimarisini korumak ve normal plazma kalsiyum seviyelerini devam ettirmek için görev alan osteoklastlar aynı zamanda hasarlı kemiklerin yenilenebilmesi için kemik rezorbsiyonu sırasında hassas dengeyi sağlamaktadırlar. (Du et al., (2025; Hirschey et al., 2010).

Yaş ilerledikçe, mezenkimal kök hücrelerinin (MSCs) adipojenik farklılaşması artmakta ve osteojenik farklılaşması zayıflamaktadır. Bu durumda anormal kemik metabolizmasının etkileri görülmektedir. Bu aşamada hücresel düzeyde oksidatif stres seviyesinin de artması kemik mineral yoğunluğunun azalması ve kemik mikro yapısının azalmasına sebep olmaktadır. Yaşlı hastada ilerleyen yaşa paralel olarak kemik iliği mezenkimal kök hücrelerinde (BM-Mscs), SIRT-3 ekspresyonu önemli ölçüde azalmaktadır ve eksikliğinde yaşanacak döngüde osteoporoz gelişimi hızlanmaktadır. Sirt-3 sayesinde ROS kaynaklı hasarı azaltmak ve SOD2 ekspresyonunu ve aktivitesini artırmak ile hücre yaşlanması hafifletilebilmektedir. Bunun nedeni, SIRT3'ün manganez süperoksit dismutaz (MnSOD) ve katalazı aktive ederek oksidatif stres kaynaklı mezenkimal kök hücre apoptozunu azaltabilmesidir (Yang et al., 2023; Du et al., (2025).

Yaşlanma aşamasında, kemik iliği mezenkimal kök hücrelerinin adipojenik farklılaşması, osteoklast farklılaşması ve kemik rezorpsiyonunu aktivitelerini bozmakta ve sonuçta kemik kaybına yol açabilmektedir (Du et al., (2025).

2. SİRTÜİN PROTEİNLERİN İŞLEVLERİ

2.1. NAD^+ Bağımlı Protein Deasetilaz Ailesi Olan Sirtüinler:

Tüm canlı hücrelerde bulunan nikotinamid adenin dinükleotid (NAD), önemli bir koenzimdir. Vücuttaki biyokimyasal reaksiyonlarda hücre metabolizmasını düzenleyerek ve oksidatif stresi azaltarak enerji üretimi ile DNA tamiri gibi hayati süreçlerde rol oynamaktadır. NAD + bağımlı protein deasetilazlar ailesi olan sirtuinler, memelilerde yedi üyeye (SIRT1-7) sahiptirler. Sirtuinler, korunan katalitik çekirdek alanına göre ve deasetilaz aktivitesinin farklılığına göre sınıflara ayrılırlar (Hirschey et al., 2010). Hücre altı lokalizasyonları ve işlevleri farklı olan sirtüinler insanlarda (memeli grup canlılar da dahil) genom stabilitesi, enerji metabolizmasının düzenlenmesi, hücresel strese yanıt verme, hücrelerin yaşam süresine yön verme gibi bir çok aktiviteyi destekleyen deasetilazdır (Tablo 1). Bunlar arasında SIRT3 esas olarak mitokondriyal matrikse yerleşir ve mitokondriyal dinamikler ile mitokondriyal metabolizmanın senesens düzenlenmesinde önemli bir rol oynamaktadırlar. (Zhang etal., 2020; Hirschey et al., 2010).

Tablo 1. Memeli Sirtuinlerinin Sınıflandırılması, İşlevi ve Özellikleri

SİRTÜİN	ENZİMATİK AKTİVİTE	HÜCREALTI LOKALİZASYONU	İŞLEV	HASTALIK
SİRT-1	Deasetilaz	Sitoplazma ve Çekirdek	1. Metabolizma Düzenlemesi	1. Yaşlanma
			2. Kromotin ve Transkripsiyon Düzenlemesi	2. Nörodejenerasyon
			3. DNA Onarımı	3. Metabolik Hastalık
			4. İltihabın Baskılanması	4. Kardiyovasküler Hastalık
				5. Kanser
SİRT-2	Deasetilaz	Sitoplazma ve Nükleer	1. Hücre Farklılaşması	1. Kanser
			2. Metabolizma Düzenlenmesi	2. Nörodejenerasyon
			3. Hücre Döngüsü Düzenlemesi	
			4. İltihap Düzenlemesi	
			5. Mikrotübül Dinamikleri	
SİRT-3	Deasetilaz	Mitekondri ve Çekirdek	1. Metabolizma Düzenlenmesi	1. Yaşlanma
			2. İltihabın Baskılanması	2. Nörodejenerasyon
			3. Oksidatif Stresin Engellenmesi	3. Metabolik Hastalık
			4. Apoptotik Hücre Ölümü Düzenlenmesi	4. Kardiyovasküler Hastalık
			5. Otofaji Düzenlemesi	5. Kanser
SİRT-4	ADP-Riboziltranferaz	Mtekondri	1. Metabolizma Düzenlenmesi	1. Nörodejenerasyon
	Lipoamidaz			2. Metabolik Hastalık
	Deasetilaz			3. Kanser
SİRT-5	Deasetilaz	Mitekondri	1. Metabolizma Düzenlenmesi	1. Metabolik Hastalık
	Desülsinilaz		2. Bağışıklık Tepsiki Modülasyonu	2. Kanser
	Demalonilaz			
	Deglutarilaz			
SİRT-6	Deasilaz	Nükleer	1. Metabolizma Düzenlenmesi	1.Yaşlanma
	Deasetilaz		2. Kromatin ve DNA Onarımı	2. Kanser
	ADP-Riboziltranferaz			3. Metabolik Hastalık
				4. Kardiyovasküler Hastalık
SİRT-7	Deasetilaz	Nükleer	1. Transkripsiyon Düzenlenmesi	1. Kanser
			2. Kromotin ayeniden Şekillenmesi	2. Metabolik Hastalık
			3. Metabolizma Düzenlenmesi	3. Kardiyovasküler Hastalık

2.2. Sirt-3'ün Yapısı ve Hücredeki Görevi

SIRT3, deasetilasyon fonksiyonunu üstlenen korunmuş bir enzimatik çekirdeğe sahiptir. Çekirdek bölgesi, NAD + bağlanması için büyük bir Rossmann katlanma alanı içerir. NAD +

bağımlı SIRT3 deasetilasyon reaksiyon süreci dört adımdan oluşur. SIRT3 asetil gruplarının hücreden uzaklaştırılmasını sağlayarak hücre rejenerasyonuna katkı sağlamaktadır. Sirt-3 aynı zamanda krotonil ve miristoil gruplarını da uzaklaştırarak asetilasyonun en kapsamlı şekilde modifiye edilmesine katkı sağlamaktadır (Lombard et al., 2007; Hirschey et al., 2010). Mitokondriyal proteinler hücre reaksiyonları ile yüksek oranda asetillenmiştir ve asetilasyonun modifikasyonu, mitokondri fonksiyonlarının kaderini değiştirmektedir. Yapılan araştırmalarda, en önemli mitokondri sirtuini olan SIRT3'ün en az 84 mitokondri proteiniyle doğrudan etkileşime girebildiği belirtilmiştir. Bu proteinler, mitokondriyal mitoz, transkripsiyon, translasyon, DNA işleme, RNA işleme, lipid metabolizması ve amino asit metabolizması dahil olmak üzere mitokondrinin biyolojik fonksiyonunun tüm yönlerinde rol oynamaktadır. Bu sebeple SIRT3, hücredeki substratların asetilasyon seviyelerini düzenleyerek mitokondriyal homeostazın korunmasını destekleyen önemli bir sirtüindir (Zhang et al., 2020; Yang et al., 2023).

2.3. Sirt-3'ün Hücrede Endojen Düzenleyici Aktiviteleri

Mitokondride endojen düzenleyiciliği ile görev alan proteinlerden Sirt-3 transkripsiyonel ve post-translasyonel modifikasyonlar üzerine çeşitli görevler almaktadır. Sirt-3, mitokondriyal enerjinin bir sensörüdür. Sirt -3 aktivitesinin ko-faktörü (NAD +) ve yan ürün nikotinamid aktiviteleri Sirt-3'ün aktivitesinin doğrudan düzenleyicileridir. Sirt-3'ün ko-faktörü olarak NAD +, deasetilasyon sürecini destekler ve nikotinamid ise reaksiyon ürününe bağlanarak ters reaksiyonu hızlandırarak bu süreci inhibe eder. SIRT3 çekirdekte transkribe edilir. Transkripsiyonel modifikasyon, Sirt-3'ün bir diğer önemli düzenlemesidir. (Lombard et al., 2007; Hirschey et al., 2010) Özellikle belirtmek gerekirse, mikroRNA'lar (miRNA'lar) esas olarak mRNA stabilitesini ve protein seviyelerini etkileyen ve SIRT3 aktivitesini de düzenleyebilen transkripsiyon sonrası düzenleyicilerdir. Yapılan çalışmalar, Sirt-3'ün gen ekspresyonunu ve protein seviyelerini inhibe edebileceğini kanıtlamıştır . Hücre biyolojisinde, hücre yüzey reseptörleri aracılığıyla hücreye sinyal ileten proteinlerle başlayan bir grup sinyal iletim yolu olan Wnt sinyal yolağında önemli bir alt akış efektörü olan β-katenin, SIRT-3 promotör aktivitesini baskılayarak ekspresyonunu kısmi olarak engelleyebilir. β-katenin, apoptozis, adipogenez, anjiogenez, sinaps oluşumu aktivitelerini sağlayan sinyal yolağıdır. Yukarıda belirtildiği gibi, bu endojen düzenleyiciler, hücresel streslere yanıt olarak SIRT3'ün ekspresyonunu ve aktivitelerini düzenleyerek homeostaza destek olurlar. (Zhang et al., 2020;

Lombard et al., 2007); Hirschey et al., 2010; https://dergipark.org.tr/tr/download/article-file/53537;)

2.4. Patofizyolojik Olaylar-Hastalıklar ve Sirt-3 Dengesi

2.4.1. SIRT-3 ve İnsan Hastalıkları

Sirt-3'ün biyolojik işlevi, sadece hücrede bulunan substratların deasetilasyonundan ibaret zannedilse de, çok sayıda biyolojik süreçte ve çeşitli hastalıkların yavaşlaması ile ilgili kritik dönemlerde sayısız rolleri olmaktadır. Sirt-3'ün en ilgi çekici rolü uzun ömürlülük ile ilişkilendirilen senesens olaylarına olan desteğidir. İlk olarak 2003 yılında SIRT-3'ün uzun ömürlülükle pozitif ilişkili olduğu bildirilmiş ve daha sonraki birçok çalışma bu sonucu doğrulayarak genişletmiştir (You & Wang, 2025) Manolagas, 2010). Aynı zamanda Sirt-3 bir koenim olan NAD^+ ile işbirliği içerisinde organ disfonksiyonu engellemeye çalışarak (hücre metabolizmasını düzenleyerek, oksidatif stresi azaltarak enerji üretimi ile DNA tamiri) hayati süreçlerde rol oynar. NAD^+ bağımlı protein olan Sirt-3 hastalıkların hızını yavaşlatmaya çalışırken aynı zamanda yandaş hastalıkların genel ilerlemesinin durdurulmasında da rol oynamaktadır. Sirt-3 belirli substrat proteinlerini ve bunlara karşılık gelen sinyal yollarını düzenleyerek osteoporozun da dahil olduğu yaş ile artan hastalıklar ile mücadele etmektedir (Xu et al., 2023; Tian et al., 2025)

2.5. Yaşlılık İle İlişkili Hastalıklarda Sirt-3

Yaşla ilişkili hastalıklar her zaman mitokondriyal disfonksiyon, yüksek oksidatif stres ve toksik proteinlerin birikimi ile birlikte görülür. Sirt-3, mitokondriyal fonksiyonu desteklemek, ATP üretimini artırmak, ROS atıklarının temizliğini hızlandırmak ve mitokondriyal metabolik homeostazı korumak için deasetilasyon yoluyla çeşitli substratları aktive eder (Liang et al., 2024). Aynı zamanda SIRT-3, mitokondriyal yenilenmeyi hızlandırmak için mitofajiyi aktive edebilir. Ayrıca Sirt-3'ün yanlış katlanmış proteinlerin üretimini inhibe ettiğini ve bunların temizlenmesini hızlandırdığını belirten çalışmaların varlığı Sirt-3'ün özellikle kemik sağlığında önemini vurgulamaktadır (Du et al., (2025); Kim et al., 2020; Zhang et al., 2020; Qin et al., 2025; Hu & Wang, 2022).

2.5.1. Sirtüinlerin Yaşlılıkta Senesensi Engelleyici Mekanizmaları

2.5.1.1. Gen İfadesinin Düzenlenmesi: En önemli mekanizmaların başında gen ifadesinin düzenlenmesi yani DNA replikasyonu gelir. Üç histon deasetilaz sınıfı vardır. Bunlardan III. sınıf deasetilazlar NAD bağımlı Sirtuin enzim ailesini kapsamakta ve maya Sir2 proteini ile

homoloji göstermektedirler (Hu & Wang, 2022; https://www.firattipdergisi.com/text.php3?id=841).

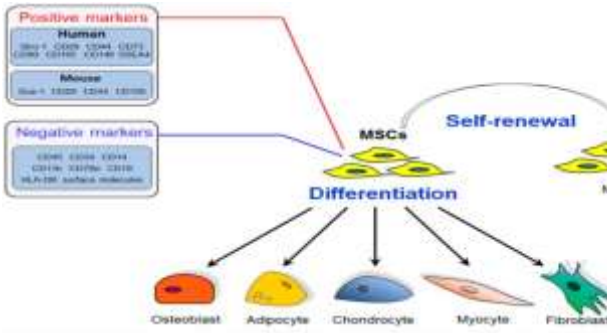
2.5.1.2. Programlı Hücre Ölümü: Programlı hücre ölümü ve hücre sağ kalımını destekleyen sürtüinler, amino asid kalıntılarından deasetilize ederek transkripsiyonel etkinliği azaltır ve oksidatif strese ve DNA zararlarına karşı programlı hücre ölümünü baskılayarak senesensi yavaşlatırlar (Brown et al., 2013). Programlı hücre ölümü normal fizyolojik bir olaydır. Giderek artmasının olası olmadığı bilinen hücre sayısının sabit tutulması için immün sistem faaliyetleri ile bu denge devam ettirilmektedir. Lenfositler apoptoz vasıtasıyla apoptotik hücre miktarında görülen artışı dengelemeye çalışmaktadırlar. Dengenin olumsuz yönde bozulmasında yaşlılık ile gelebilecek her türlü hastalık ile karşılaşılmaktadır. Senesens belirtisi veren hücreler ile yapılan çalışmalarda sirtüinlerin sayısının düşük olduğu görülmüştür (https://www.firattipdergisi.com/text.php3?id=841).

2.5.1.3. Senesensi Yavaşlatıcı Etkisi: Sirtuinlerin yaşlanma mekanizmasında senesensi engelleyici rolleri dikkat çekmektedir. DNA'nın yerinde yeni ve anarmol kombinasyonu engellemek ve böylelikle yaşlanma sürecini yavaşlatmak amacıyla deasetilasyon görevini devam ettirmektedirler (Zhang et al., 2020; https://www.firattipdergisi.com/text.php3?id=841).

2.5.1.4. DNA Onarımı: Sirtuinlerinin DNA onarımında önemli rollerinin olduğu düşünülmektedir. Özellikle Sirt-3, DNA onarım kapasitelerini ve DNA zincir kırılmalarını düzenleyebilen genlerdir. Osteoporozda yaş ile birlikte artan oksidatif stres, DNA hasarına sebep olabilmektedir. Kemik mineral yoğunluğunun biyolojisinde ve yaşa bağlı yandaş hastalıkların patogenezinde önemli bir rol oynamaktadır (https://dergipark.org.tr/tr/download/article-file/1970483). Son yıllarda yapılan çalışmalarda, oksidatif stresin yaşa bağlı kemik kütlesi ve gücündeki azalmanın temel bir sebebi olabileceği ve oksidatif strese karşı savunmayı azaltacak herhangi bir durumda yaşlanmanın kemik üzerindeki etkilerinin hızlanacağı ifade edilmektedir. Bu sebeple reaktif oksijen türlerinin oluşumu, transkripsiyon programları ve osteoporoza karşı savunma arasındaki dengenin takip edilmesi gerekmektedir (Manolagas, 2010).

Yaşlanmanın en belirgin özelliklerinden biri, doku onarımının bozulmasıdır. Dokuya özgü kök hücreler sayesinde organizmanın yaşam süresi boyunca dokular onarılmakta ve korunmaktadır (You & Wang, 2025). Kendi kendini yenileme formunu değiştirme yeteneği olan kök hücrelerin bu özellikleri yaşla birlikte düzensizleşir. Kök hücre yaşlanmasına sebep olan her hangi bir

durumda, kalıcı hücre döngüsünün bozulması, apoptoz ve kümülatif hücresel ve genomik hasarlar görülebilmektedir (Brown et al., 2013). Sirt-3, mezenkimal kök hücrelerin yaşam süresini ve farklılaşmasını artırarak yaşlanmayı yavaşlatıcı etkisini gösterebilmektedir. Kemik iliği stromal hücreleri olarak da bilinen MSC'ler, kemik iliği, yağ dokuları, karaciğer, kas ve göbek kordonu gibi doğum sonrası hemen hemen tüm organ ve dokularda bulunan çok potansiyelli yetişkin kök hücrelerdir. MSC'ler kendi kendini yenileme özelliği bulunan ve osteoblastlar, adipositler, kondrositler dahil olmak üzere birden fazla hücre soyuna farklılaşma yeteneğine sahip kök hücrelerdir (Ralston & Uitterlinden, 2010; Lombard et al., 2007). Çeşitli onarıcı sistemlerin etkisi altında mitokondriyal füzyon, bölünme, hareket ve yeniden şekillenmenin sürekli olduğu süreç "mitokondriyal dinamikler" olarak adlandırılmaktadır. Mitokondriyal dinamiklerdeki bozulmalar mitokondriyal disfonksiyona ve ROS indüksiyonuna yol açabilmektedir. Bu aşamada Fibroblastların aktifleşmesine sebep olan büyüme faktörü 21'in (FGF21) ekzojen aşırı ekspresyonu, AMPK sinyal yolu aracılığıyla Mfn2 seviyesinin azalmasına ve ROS üretiminin engellemesine sebep olarak hücrede koruyucu işlev görmektedir. Bu durumda hücrede yaşlanmış BM-MSC'ler etkili bir şekilde gençleştirilebilmektedir (Tian et al., 2025).



Şekil 1. Mezenkimal Kök Hücrelerinin Özelliklerinin Şematik Diyagramı.

MSC'leri tanımlamak için hem pozitif hem de negatif belirteçler mevcuttur. MSC'ler, osteoblast, adiposit, kondrosit, miyosit ve fibroblast dahil olmak üzere birden fazla hücre tipine farklılaşmaktadır (Şekil 1). Bu hücreler kendini yenileme özelliklerine sahip, yaşlanma karşıtı aktiviteleri destekleyen hücrelerdir (Hu et al., 2018).

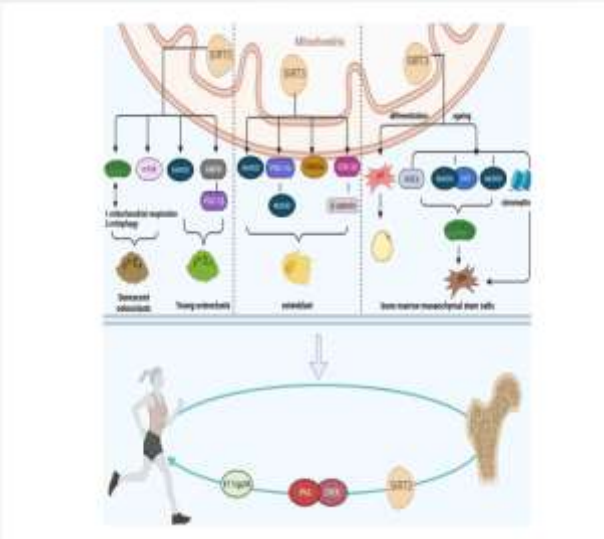
Mezenkimal kök hücreleri (MSC'ler) vücuttaki hemen hemen her dokuda bulunurlar. MSC'ler T ve B hücre proliferasyonunu baskılayarak ve makrofajların immünofenotipini daha immün baskılayıcı bir M2 fenotipine dönüştürerek senesensin engellenmesinde görev alırlar. Bu immünomodülatör özellikleri nedeniyle, MSC'ler, greft-konakçı hastalığı (GVHD), miyokard enfarktüsü, romatoid artrit, Crohn hastalığı, tip 1 diyabetes mellitus, glomerülonefrit, karaciğer hastalığı, osteoartrit ve multipl skleroz gibi inflamatuar hastalıklarda ve hasarlı dokuların

iyileştirilmesinde potansiyel fayda sağlayıcı olarak görev yapmaktadırlar (Hu et al., 2018; Denu, 2017). Senil osteoporoz durumunda mezenkimal kök hücreler kemik, kıkırdak, kas ve bağ dokusuna farklılaşarak yenileyicilik görevini devam ettirmektedirler. Hücre senesensine engel olmada hayati önemi olan MSC'lerin sağlıkla devam edebilmesi için gerekli hücre ortamının sağlanması gerekmektedir (Brown et al., 2013). Yaşlanan kemik iliği mezenkimal kök hücrelerinde (BM-MSC) gençleşme mekanizmalarına yönelik araştırmaların odak noktaları şu anda mitokondriyal fonksiyon, oksidatif stres ve kronik inflamasyon başlıkları ile devam etmektedir. Diğer potansiyel etkileyici faktörler arasında besin algılama sinyal yolları, otofaji, epigenetik düzenleme ve hücreler arası iletişim ile protein ve lipid homeostazı yer almaktadır. Bu mekanizmalar birbirinden bağımsız değildir; aksine, karmaşık ağlar aracılığıyla birbirine bağlıdırlar (Tian et al., 2025).

Yaşlanma ile artış gösteren doku fibrozisi, kronik hastalıklar ve yaşlanma sırasında organ fonksiyonlarında önemli değişiklikler yaşanması tüm hücre ve dokularda olduğu gibi kemik hücrelerinde de süreç içerisinde hasarlanmanın gelişmesini arttırmaktadır (Miwa et al., 2022). Bu aşamada doğal fizyolojik yaşlanma sürecinde, senesens aşamasında fibroblastların miyofibroblastlara dönüşerek ekstraselüler matrisi sentezleyebilen hücreler haline geldiği bilinmektedir. Bu dönüştürücü büyüme faktörü β1 (TGF-β1) aracılığıyla ektraselüler matrisin sentezlenmesine sebep olan miyofibroblastlar oluşmakta ve yaşlanma sürecini hızlandıran doku fibrozisi ve hücresel yaşlanma görülmektedir. Yapılan bir araştırmada, Sirt-3'ün profibrotik TGF-β1 sinyalini baskılayarak fibroblastların miyofibroblastlara dönüşümünü engelleyebileceği ifade edilmiştir (Sundaresan et al., 2015). Sonuç olarak araştırma bulgularında Sirt-3 eksikliğinin, fibroblastların miyofibroblastlara dönüşmesine duyarlılığının azalması nedeniyle yaşa bağlı organ fibrozisinin gelişimine katkıda bulunduğunu ifade etmektedir (Sundaresan et al., 2015; Xu et al., 2023).

Yaşlı hastada yaşlanmayı ve osteoporoz gelişimini hızlandıran allta yatan moleküler mekanizmaların, kronik inflamasyon, epigenetik değişiklikler, otofaji işlev bozukluğu, oksidatif stres, metabolik işlev bozukluğu ve mitokondriyal kararsızlık olmak üzere organizma yaşlanmasını hızlandıran durumlar ile yakından ilişkili olduğu görülmüştür (You & Wang, 2025). Moleküler araştırmalar, SIRT-3'ün bu süreçler boyunca birden fazla yaşlanma karşıtı programı düzenleyen merkezi bir koordinatör olarak görev yaptığını tanımlamışlardır (Şekil 2).

Bu aşamada önemli olanın sağlıklı yaşam becerileri ile hücresel döngüye pozitif yönde destek olmak gerektiğidir (Xu et al., 2023).



Şekil 2. SIRT3'ün Kemik Homeostazını Koruma Mekanizması ve Sağlıklı Yaşam İle İlişkisi.

Kemik homeostazının bozulması, kemikle ilişkili çeşitli hastalıklara yol açar. Osteoblastlar (OB) ve osteoklastlar (OC) arasındaki denge bozulduğunda, kemik yapısı ve fonksiyonu bozulur ve sonuç olarak osteoporoz (OP), osteoartrit (OA) ve intervertebral disk dejenerasyonu (IDD) gibi kemik hastalıklarına neden olur. Kemik homeostazındaki dengesizliğin altında yatan mekanizmaların araştırılması, kemik hastalıklarının önlenmesi ve tedavisine dair bilgiler sağlamaktadır (Xu et al., 2023).

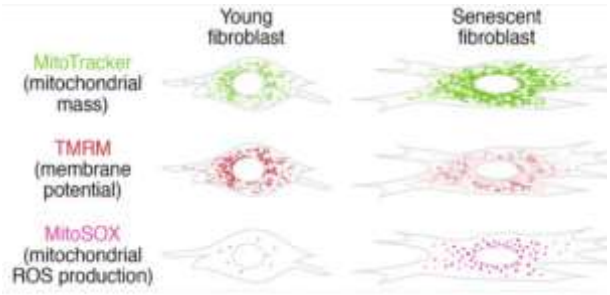
Sirt-3, mitokondride bulunan ve metabolizmayı teşvik ederek, metabolik homeostazı koruyarak, oksidatif stresi hafifleterek ve hücre yaşlanmasını geciktirerek çeşitli yaşlanma ile ilgili hastalıkları hafifletebilen, uzun ömürlülükle ilgili bir gendir Mitokondriyal hedeflerin deasetilasyonu yoluyla Sirt-3, hücresenin antioksidan kapasitesini artırır, metabolik esnekliği destekler ve ROS birikimini azaltır; bunların tümü DNA hasarını en aza indirmek ve yaşlanmanın başlangıcını engellemek için kritik öneme sahiptir.(Manolagas, 2010; Brown et al., 2013; Hirschey et al., 2010).

Sirtuinler, birçok organizmada uzun ömürlülüğü destekleyerek, hücre kültürü sistemleriyle yaşlanmayı engelleyici olarak görev yapan homolog bileşenlerdir. SIRT3'ün, Forkhead box O3a/PTEN-indüklenebilir varsayımsal kinaz protein 1 (Foxo3a/PINK1)-Parkin sinyal yolu aracılığıyla mitokondriyal otofajiyi düzenlediği ve bu sayede diyabetik kornea epitel yaralarının in vivo ve in vitro iyileşmesini desteklediği ve diyabetik keratopatiyi iyileştirdiği gösterilmiştir. Mitokondriyal otofaji yaşlanma ile yakından ilişkilidir. İleri glikasyon son ürünleri olan AGE'ler, mitokondriyal otofajiyi inhibe ederek BMSC yaşlanmasını teşvik eder. Özellikle, SIRT3'ün aşırı ekspresyonu, BMSC'lerde AGE kaynaklı yaşlanmayı tersine çevirirken,

SIRT3'ün susturulması bu etkiyi şiddetlendirir. Bu bulgular, SIRT3'ün mitokondriyal otofajiyi aktive ederek ve mitokondriyal fonksiyonu iyileştirerek BMSC'lerde AGE kaynaklı yaşlanmayı tersine çevirebileceğini göstermektedir (Xu et al., 2023).

Başka bir araştırma da SIRT3'ün in vivo lokalizasyonu ve işlevi araştırılmış ve SIRT3, mitokondrial aktivitenin arttığı sağlıklı hücrelerede yüksek oranda çözünür bir mitokondriyal protein olarak görülmüştür. SIRT3 protein seviyeleri, mitokondriyal protein MnSOD'nin ekspresyon seviyeleriyle korelasyon göstermiş ve özellikle mitokondri bakımından zengin dokularda (beyin, kalp, karaciğer ve kahverengi yağ dokusu) oranı daha yüksek bulunmuştur. Yapılan bu araştırmanın SIRT3 ve mRNA ekspresyonu üzerine yapılan önceki çalışmalar ile de uyumlu bulunduğu ifade edilmiştir (Lombard et al., 2007).

SIRT-3, ileri glikasyon son ürünleri olan AGE'lerin birikiminin neden olduğu hücre senesensinde ve senil osteoporozda koruma sağlayabilmektedir. AGE'ler etkileşim mekanizmaları ile NADPH oksidazının aktive olmasına sebep olarak ROS (Reaktif oksijen türleri) içeriğinin artmasına sebep olmaktadırlar. ROS, sinyal iletiminden hücre hasarına kadar uzanan, farklı biyolojik işlevlere sahip çok çeşitli oksidan moleküllerini tanımlayan genel bir terimdir. Hücredeki ROS içeriğinin yaklaşık %90'ı mitokondrilerde üretilir. Hasarlı mitokondrilerin kendi kendini devam ettiren bir döngü içinde devam ettiği süreçte ROS ürünlerinin birikmesi artmakta ve hücre yapısı değişmektedir. (Şekil 3). Bu aşamada değişmiş hücre yapısının yaşlanmayı hızlandırıcı etki yaptığı bilinmektedir (Khan et al., 2023; Miwa et al., 2022).



Şekil 3. Yaşlanmada Mitokondriyal İşlev Bozukluğu.

İşte bu aşamada sağlıklı beslenme alışkanlıkları ile fenolik bileşiklerin alımı sirtünlerin aktivitesini arttırarak yaşlanma hızını değiştirebilmektedir. Bu durumda mitokondriyal homeostazın yaşlanma sürecinde düzenlenebilir olduğu düşünülmektedir (Khan et al., 2023).

Sirt-3, geri dönüşümlü enzim deasetilasyonu yoluyla yağ asidi oksidasyonunu düzenleyerek hücresel yaşlanmanın yavaşlamasına destek olabilmektedir. Mitokondriyal yağ asidi oksidasyonu için yeni bir düzenleyici mekanizma olarak tanımlamakta olan SIRT3'ün özellikle kalori kısıtlaması sürecinde mitokondriyal ara metabolizmayı ve yağ asidi kullanımını modüle ettiği açıklanmaktadır. Bu aşamada SİRT-3, açlık döneminde karaciğerlerde asilkarnitin ve trigliseritlerin anormal birikimini engeleyerek organ disfonksiyonun engellenmesine katkı sağlamaktadır (Hirschey et al., 2010). Sirt-3 hücrede asetilasyon modifikasyonları mitokondriyal fonksiyon ve mitekondri akıbetinin tüm yönlerini etkiler. Sirt-3, en az 84 mitokondriyal proteinin asetilasyonunu doğrudan düzenleyen baskın mitokondriyal deasetilazdır (You & Wang, 2025). Bu proteinler, mitokondriyal mitofaji, transkripsiyon , translasyon , DNA işleme, RNA işleme, lipid metabolizması ve amino asit metabolizması dahil olmak üzere neredeyse tüm mitokondriyal fonksiyonlarda rol oynamaktadırlar (Hirschey et al., 2010; Lombard et al., 2007).

Sirt-3, güçlü deasetilasyon fonksiyonu aracılığıyla uzun zincirli koenzim A dehidrojenaz kaynaklı yağ asidi oksidasyonunu düzenleyerek enerji metabolizmasını desteklerler. Sistemik olarak Sirt-3 geninin azaldığı durumlarda araştırmalar göstermiştir ki: yağ asidi oksidasyonunda bozulma görülmektedir. Bu nedenle, Sirt-3 mitokondriyal homeostazda kritik öneme sahiptir. (Lombard et al., 2007) Ve anormal fonksiyonu mitokondriyal disfonksiyona ve çeşitli hastalıklara neden olabilmektedir. Sirt-3, esas olarak yaşlanma ve nörodejeneratif hastalıklar, kardiyovasküler hastalıklar, sarkopeni, osteoporoz, metabolik sendrom ve diyabetik nefropati gibi yaşa bağlı hastalıklarla ilişkilidir. Mitokondriyal disfonksiyonun tetiklediği oksidatif stres, osteoblast farklılaşmasını bozarak osteoklast aktivitesini artırabilir; bu durum da kemik homeostazını bozarak bir dizi kemik hastalığına yol açabilmektedir. (Xu et al., 2023).

SONUÇ VE ÖNERİLER

Bu sebeplerle Sirt-3 ve önemli Sirtüinlerin hedef substratlar üzerindeki deasetilaz etkileri ile sirtüin aktivasyonu sağlanmaya çalışılmakta ve epigenetik değişikliklerin senesensi engellemesi amaçlanmaktadır. Bu alanda yapılacak yeni araştırmalar Sirt-3'ün hücre senesensi üzerine doğrudan ve dolaylı etkisinin öğrenilmesi açısından yol gösterici olacaktır. Özellikle NAD+ bağımlı deasetilasyon işlevi ile sirtüinler birçok hücre substratını deasetile ederek transkripsiyon aşamasında gen protein işlevlerinin değişikliğini sağlayabilmektedir.

Bu aşamada sirtüinler, bir genin DNA diziliminin bir RNA molekülüne kopyalanması aşamasında gene ait bilgilerin protein yapımında kullanılması sürecinin önemli basamağına dahil olarak mitekondrideki disfonksiyonu engellemeye çalışmaktadırlar. Çalışmalarda dikkati

çeken konu epigenetik değişikliklerin hücre yenilenmesi aşamasına doğru kaymasına sebep olan durumların tespit edilerek hücre senesensini engellemesi ve osteoporoz için riskin en aza indirilmesidir.

Sirtüin aktivasyonu sayesinde pozitif metabolik yanıtlara yol açan mekanizma yolaklarının, yapılacak daha fazla klinik çalışma ile aydınlatılmaya ihtiyacı vardır. Yaşam boyu sağlıklı ve dengeli beslenme ile osteoporoz ve diğer geriatrik sendromların etkisinin en aza indirilmesi için beslenmenin önemi kritik bir rol oynamaktadır. Sirt-3 aktivitesinin artışının sağlanması için yaşlıların yaşam boyu devam edecek beslenme düzenine baştan ulaşması ve sedanter yaşam diye adlandırabileceğimiz tüm alışkanlıklardan ve davranışlardan kaçınması gerekmektedir. Bu aşamada özellikle beslenme ile Sirt-3 aktivitesini destekleyebilmek için diyetle fenolik bileşiklerin alınması osteoporoz gelişiminde sürecin hızını azaltabilecek ve dahası osteoporoz riskini minumuma indirerek hastalığın başlamasına engel olabilecektir.

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CHATGPT TİNNİTUS HAKKINDA SIKÇA SORULAN SORULARA GÜVENİLİR YANITLAR SAĞLAYABİLİR Mİ?

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ÖZET

Tinnitusun bireyin yaşam kalitesini önemli ölçüde etkileyebildiği iyi bilinmektedir. Bu nedenle, bireylerin tinnitusa ilişkin doğru bilgiye ulaşmaları oldukça önemlidir. Bu çalışma, tinnitusa ilişkin doğru bilgiye ulaşmada internet kullanımının rolünü değerlendirmeyi amaçlamaktadır. Bu amaca yönelik olarak bu çalışmada, ChatGPT 'nin tinnitus ile ilgili sıkça sorulan sorulara güvenilir yanıtlar verme kapasitesi, özellikle doğruluk, kapsamlılık ve okunabilirlik açısından belirlenmeye çalışılmıştır. ChatGPT tarafından oluşturulan tinnitus ile ilgili sık sorulan 50 sorudan 10 tanesi değerlendirme için seçildi. Yanıtları değerlendirmek için 5 tarafsız uzman dört puanlık bir kalite ölçeği kullandı. Sınıf içi korelasyon katsayısı (ICC) değerlendiriciler arası güvenilirliği ölçmek için kullanılırken, Ateşman Okunabilirlik İndeksi kullanıldı. Genel olarak, yanıtlar tatmin edici bulundu. Değerlendiriciler arası uyum, iyi olarak kabul edilen 0.762'lük bir ICC değeri ile gösterildi. Metin, okunabilirlik puanlarına göre, yedinci ve sekizinci sınıf öğrencilerinin anlayabileceği bir düzeyde olduğundan, okuyucuların çoğunluğu tarafından anlaşılabiliyordu. Ancak, bazı yanıtlarda yeterli ayrıntı yoktu ve bu da daha fazla geliştirilmesi gereken alanları gösteriyordu. Bu çalışma, ChatGPT modelinin iyi değerlendiriciler arası güvenilirlik ve tinnitus ile ilgili sıkça sorulan sorulara tatmin edici yanıtlar verme kapasitesi gösterdiğini ortaya koymuştur. Bununla birlikte, çalışma yanıtlardaki sınırlılıkları ve kapsamlı veri eksikliğini de ortaya koymuştur. Bu bulgular, tinnitusa ilişkin bilgilerin uzmanlar tarafından doğrulanması ve denetlenmesi gerektiğini, kapsamlı ve kişiye özel rehberlik gerektirdiğini göstermektedir.

Anahtar Kelimeler: Tinnitus, generative artificial intelligence, ChatGPT, Understandıng.

CAN CHATGPT PROVIDE RELIABLE ANSWERS TO FREQUENTLY ASKED QUESTIONS ABOUT TINNITUS?

ABSTRACT

It is well known that tinnitus can significantly affect an individual's quality of life. Therefore, access to accurate information about tinnitus is of great importance for individuals. This study aimed to evaluate the role of internet use in accessing accurate information about tinnitus. For this purpose, the study sought to determine ChatGPT's capacity to provide reliable answers to frequently asked questions about tinnitus, particularly in terms of accuracy, comprehensiveness, and readability. Of the 50 frequently asked questions about tinnitus generated by ChatGPT, 10 were selected for evaluation. Five independent experts used a four-point quality scale to assess the responses. The intraclass correlation coefficient (ICC) was used to measure inter-rater reliability, while the Ateşman Readability Index was applied to assess readability. Overall, the responses were found to be satisfactory. Inter-rater agreement was demonstrated by an ICC value of 0.762, which is considered good. Based on readability scores, the text was understandable for most readers, corresponding to a level appropriate for seventh- and eighth-grade students. However, some responses lacked sufficient detail, indicating areas that require further improvement. This study demonstrated that the ChatGPT model shows good inter-rater reliability and a satisfactory capacity to provide answers to frequently asked questions about tinnitus. Nevertheless, the study also revealed limitations in the responses and a lack of comprehensive data. These findings indicate that information related to tinnitus should be verified and supervised by experts and that comprehensive and personalized guidance is required.

Keywords: Tinnitus, generative artificial intelligence, ChatGPT, comprehension.

DİYABETİK AYAĞA BİRİNCİ BASAMAK SAĞLIK HİZMETLERİ YAKLAŞIMI

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Amaç:

Diyabetik ayak, non-travmatik alt ekstremite amputasyonlarının en önemli nedenlerinden biri olup, erken tanı ve uygun yönlendirme ile büyük ölçüde önlenebilir bir klinik tablodur. Bu bildirinin amacı, birinci basamak sağlık hizmetlerinin diyabetik ayak yönetimindeki rolünü ve etkin yaklaşım prensiplerini ortaya koymaktır.

Gereç ve Yöntem:

Bu çalışma, diyabetik ayak ile ilgili güncel ulusal ve uluslararası kılavuzlar ile literatürün derlenmesi ve değerlendirilmesi esasına dayanmaktadır. Birinci basamakta uygulanabilir risk değerlendirme yöntemleri, ayak muayene protokolleri ve sevk kriterleri incelenmiştir.

Bulgular:

Birinci basamakta diyabetik ayak gelişimi açısından yüksek riskli hastaların erken tanımlanması, amputasyon oranlarının azaltılmasında kritik öneme sahiptir. Uzun süreli diyabet öyküsü, kötü glisemik kontrol, periferik nöropati ve periferik arter hastalığı başlıca risk faktörleri olarak saptanmıştır. Sistematik ayak muayenesi, monofilament testi ve periferik nabız değerlendirmesi, erken dönemde patolojilerin tespitinde etkili bulunmuştur. Açık yara, enfeksiyon veya iskemi bulgularının varlığında gecikmeden multidisipliner merkezlere sevk edilen hastalarda klinik sonuçların daha iyi olduğu gözlenmiştir. Hasta eğitiminin yara gelişimi ve amputasyon riskini anlamlı düzeyde azalttığı bildirilmektedir.

Sonuç:

Diyabetik ayak yönetiminde birinci basamak sağlık hizmetleri temel ve vazgeçilmez bir basamaktır. Etkin tarama, hasta eğitimi ve zamanında sevk, morbidite ve amputasyon oranlarını azaltan en etkili stratejilerdir.

PRİMARY HEALTH CARE APPROACH TO DİYABETİC FOOT

Objective:

Diabetic foot is one of the leading causes of non-traumatic lower extremity amputations and represents a largely preventable clinical condition when early diagnosis and appropriate referral are achieved. The aim of this study is to emphasize the role of primary health care services in the management of diabetic foot and to outline effective approach principles.

Materials and Methods:

This study is based on a review and evaluation of current national and international guidelines and relevant literature on diabetic foot. Risk assessment methods, foot examination protocols, and referral criteria applicable in primary health care settings were examined.

Results:

Early identification of patients at high risk for the development of diabetic foot in primary care settings plays a critical role in reducing amputation rates. Long-standing diabetes, poor glycemic control, peripheral neuropathy, and peripheral arterial disease were identified as the main risk factors. Systematic foot examination, monofilament testing, and assessment of peripheral pulses were found to be effective in detecting early-stage pathologies. Clinical outcomes were observed to be better in patients who were promptly referred to multidisciplinary centers in the presence of open wounds, signs of infection, or ischemia. Patient education has been reported to significantly reduce the risk of wound development and amputation.

Conclusion:

Primary health care services constitute a fundamental and indispensable component of diabetic foot management. Effective screening, patient education, and timely referral are the most efficient strategies for reducing morbidity and amputation rates.

MİDKİNE PARAMETRESİNİN BEŞERİ HEKİMLİKTE KLİNİK KULLANIMI VE VETERİNER HEKİMLİKTE TAŞIDIĞI POTANSİYEL

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ÖZET

Midkine (MK), embriyonel karsinom hücrelerinin retinoik asit ile farklılaşma sürecinde aşırı ekspre olan bir genin araştırılması esnasında keşfedilen, son 40 yılda gelişimsel biyoloji alanında yeni bir araştırma alanı olarak yer alan bir parametredir. Retinoik asit ile indüklenen farklılaşma ile ilişkili protein ailesi olarak adlandırılmaktadır. Bu protein ailesi genellikle "midkine/pleiotrophin ailesi", "heparin bağlayıcı büyüme faktörü ailesi" ya da "neurit büyüme tetikleyici faktör ailesi" olarak da isimlendirilmektedir. Bu poteinler, diğer metabolik proteinlerin heparan sülfat proteoglikanlara ve çeşitli hücre yüzeyi reseptörlerine bağlanmasını sağlayarak çok geniş bir biyolojik etki spektrumu meydana getirirler. Midkine proteinleri embriyonik gelişimde, nöral farklılaşma, organogenez, hücre migrasyonu, survival ve patterning süreçlerinde rol oynamaktadır. Gelişimsel dönemlerde yüksek oranda ekspre edilmesine rağmen, sağlıklı erişkin dokularda oldukça sınırlıdır. Fakat patolojik mekanizmalar ile birlikte indüklendiği ve hali hazırda süren neoplastik bazı oluşumlar için bir biyomarker olarak kullanılabildiği görülmektedir. Bu durum, bu protein ailesinin yalnızca gelişimsel görevler değil, aynı zamanda patolojik durumlarda kritik biyodüzenleyiciler olarak görev aldığının bir göstergesidir. Sonuç olarak Midkine, embriyolojik dönemde farklılaşma ve organ gelişimi üzerine üstlendiği görevler ile öne çıkan, fonksiyonel açıdan çok yönlü protein ailesinin kurucu üyesi olup, inflamasyon, onkogenez ve doku onarım durumlarında merkezi bir molekül olarak değerlendirilmektedir. Özellikle insanlarda onkoloji alanında erken evrelerde duyarlı bir biyobelirteç olarak yer almaktadır. Ayrıca enfeksiyonlarda, sepsis tablolarında ve inflamatorik hastalıklarda diğer belirteçler ile korele ve onlardan daha erken yükselen bir belirteç olduğu ve meydana gelen bu tablolar sonucu yangının şiddeti ve oluşan organ hasarlarının tespitinde kullanılabileceği bildirilmektedir. Midkine; son 50 yıl içerisinde keşfedilen ve yüksek potansiyel taşıyan bir biyomarker olarak tanımlanmaktadır. Veteriner hekimlikte hali hazırda herhangi bir hayvan türü ile yapılan çalışmaya rastlanılmadı. Bu parametrenin özelliklerinin anlaşılması ve var olan literatür bilginin değerlendirilmesi ile, Midkine!nin veteriner hekimliğe uyarlanabileceği ve yapılacak çalışmalara genel bilgilerin

aktarılması ile kaynak olarak katkı sağlanabilineceği düşünülmektedir. Bu derleme ile Midkine proteinin hakkında var olan literatür bilgi özetlenmiş ve veteriner hekimlikte Midkine parametresi ile yapılacak olan çalışmalara referans teşkil edilmesi hedeflenmiştir.

Anahtar Kelimeler: Midkine, noplazi, inflamasyon, veteriner hekim, biyomarker

CLINICAL APPLICATION OF THE MIDKINE PARAMETER IN HUMAN MEDICINE AND ITS POTENTIAL IN VETERINARY MEDICINE

ABSTRACT

Midkine (MK) is a parameter discovered during the investigation of a gene overexpressed in the differentiation process of embryonic carcinoma cells with retinoic acid, which has emerged as a new field of research in developmental biology over the past 40 years. It is referred to as the protein family associated with retinoic acid-induced differentiation. This protein family is also commonly named the “midkine/pleiotrophin family,” “heparin-binding growth factor family,” or “neurite growth-triggering factor family.” These proteins produce a very broad spectrum of biological effects by enabling other metabolic proteins to bind to heparan sulfate proteoglycans and various cell surface receptors. Midkine proteins play a role in embryonic development, neural differentiation, organogenesis, cell migration, survival, and patterning processes. Although they are highly expressed during developmental periods, they are quite limited in healthy adult tissues. However, it has been observed that they are induced in conjunction with pathological mechanisms and can be used as a biomarker for certain ongoing neoplastic formations. This indicates that this protein family not only performs developmental functions but also acts as critical biological regulators in pathological conditions. In conclusion, Midkine is a founding member of a functionally versatile protein family that stands out for its role in differentiation and organ development during the embryonic period. It is considered a central molecule in inflammation, oncogenesis, and tissue repair. It is particularly useful as a sensitive biomarker in the early stages of oncology in humans. Furthermore, it has been reported that in infections, sepsis, and inflammatory diseases, it correlates with other markers and rises earlier than them, and can be used to determine the severity of the inflammation and the resulting organ damage. Midkine is defined as a biomarker discovered within the last 50 years and carrying high potential. Currently, no studies involving any animal species have been found in veterinary medicine. By understanding the characteristics of this parameter and evaluating the existing literature, it is thought that Midkine can be adapted to veterinary medicine and contribute as a source by providing general information for future studies. This review

summarizes the existing literature on the Midkine protein and aims to serve as a reference for future studies on the Midkine parameter in veterinary medicine.

Key Words: Midkine, neoplasia, inflammation, veterinary medicine, biomarker

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1. INTRODUCTION

Midkine (MK) is a heparin-binding, small growth factor and cytokine that is part of a small protein family consisting of two members, along with pleiotrophin (PTN)(T Muramatsu 2014). It has a molecular weight of approximately 13 kDa and consists of two main domains: an N-terminal and a C-terminal, stabilized by two disulfide bridges (T Muramatsu 2014). MK has a wide range of biological functions, including cellular proliferation, migration, differentiation, anti-apoptotic effects, and regulation of various immune responses (Kadomatsu et al. 2013; T Muramatsu 2014). It is highly expressed during the embryonic period, while its expression is quite limited in healthy adult tissues and is mostly re-induced in inflammatory conditions, tissue damage, or neoplasia (Kadomatsu et al. 2013; Jones 2014). The overexpression of MK in various cancer types and its detection at elevated levels in circulation has made it a diagnostic and prognostic biomarker (Jones 2014; Krzystek-Korpacka and Matusiewicz 2012).

Midkine was first discovered in 1988 during research into a gene that was overexpressed during differentiation in embryonic carcinoma cells forced to differentiate with retinoic acid. Kadomatsu and colleagues identified MK by screening transcripts that were significantly increased during this differentiation process, and therefore MK was named the “retinoic acid-induced gene product” (Kadomatsu et al. 2013). Subsequently, in 1989, “heparin-binding growth-associated molecule” (HB-GAM) was identified from the perinatal rat brain and “pleiotrophin (PTN)” was isolated from uterine tissue; structural and sequence analyses revealed that MK and PTN are two members of the same protein family (T Muramatsu 2014).

From a physiological perspective, MK is a growth factor that is highly expressed, particularly during embryogenesis and organogenesis, and plays a role in the fine-tuning of developmental processes by regulating cell proliferation, migration, differentiation, survival, and cytokine expression (Kadomatsu et al. 2013; Jones 2014). Its expression is significantly suppressed in healthy adult tissues and is detected at low levels mainly in the renal tubular epithelium; however, it is frequently and excessively induced in pathological processes such as malignancies, inflammatory diseases, tissue damage, and ischemic conditions (T Muramatsu 2014; Filippou et al. 2020). The demonstration of increased MK levels in both tumor tissue and circulation in various cancer types has highlighted MK as a diagnostic and prognostic

biomarker and a potential therapeutic target (Jones 2014; Filippou et al. 2020). In this regard, midkine can be defined as a multifaceted growth factor/cytokine located at the intersection of developmental biology, inflammation, oncogenesis, and tissue repair (Kadomatsu et al. 2013; Filippou et al. 2020).

2. MIDKINE DISCOVERY PROCESS AND PROTEIN FAMILY

Midkine (MK) was first discovered in 1988 during research into a gene that was overexpressed in embryonic carcinoma cells during the differentiation process induced by retinoic acid. Kadomatsu and colleagues cloned the gene now known as midkine by screening for transcripts that were significantly increased in F9 embryonic carcinoma cells treated with retinoic acid, and therefore MK was initially defined as the "retinoic acid-induced differentiation-related protein" (Kadomatsu et al. 2013; T Muramatsu 2014). The discovery of midkine marked an important milestone in understanding retinoic acid-mediated cellular differentiation mechanisms; it also created a new field of research in developmental biology.

In the years following this discovery, independent research groups isolated heparin-binding growth factors from both the perinatal rat brain and uterine tissue; these molecules were named HB-GAM (heparin-binding growth-associated molecule) and pleiotrophin (PTN), respectively (Kadomatsu et al. 2013; Muramatsu and Muramatsu 2012). Sequence and structural analyses revealed that MK and PTN are highly homologous to each other, leading to the conclusion that these two proteins belong to the same family (Kadomatsu et al. 2013). Thus, MK and PTN have been defined as a small but biologically powerful protein family in mammals, consisting of only two members.

The Midkine/pleiotrophin family plays a critical role in embryonic development, neuronal differentiation, organogenesis, cell migration, survival, and patterning processes (Jones 2014; Muramatsu and Muramatsu 2012). Despite high expression during developmental periods, MK and PTN expression is quite limited in healthy adult tissues. Therefore, this family is generally classified as "developmentally regulated growth factors." However, the re-induction and often excessive levels of MK in pathological processes such as malignancy, inflammation, ischemia-reperfusion injury, autoimmunity, and tissue injury have assigned this protein family not only developmental tasks but also critical biological regulatory roles under pathological conditions (Jones 2014; Krzystek-Korpacka and Matusiewicz 2012).

In conclusion, midkine, based on research into embryonic differentiation, is an evolutionarily conserved, heparin-binding, cysteine-rich, and small but functionally versatile protein family that, together with pleiotrophin, is a founding member of this family. It is

involved in both developmental biology and inflammation, oncogenesis, and tissue repair. heparin-binding, cysteine-rich, and small but functionally versatile protein family. It is considered a central molecule in both developmental biology and pathological processes such as inflammation, oncogenesis, and tissue repair.

3. MIDKINE'S PHYSIOLOGICAL FUNCTIONS AND ROLES IN PATHOLOGICAL PROCESSES

Midkine (MK) is a heparin-binding growth factor that is highly expressed during developmental stages and is mostly re-induced by pathological stimuli in adult life. Its structural properties, broad receptor range, and ability to activate numerous cellular signaling pathways make MK a central molecule in both physiological development processes and disease pathogenesis.

3.1. Midkine's Physiological Functions

Embryogenesis and Organogenesis

Midkine is notable for its expression patterns, which reach peak levels during the mid-gestation period (e.g., E11.5–E13.5) of embryonic development (Kadomatsu et al. 1988; Kang et al. 2004). During this period, it is particularly expressed in tissues where epithelial-mesenchymal interactions are intense, such as the lung, gastrointestinal tract, pancreas, metanephros, and cardiovascular system. MK plays a role in regulating cell proliferation, directed migration, differentiation, and tissue patterning processes. These functions are critical for the healthy progression of fundamental morphogenetic processes that determine organ design (Sun and Fukui 1998).

Norological Improvement and Nervous System Functions

MK supports processes in neural development such as neurite outgrowth, axon guidance, neuronal survival, and synaptic organization. These effects are particularly dependent on the activation of the MAPK/ERK and PI3K/AKT pathways via the PTPζ, LRP1, and Notch-2 receptors. MK deficiency during the developmental period has been associated with impaired neural circuit formation and synaptic organization (Kadomatsu and Muramatsu 2004).

Cell Migration and Tissue Interaction

MK is a potent chemotactic factor that regulates controlled cell migration in both embryogenesis and the adult organism. It determines the migration pathways of specific cell populations such as neural crest cells, mesenchymal cells, and immune cells. Due to these properties, MK acts as a "microenvironment regulator" in developmental processes (Muramatsu 2011; Sumi et al. 2000).

Homeostasis and Limited Expression in Adult Tissues

MK expression is quite low in healthy adults and is mostly detected in renal tubular epithelium, lung alveolar cells, and to a limited extent in immune cells. This low basal expression indicates that MK is not so much a homeostatic molecule in adult physiology as it is a "stress response protein that is activated when needed" (Kadomatsu et al. 2013).

3.2. The Role of Midkine in Pathological Processes

Midkine's role in pathological processes is a natural extension of its physiological functions; however, in a pathological environment, MK production can spiral out of control and contribute to disease progression.

Cancer and Oncogenesis

MK is a growth factor that is overexpressed in many malignancies and is notable for its increased levels in both tumor tissue and circulation. Its mechanism of action in cancer development involves multiple factors. It activates the PI3K/AKT and MAPK/ERK pathways via ALK, LRP1, and integrin receptors. This increases cell proliferation. It prolongs the lifespan of tumor cells by suppressing cell death. This is referred to as an anti-apoptotic mechanism. It increases proliferation in endothelial cells and stimulates new blood vessel formation. Invasion and metastasis: It enhances metastatic potential by modulating cell adhesion molecules (Jones 2014).

Inflammation and Immun Regulation

MK is a cytokine rapidly induced in inflammatory areas and plays a decisive role in shaping the pathological inflammatory response. MK increases the migration of neutrophils and macrophages to the site of inflammation. MK enhances the proinflammatory response by suppressing regulatory T cells. It increases the expression of various cytokines in both innate and acquired immune responses. It may contribute to endothelial activation and vasculitis-like pathologies (Krzystek-Korpacka et al. 2010).

Tissue Damage, Ischemia, and Reperfusion Injury

MK expression increases dramatically after ischemia or toxic damage. In the heart, MK reduces tissue loss through anti-apoptotic mechanisms in myocardial ischemic reperfusion injury. In the brain, MK reduces neuronal loss after cerebral ischemia and supports neurogenesis. In the kidneys, MK reduces tubular damage in ischemia and nephrotoxicity models (Kitahara et al. 2010; Jones 2014).

Fibrosis and Chronic Tissue Remodeling

Under conditions of prolonged inflammation and tissue damage, MK can regulate fibroblast activation, extracellular matrix accumulation, and tissue remodeling processes. Therefore, in chronic pathologies such as cardiac remodeling, MK has a dual role that can influence both protective and fibrotic processes (Nordin et al. 2013).

Infections and Systemic Inflammation

In Krzystek-Korpacka's systematic review, it has been shown that MK levels are elevated in many infections and systemic inflammatory diseases. This suggests that MK plays a role in the pathogenesis of infection through mechanisms such as immune cell activation, chemotaxis, and endothelial permeability (Krzystek-Korpacka and Matusiewicz 2012).

Midkine, which fine-tunes development under physiological conditions, is a molecule that is often re-induced in pathological processes and whose activity increases exponentially in conditions such as inflammation, tissue damage, and cancer. This dual nature makes MK both a fundamental actor in physiology and one of the central regulators of disease biology.

4. MIDKINE CLINICAL APPLICATIONS IN HUMAN MEDICINE

Midkine (MK) is a heparin-binding growth factor that is normally present at low levels under physiological conditions but rapidly increases in response to various pathological stimuli such as inflammation, tissue damage, hypoxia, malignant transformation, and immune response. Its detectability in serum and plasma has made MK an increasingly important biomarker in translational medicine (Weckbach et al. 2011). MK's short biological half-life offers a unique advantage in that it can be detected even in the early stages of pathological changes. Thanks to these characteristics, MK has versatile clinical applications, including early diagnosis, assessment of disease activity, monitoring of treatment response, and prediction of prognosis (Jones 2014).

Diagnostic Applications of Midkine in Human Medicine

The clinical field in which circulating CEA levels are most frequently studied is oncology. CEA rises significantly even in the early stages of many solid tumors. It has been reported that CEA is a sensitive marker even in the early stages of malignancies such as lung cancer, pancreatic adenocarcinoma, colorectal cancer, hepatocellular carcinoma, prostate cancer, and ovarian cancer. Jones (2014) reported that MK rises earlier than classic biomarkers such as CEA or CA-19-9 in some tumors and suggested that MK could be a “pan-cancer marker” (Jones 2014).

In their comprehensive analyses, Krzystek-Korpacka and Matusiewicz demonstrated that MK levels are elevated not only in malignancies but also in conditions such as inflammatory bowel disease, sepsis, acute coronary syndrome, severe bacterial infections, and autoimmune diseases. Therefore, MK is considered a broad-spectrum biomarker reflecting the activity of inflammation (Krzystek-Korpacka and Matusiewicz 2012).

The impact of disease management practices

C-reactive protein (CRP) levels significantly increase during flare-ups of many chronic inflammatory diseases such as inflammatory bowel disease, rheumatoid arthritis, systemic lupus erythematosus, and vasculitis. MK has been shown to correlate with classic inflammatory markers such as CRP and IL-6, but in some studies, it has been shown to rise earlier than these markers (Jawad and Hussein 2022).

Krzystek-Korpacka (2012) reported that C-reactive protein (CRP) reflects the severity of systemic inflammation in infection and sepsis, and that circulating CRP levels can be used to predict the risk of organ damage (Krzystek-Korpacka and Matusiewicz 2012).

Decreased tumor marker levels following chemotherapy, radiotherapy, or targeted therapies may indicate a reduction in tumor burden and a response to treatment. Conversely, a recurrence of elevated tumor marker levels may serve as an early warning sign of relapse or metastasis (Tanabe et al. 2008).

A decrease in MK levels after ischemia-reperfusion injury may indicate that tissue damage has subsided. This is particularly important in clinical conditions such as acute coronary syndrome, cerebral ischemia, and kidney injury (Majaj and Weckbach 2022).

Prognostic Potential of Midkine

Various clinical studies have demonstrated that circulating MK levels have prognostic value. Elevated serum MK levels are strongly associated with shorter overall survival, high metastasis risk, aggressive tumor phenotype, and treatment resistance (Kadomatsu et al. 2013; Krzystek-Korpacka and Matusiewicz 2012; T. Muramatsu 2014).

5. THE POTENTIAL OF VETERINARY MEDICINE

In conclusion, when human literature is evaluated as a whole, midkine appears to be a common biological marker of inflammation, tissue damage, and cellular stress responses. Although midkine has high sensitivity potential in many diseases, it should not be considered a diagnostic biomarker on its own due to its limited specificity. Its clinical value lies more in providing additional information about disease activity or prognosis in selected patient groups and contributing to multi-biomarker approaches. Therefore, midkine is considered an important

candidate biomarker for translational research rather than a parameter that has yet to enter routine use in human medicine. A similar situation holds potential in veterinary medicine. There are no studies associating midkine with any disease or healthy individuals in veterinary medicine. In this respect, midkine is an area to be studied and offers a new perspective on diseases that are difficult to diagnose. We believe that the midkine parameter can be considered a potential parameter for veterinary medicine and recommend that it be evaluated as a new field for researchers.

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İZOLE PANKREAS KANALI GENİŞLEMESİNDE MRCP'NİN TANISAL PERFORMANSI: BENİNG VE MALİGN NEDENLERİN DEĞERLENDİRİLMESİ

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ÖZET

Ana pankreatik kanal (APK) dilatasyonu çoğunlukla obstrüktif nedenler (pankreas tümörü, kronik pankreatit, safra taşı) veya IPMN gibi intraduktal lezyonlardan kaynaklanmaktadır. Bu çalışmada, daha yüksek duyarlılığa sahip Manyetik rezonans kolanjiyopankreatografi (MRCP) ile görünür kitle veya obstrüktif patoloji (safra taşı, kist vb) olmaksızın saptanan izole APK dilatasyonunun benign ve malign ayrımını sağlayacak özelliklerini ve bu özelliklerin tanı başarısını artırıp artırmadığını araştırmayı amaçladık.

Kasım 2015 ile Mart 2025 tarihleri arasında merkezimizde, görünür bir kitle veya obstrüktif neden olmaksızın MRCP de ana pankreatik kanal dilatasyonu saptanan 92 hasta retrospektif olarak çalışmaya dahil edilmiştir.

Olguların %85,9'u benign (n = 79) ve %14,1'i malign (n = 13) olarak sınıflandırılmıştır. "Dar segment uzunluğu", malign grupta anlamlı derecede daha yüksek bulunmuştur (z = –4,033, p < .001). Malign olgularda dar segmentin medyan uzunluğu 15,00 mm (Q1–Q3 = 14–17) olup, benign gruba kıyasla yaklaşık dört kat daha uzundu (medyan = 3,70 mm, Q1–Q3 = 2,5–7). Benzer şekilde, eşlik eden yan dal dilatasyonu/kist boyutu da malign grupta (medyan = 16,00 mm, Q1–Q3 = 4,8–25) anlamlı ölçüde daha büyük saptanmıştır (z = –2,715, p = .007).

Dilatasyonun en geniş segmentinin lokalizasyonu açısından da gruplar arasında anlamlı fark saptanmıştır. Malign olguların çoğunda lezyon boyun seviyesinde lokalizeyken (%53,8), benign olgularda ise baş bölgesi baskın lokalizasyondu (%88,6) (p = .001). Ayrıca, pankreatik kanal darlığının sonlanım şekli açısından gruplar arasında anlamlı fark gözlenmiştir. Malign olgularda darlık sonlanımı çoğunlukla "künt" iken (%88,9), benign grupta "incelerek sonlanma" paterni daha yaygındı (%72,7) (p = .001).

MRCP, izole APK dilatasyonlarında maligniteyi dışlamak ve uygun hasta yönetimini planlamak için güvenli, hızlı, non-invaziv bir tetkik olması sebebiyle yüksek riskli grupta tarama amaçlı kullanılabilir. Saptanan dar segment uzunluğu, dilate yan dal/kist boyutu, darlığın boyun bölgesinde yerleşimi, kanalın künt sonlanımı ve doğrudan cerrahi ile doğrulanan

histolojik tanı gibi bulgular, malignite lehine anlamlı ipuçları sağlamakta, doğru yönetim stratejilerinin belirlenmesine katkı sağlamaktadır.

Anahtar Kelimeler: Ana pankreatik kanal dilatasyonu, Manyetik rezonans kolanjiyopankreatografi (MRCP), İzole pankreatik kanal dilatasyonu, Pankreatik malignite, Benign–malign ayrımı

DIAGNOSTIC PERFORMANCE OF MRCP IN ISOLATED PANCREATIC DUCT DILATATION: ASSESSING BENING AND MALIGNANT CAUSES

ABSTRACT

Main pancreatic duct (MPD) dilatation most commonly results from obstructive causes such as pancreatic tumours, chronic pancreatitis, gallstones, or intraductal lesions including intraductal papillary mucinous neoplasms (IPMNs). This study aimed to identify imaging features that enable differentiation between benign and malignant causes of isolated MPD dilatation detected on magnetic resonance cholangiopancreatography (MRCP) in the absence of a visible mass or obstructive pathology (e.g. gallstones, cysts), and to evaluate whether these features improve diagnostic performance.

Between November 2015 and March 2025, a total of 92 patients in whom isolated MPD dilatation was identified on MRCP without an apparent mass or obstructive cause were retrospectively included. Of these, 85.9% were classified as benign (n = 79) and 14.1% as malignant (n = 13).

The length of the “narrowed segment” was significantly greater in the malignant group ($z = -4.033$, $p < .001$). The median length of the narrowed segment in malignant cases was 15.00 mm (Q1–Q3 = 14–17), approximately four times longer than that in the benign group (median = 3.70 mm, Q1–Q3 = 2.5–7). Similarly, the size of the accompanying side-branch dilatation or cyst was significantly larger in the malignant group (median = 16.00 mm, Q1–Q3 = 4.8–25) compared with benign cases ($z = -2.715$, $p = .007$).

A significant difference was also observed in the localisation of the widest segment of ductal dilatation. In malignant cases, the lesion was most commonly located at the pancreatic neck (53.8%), whereas in benign cases the pancreatic head was the predominant site (88.6%) ($p = .001$). In addition, the termination pattern of pancreatic ductal narrowing differed significantly between groups: malignant cases most frequently demonstrated a blunt-ending stricture (88.9%), while a tapering termination pattern was more common in the benign group (72.7%) ($p = .001$).

MRCP may be used as a safe, rapid, and non-invasive screening tool in high-risk patients with isolated MPD dilatation to exclude malignancy and guide appropriate patient management. Imaging findings such as the length of the narrowed segment, size of dilated side branches or cysts, localisation of the stricture at the pancreatic neck, blunt ductal termination, and histological confirmation obtained through direct surgical intervention provide significant clues favouring malignancy and contribute to the selection of optimal management strategies.

Keywords: Main pancreatic duct dilatation, Magnetic resonance cholangiopancreatography (MRCP), Isolated pancreatic duct dilatation,Pancreatic malignancy, Benign–malignant differentiation

ÜNİVERSİTE ÖĞRENCİLERİNDE PSİKOLOJİK SAĞLAMLIK: BİREYSEL RİSK FAKTÖRLERİNE İLİŞKİN TEORİK BİR İNCELEME

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ÖZET

Üniversite öğrencilerinde psikolojik sağlamlık, bireylerin duygusal, sosyal ve akademik alanlarda yaşadıkları stresli durumlar karşısında esnek davranabilme, zorluklarla başa çıkabilme ve farklılaşan yaşam koşullarına karşı uyum sağlayabilme kapasitesi olarak ele alınmaktadır. Bu çalışma, üniversite öğrencilerinde psikolojik sağlamlığı olumsuz etkileyen bireysel risk faktörlerini incelemeyi amaçlamaktadır. Araştırma kapsamında düşük öz-yeterlik algısı, geçmiş travmatik yaşantılar, yoğun duygusal yük, işlevsiz baş etme stratejileri, belirsizliğe tahammülsüzlük, düşük benlik saygısı ve bağımlılık eğilimleri temel bireysel risk faktörleri olarak ele alınmıştır. Çalışma, literatürde yer alan çalışmalar temel alınarak doküman analizi yöntemiyle yürütülmüş olup söz konusu risk faktörlerinin öğrencilerin psikolojik sağlamlık düzeyleri üzerindeki etkileri sistematik ve bütüncül bir yaklaşımla incelenmiştir. Elde edilen sonuçlar, düşük öz-yeterlik algısının öğrencilerin stresle başa çıkma becerilerini zayıflattığını; geçmiş travmalar ve yoğun duygusal yük gibi faktörlerin psikolojik sağlamlığı olumsuz yönde etkilediğini ortaya koymaktadır. Bunun yanı sıra işlevsiz baş etme stratejileri, belirsizliğe tahammülsüzlük, düşük benlik saygısı ve bağımlılık eğilimlerinin öğrencilerin uyum kapasitelerini düşürdüğü belirlenmiştir. Buna karşılık, bireyin içsel kaynakları, sosyal destek sistemleri ve pozitif psikoloji temelli unsurların üniversite öğrencilerinin psikolojik sağlamlığını güçlendiren temel koruyucu faktörler arasında yer aldığı ortaya konulmuştur. Çalışma, üniversite yıllarının psikolojik sağlamlık açısından kritik bir dönem olduğunu ve bu dönemin öğrencilerin duygusal düzenleme kapasitesi, sosyal uyum düzeyleri ve akademik performansları üzerinde belirleyici bir rol oynadığını göstermektedir. Ancak konunun çok boyutlu yapısı ve bireysel risk faktörlerinin geniş bir yelpazeye sahip olması nedeniyle, bu faktörlerin tümü çalışmanın kapsamı gereği sınırlı tutulmuştur.

Anahtar Kelimeler: Psikolojik sağlamlık, üniversite, öğrenci, risk, öz-yeterlik

PSYCHOLOGICAL RESILIENCE AMONG UNIVERSITY STUDENTS: A THEORETICAL REVIEW OF INDIVIDUAL RISK FACTORS

ABSTRACT

Psychological resilience among university students is defined as the capacity to behave flexibly, cope with difficulties, and adapt to differentiated life conditions in response to stressful situations encountered in emotional, social, and academic domains. This study aims to examine individual risk factors that negatively affect psychological resilience among university students. Within the scope of the study, low self-efficacy perception, past traumatic experiences, high emotional burden, dysfunctional coping strategies, intolerance of uncertainty, low self-esteem, and addiction tendencies were addressed as fundamental individual risk factors. The study was conducted using the document analysis method based on studies available in the literature, and the effects of these risk factors on students' levels of psychological resilience were examined through a systematic and holistic approach. The results indicate that low self-efficacy perception weakens students' ability to cope with stress, while factors such as past traumas and high emotional burden negatively affect psychological resilience. In addition, dysfunctional coping strategies, intolerance of uncertainty, low self-esteem, and addiction tendencies were found to reduce students' adaptive capacities. In contrast, individuals' internal resources, social support systems, and positive psychology–based elements were identified as fundamental protective factors that strengthen psychological resilience among university students. The study highlights that the university years represent a critical period for psychological resilience and that this period plays a determining role in students' emotional regulation capacity, levels of social adjustment, and academic performance. However, due to the multidimensional nature of the subject and the wide range of individual risk factors, the scope of this study has been limited to these specific factors.

Keywords: Psychological resilience, university, student, risk, self-efficacy

1. GİRİŞ

1980'li yıllardan itibaren psikoloji literatüründe '*resilience*' kavramıyla ele alınan psikolojik sağlamlık, bireylerin stres ve olumsuz koşullar karşısında toparlanma, uyum sağlama, esneklik gösterme ve işlevselliğini yeniden kazanma kapasitesini ifade eden bir kavram hâline gelmiştir (Berliner ve ark., 2011, s. 13; Masten, 2014, s. 7). Psikoloji literatüründe "psikolojik sağlamlık" kavramı, bireyin ruh sağlığı üzerinde önemli olumsuz etkiler oluşturabilecek stresli koşullardan kurtulabilme yetisi şeklinde tanımlanmaktadır (Budak, 2017, s. 732). Bu kavram, yalnızca kriz veya travma durumlarında değil, günlük yaşamın getirdiği stresli durumlarla başa çıkma

yeteneğini de kapsar (Masten, 2001, s. 28). Rutter (1987), psikolojik sağlamlığı risk faktörlerine ve olumsuz koşullara rağmen bireylerin uyum sağlama ve olumlu tutum sergileme kapasitesi olarak tanımlamış; bu sürecin yalnızca bireysel özelliklere değil, çevresel koşullara ve sosyal destek sistemlerine de bağlı olduğunu vurgulamıştır (s. 316). Benard (1991) ise psikolojik sağlamlığı, zorlukları aşmanın ötesinde, bu koşullar içinde olumlu uyum sağlayarak gelişimsel ilerlemeyi sürdürme yeteneği olarak tanımlamıştır (s. 3). Bu çerçevede, psikolojik sağlamlık bireyin yalnızca hayatta kalmasını değil, aynı zamanda gelişim göstermesini ve olumlu sonuçlar elde etmesini kapsayan çok boyutlu bir kavramdır (Berliner ve ark., 2011, s. 13; Fraser ve ark., 1999, s. 136; Ungar, 2012, s. 13).

Psikolojik sağlamlık düzeyi yüksek bireyler stresli durumlarda daha iyi uyum sağlamakta ve kişisel gelişimlerini sürdürmektedirler. Psikolojik sağlamlık, bireylerin travmadan sonra önceki durumlarından daha verimli bir düzeye ulaşmasını (Üzar Özçetin ve Hiçdurmaz, 2017, ss. 392–393) ve yaşantılarında anlamlı gelişimsel süreçlere girmelerini sağlamaktadır (Işık, 2023, s. 47). Bu kavram, özellikle üniversite yıllarında önem kazanmaktadır. Üniversite öğrencileri; sosyal, duygusal, mesleki ve ekonomik birçok alanda yeni deneyimler edinirken kimlik ve yönelimlerini oluşturdukları bu dönemde; karşılaştıkları zorluklarla başa çıkma becerilerini geliştirmek zorundadırlar. Psikolojik sağlamlık, bu süreçte bireyin işlevselliğini sürdürebilmesi ve zorluklara karşı etkin başa çıkabilmesi için belirleyici bir faktördür (Aydın ve Egemberdiyeva, 2018, ss. 39–40). Bunun yanı sıra sosyal ve duygusal uyum süreçlerinde de önemli bir rol oynamaktadır (Akbay ve Gizir, 2010, s. 62).

Literatürde; çocukluk çağı ruhsal travmaları, duygusal öz-yeterlik, teknoloji kullanımı ve bireysel, duygusal özellikler gibi çeşitli faktörlerin psikolojik sağlamlıkla ilişkili olduğu gösterilmiştir. Alanyazında önemli sayıda nicel yöntemlerle yürütülmüş çalışma mevcut olup, bireysel risk faktörlerinin nitel boyutları ve kavramsal temellerinin daha ayrıntılı biçimde ele alınmasına ihtiyaç duyulduğu görülmektedir. Bu doğrultuda, psikolojik sağlamlığın nitel bir bakış açısıyla incelenmesi ve bireysel risk faktörleri çerçevesinde değerlendirilmesi literatüre katkı sağlayabilecek bir yaklaşım olarak düşünülmektedir.

Bu çalışma, üniversite öğrencilerinde psikolojik sağlamlık kavramını bireysel risk faktörleri odağında ve teorik düzeyde ortaya koymayı amaçlamaktadır. Araştırmanın temel sorusu, "Üniversite öğrencilerinde bireysel risk faktörleri psikolojik sağlamlık bağlamında nasıl değerlendirilmektedir?" şeklinde belirlenmiş olup, elde edilecek sonuçların akademik çalışmalar, eğitim ve rehberlik uygulamalarına yol gösterici olması hedeflenmektedir.

2. YÖNTEM

Araştırmanın amacına uygun olarak, verilerin toplanması ve analiz edilmesinde doküman analizi yöntemi tercih edilmiştir. Bu yöntem, akademik kitaplar, hakemli makaleler, tezler ve açık erişimli güvenilir kaynaklar aracılığıyla mevcut bilgilerin sistematik biçimde incelenmesine olanak sağlar.

Kaynak seçimi sürecinde hem ulusal hem uluslararası literatür dikkate alınmış ve psikolojik sağlamlık ile ilişkili güvenilir çalışmalardan faydalanılmıştır. Analiz aşamasında kaynaklar, önceden belirlenen kategoriler doğrultusunda gözden geçirilmiş; bireysel risk faktörleri sınıflandırılmış ve psikolojik sağlamlıkla bağlantıları incelenmiştir. Elde edilen veriler, araştırma soruları kapsamında betimsel bir yaklaşımla analiz edilerek raporlaştırılmıştır.

3. ARAŞTIRMA VE BULGULAR

3.1. Psikolojik Sağlamlıkta Bireysel Risk Faktörleri

Psikolojik sağlamlıkta bireysel risk faktörleri, bireyin psikolojik, sosyal ve akademik yaşamını olumsuz etkileyebilecek kişisel özelliklerdir. Birden fazla risk faktörünün eş zamanlı veya ardışık etkileri, bireyin psikolojik kırılganlığını artırarak '*kümülatif risk*' oluşturmaktadır. *Kümülatif risk*, tekil risklerden daha güçlü bir etkiyle psikolojik sağlamlığı zayıflatabilmektedir (Masten ve Reed, 2002, s. 76). *Kümülatif risk* yaklaşımına göre; risk faktörlerinin eş zamanlı görülmesi ya da zaman içinde üst üste binmesi, birey üzerindeki olumsuz etkilerin katlanarak artmasına neden olabilmektedir. Çoklu risk faktörlerinin yarattığı toplam etki, bu faktörlerin tek tek yarattığı etkilerin toplamından çok daha yıkıcı olabilmektedir. Örneğin, prematüre doğum tekil bir risk iken, yoksulluk durumunda gerçekleşen prematüre doğum, gelişimsel sonuçları çok daha ağırlaştırmaktadır. Dolayısıyla riskin yaşanma sıklığı, şiddeti ve sürekliliği, bireyin psikolojik sağlamlığını tehdit eden asıl belirleyicilerdir (Masten ve Wright, 1998, ss. 9–11).

Örneğin bir üniversite öğrencisinin sadece sınav kaygısı yaşaması tekil bir risk faktörü oluştururken bu duruma ekonomik güçlüklerin ve aile içi çatışmaların eklenmesi, bireyin baş etme kapasitesini zorlayarak kümülatif bir risk oluşturabilir. Bu bağlamda üniversite öğrencileri için de psikolojik sağlamlık düzeyini etkileyen bireysel risk faktörleri çok boyutlu ve birbirleriyle etkileşim içinde olabilmektedir. Bu risk faktörleri öğrencilerin stresle başa çıkma kapasitelerini ve dolayısıyla psikolojik sağlamlıklarını olumsuz etkileyebilmektedir (Öz ve Yılmaz, 2009, s. 84; Taş ve Yıldız, 2023, s. 26).

3.1.1. Düşük Öz-Yeterlik Algısı

Literatürde öz-yeterlik, bireyin belirli bir görevi veya durumu başarıyla yerine getirme kapasitesine ilişkin kişisel inancıdır (Zimmerman, 2000, ss. 83–84). Bandura'ya (1997) göre öz-yeterlik, bireyin belirli kazanımları üretmek için gerekli eylemleri organize etme kapasitesine dair algısını ifade eder (s. 3). Öz-yeterlik algısı güçlü bireyler, karşılaştıkları görevleri başarılı bir şekilde yerine getirirken; düşük öz-yeterlik algısına sahip olanlarda başarısızlık riski artmakta ve kaygı düzeyi yükselmektedir (Yılmaz ve Bökeoğlu, 2008, s. 148). Öz-yeterlik inancının güçlü olması yalnızca bireyin stresle baş etme kapasitesini değil, psikolojik sağlamlığını ve yaşam doyumunu da olumlu yönde etkilemektedir (Aypay, 2010, ss. 127–128). Buna karşılık düşük öz-yeterlik algısına sahip bireylerin sorunlar karşısında inkâr, kaçınma veya dışsallaştırma gibi pasif stratejilere yönelme eğilimi gösterdikleri belirtilmiştir (Lazarus ve Folkman, 1984, s. 145).

Clark ve Beck'e (2010) göre, yoğun kaygı yaşayan bireyler denge ve güven içeren unsurları görmezden gelerek dikkatlerini tehdit unsurlarına yöneltmektedir. Bu süreçte birey, zayıflıklarına odaklanmakta, olumlu baş etme kaynaklarını küçümsemekte, hatalarını bilişsel olarak büyüterek (*magnification*) sonuçları felaketleştirmektedir (catastrophizing). Bireyin kontrol duygusunu zayıflatan bu tür bilişsel çarpıtmalar, baş edememe inancını pekiştirerek öz-yeterlik algısını düşürmektedir (s. 47). Sonuç olarak öz-yeterlik algısı zayıflayan bireylerde psikolojik sağlamlık kapasitesi düşmekte ve bu durum bireyin stres faktörlerine karşı kırılganlığını artırabilmektedir.

Akademik bağlamda ise yüksek öz-yeterlik, öğrencilerin akademik görevlerde daha fazla sorumluluk almalarını ve başarılarını artırmalarını sağlarken (Lalonde, 1979, akt. Satıcı, 2013, s. 23) düşük öz-yeterlik algısı öğrencilerin akademik beklentilerini sınırlayarak kişisel uyumlarını güçleştirmektedir (Chemers ve ark., 2001, ss. 61–62). Akademik öz-yeterlik algısı düşük olan öğrencilerde öğrenme süreçlerinde motivasyon eksikliği yaşanabilmekte ve bu durum bireylerin depresyon gibi psikopatolojik durumlara karşı kırılganlığını artırabilmektedir (Millburg, 2009).

Bu veriler ışığında üniversite yılları; bireyin yaşam doyumunu ve genel iyi oluşunu kapsayan yaşam kalitesinin yapılandırıldığı, aynı zamanda kişisel gelişimin desteklendiği bir dönemdir. Bu bağlamda öz-yeterlik, yaşam kalitesini ve psikolojik iyi oluşu destekleyen önemli bir bileşen olarak değerlendirilmektedir. Özellikle akademik öz-yeterlik, öğrencilerin yaşam doyumlarını ve akademik başarılarını artıran temel unsurlardan biridir (Aypay, 2010, s. 119; Hamad Amin ve Coşkun Özyol, 2020, ss. 23–24). Buna karşın, öz-yeterlik algısının zayıf olması, akademik

motivasyonu ve öğrenmeye etkin katılımı düşürmekte, eğitim süreçlerinin etkinliğini kısıtlamaktadır. Bu noktada öz-yeterlik algısının geliştirilmesi, hem kuramsal hem de uygulamalı açıdan eğitim süreçlerinin verimliliğini artıran temel bir gereklilik olarak görülmektedir (Schunk ve Mullen, 2012, s. 232).

Son yıllarda yapılan çalışmalar, literatürde öz-yeterlik ile psikolojik sağlamlık arasında pozitif ve anlamlı ilişkiler olduğunu ortaya koymaktadır (Ateş ve Sağar, 2022; Karcı ve Balcı Çelik, 2024; Şencan ve Yılmaz Bingöl, 2024). Bu doğrultuda düşük öz-yeterlik, öğrencilerin içsel kaynaklarını harekete geçirmesini zorlaştırarak akademik ve sosyal uyumlarını zayıflatan ve psikolojik sağlamlıklarını tehdit eden kritik bir risk faktörü olarak değerlendirilmektedir.

3.1.2. Geçmiş Travmalar ve Duygusal Yük

Çocuklukta yaşanan ihmal, istismar veya işlevsiz aile ortamında büyüme gibi deneyimler, bireyde kronik stres faktörlerinin oluşmasına zemin hazırlayarak yaşam boyu devam eden depresyon ve anksiyete gibi psikolojik bozukluklara yatkınlığı artırabilmektedir. Son dönem çalışmalar, çocukluk travmalarının etkilerini hafifletmede genetik yatkınlık, bireysel başa çıkma becerileri ve sosyal destek gibi faktörlerin kritik rol oynadığını vurgulasa da (Wang ve ark., 2024, s. 2) söz konusu erken dönem travmalar, yetişkinlikte sosyal uyum sorunlarına, olumsuz benlik algısına ve düşük özsaygıya yol açabilmektedir.

Psikolojik sağlamlık, bu olumsuz etkilerle başa çıkmada kritik bir koruyucu faktördür. Sosyal destek ve koruyucu müdahaleler, travma yaşamış bireylerin psikolojik sağlamlığını güçlendirerek kişilerarası ilişkilerde uyumu artırır (Yöyen ve Bozacı, 2023, ss. 136–137). Dolayısıyla, geçmişte yaşanan bireysel travmaların yanı sıra, yaşam boyu karşılaşılan farklı travmatik deneyimler de bireyin psikolojik sağlamlığını benzer şekilde etkileyebilmektedir. Bireysel yaşantıların ötesinde doğal afetler, savaş, şiddete maruz kalma veya zorunlu göç gibi ağır travmalar da bireyler için uzun süreli duygusal yük oluşturabilmektedir. Bireysel baş etme becerileri, sosyal destek ve kültürel değerler, psikolojik sağlamlığı güçlendirerek travmanın olumsuz etkilerini hafifletmekte ve iyileşmeyi desteklemektedir (Hanay, 2022, s. 15).

Üniversite bağlamında ise bu tür geçmiş travmalar ve duygusal yükler; öğrencilerin akademik motivasyonlarını düşürebilmekte, kampüs yaşamına uyumlarını güçleştirerek psikolojik sağlamlıklarını tehdit eden bireysel bir risk faktörüne dönüşebilmektedir.

3.1.3. İşlevsiz Baş Etme Stratejileri

Bireyler yaşamları boyunca denge ve uyum süreçlerini zorlaştıran stresörlerle karşılaşmakta ve bu durumlara uyum sağlayabilmek için çeşitli başa çıkma stratejileri geliştirmektedir. Stresle

başa çıkma; süreci kontrol altına almayı ve ortaya çıkan bedensel, ruhsal gerginliği azaltmayı amaçlayan bilişsel, duygusal ve davranışsal çabalardan oluşmaktadır. Bu stratejiler bireysel özelliklere (yaş, cinsiyet, kültür, sağlık vb.) göre değişkenlik göstermekte ve bireyin tecrübelerine bağlı olarak şekillenmektedir (Özer, 2016, s. 593).

Garnefski ve ark. (2001), bireylerin olumsuz durumlarla başa çıkmada kullandıkları işlevsiz stratejilerin kısa süreli bir rahatlama sağlasa da ruhsal açıdan zararlı sonuçlar doğurabileceğine dikkat çekmektedir. Kendini veya başkalarını suçlama, özsaygı ve sosyal ilişkileri olumsuz etkilemektedir. *Felaketleştirme*, sorunların abartılı ve karamsar şekilde algılanmasına; *ruminasyon* ise sürekli olumsuz düşüncelere odaklanmaya yol açmaktadır (ss. 1315–1317).

Başa çıkma stratejileri, yalnızca stresle mücadele sürecini değil aynı zamanda bireyin psikolojik süreçlerini de doğrudan etkilemektedir. Bu noktada psikolojik yükü artıran işlevsiz stratejiler bireyin toparlanma sürecini zorlaştırmakta sorunu çözmek yerine bireyleri kaygı ve depresyona yatkın hâle getirerek psikolojik sağlamlığı zayıflatmaktadır (Garnefski ve ark., 2001, s. 150; Keskin ve Cenkseven Önder, 2025, s. 89). Bu bağlamda işlevsiz stratejilerin minimum düzeyde kalması, bireylerin uyum ve dayanıklılık süreçlerini destekleme açısından kritik bir öneme sahiptir. Etkin baş etme stratejileri ise bilişsel ve duygusal boyutları bir araya getirerek işlevsel bir mekanizma oluşturmakta ve bireyin ilk anda ortaya çıkan duygusal tepkilerinin ardından durumu yeniden değerlendirmesini ve daha uyumlu tepkiler geliştirmesini mümkün kılmaktadır (Lazarus ve Folkman, 1984, s. 26; Özer, 2016, s. 601).

Sonuç itibariyle üniversite öğrencilerinin akademik, sosyal ve özel yaşamlarındaki stres faktörlerini yönetebilmek için etkili başa çıkma stratejilerini benimsemeleri, psikolojik sağlamlıklarını korumaları, akademik başarı ve kişisel uyum süreçlerini sürdürebilmeleri açısından önemlidir.

3.1.4. Belirsizliğe Tahammülsüzlük

Psikolojik sağlamlığı etkileyen bireysel risk faktörlerinden biri belirsizliğe tahammülsüzlüktür. Belirsizliğe tahammülsüzlük, öngörülemez durumlar karşısında bireyin duygusal, bilişsel ve davranışsal uyum sağlayamama durumunu ifade etmektedir. Belirsizliğe tahammülsüzlük, bireyin her şeyi önceden bilme ve kontrol etme isteğini, kırılganlığını artırmakta ve bunun sonucunda belirsiz durumlar kaygı verici, tehditkâr ve korkutucu olarak algılanmaktadır (Carleton, 2016, ss. 31–32). Bu tutumun yüksek olduğu bireylerde depresyon ve kaygı düzeyleri artarken, yaşam doyumu azalmaktadır (Geçgin ve Sahranç, 2017, ss. 740–741).

Belirsizliğe tahammülü olmayan bireyler, endişeye odaklanmakta, karar vermekte ve çözüm üretmekte zorlanmaktadırlar. Buna karşılık, psikolojik sağlamlığı yüksek bireyler stresli ve

belirsiz durumlara karşı daha dirençli davranmakta ve belirsizliği tolere etme kapasiteleri artmaktadır. Araştırmalar, belirsizliğe tahammülsüzlük ile psikolojik sağlamlık arasında anlamlı negatif bir ilişki bulunduğunu göstermektedir (Dönmez ve Kavla, 2025, s. 35; Kılınç ve Uzun, 2022, s. 2785). Bu durumun bir yansıması olarak Ciarrochi ve ark. (2005), üniversite öğrencileri üzerinde yaptıkları çalışmada, belirsizliğe tahammülsüzlüğü yüksek bireylerin stresli durumlar karşısında daha dayanıksız olduklarını, depresyon ve umutsuzluk düzeylerinin ise artış gösterdiğini saptamıştır (ss. 187–189).

Üniversite öğrencilerinin akademik yaşantı, kariyer planlaması ve mezuniyet sonrası süreçle ilgili karşılaştıkları öngörülemez ve endişe yaratan durumlar değerlendirildiğinde; belirsizliğe tahammül seviyesinin düşük olması, psikolojik sağlamlığı zayıflatan kritik bir bireysel risk faktörü olarak öne çıkmaktadır.

3.1.5. Düşük Benlik Saygısı

Benlik saygısı (*self-esteem*) kavramı, ilk olarak Rosenberg'in (1965) Society and the Adolescent Self-Image adlı çalışmasında, bireyin kendine yönelik algılarını kapsayan ve psikolojik uyum üzerinde belirleyici rol oynayan bir kavram olarak tanımlanmıştır (Rosenberg, 1965, ss. 16–19). Düşük benlik saygısına sahip bireyler, kendilerini yeterince değerli hissetmediklerinden yaşamları üzerindeki kontrollerinin sınırlı olduğuna inanmakta ve stresli durumlar karşısında daha yoğun olumsuz duygular deneyimleyebilmektedirler (Karaırmak ve Siviş Çetinkaya, 2011, s. 37). Bu bağlamda düşük benlik saygısının, psikolojik sağlamlığı doğrudan baskılayan bireysel bir risk faktörü olduğu düşünülmektedir.

Türkiye'de ergenler ve gençler üzerinde yapılan güncel bir araştırma, psikolojik sağlamlık, benlik saygısı ve yaşam doyumu arasında pozitif yönlü bir etkileşim olduğunu doğrulamaktadır. Buna göre benlik saygısı gençlerin zorluklarla mücadele etmesini ve kriz durumlarını fırsata çevirmesini sağlayan kritik bir koruyucu faktördür (Turan ve ark., 2025). Benzer şekilde benlik saygısının; aile, akran ve öğretmen desteğiyle güçlendiği, bu durumun da öğrencinin akademik başarısını ve genel yaşam doyumunu yukarı çektiği belirlenmiştir (Çetinceli ve Acar, 2022, s. 422).

Bu veriler doğrultusunda yüksek benlik saygısının bireyin zorluklarla etkili başa çıkmasını desteklediği, düşük benlik saygısının ise psikolojik sağlamlığı aşındırdığı söylenebilir (Karaırmak, 2006, s. 134). Düşük benlik saygısı, bireyin kendi yeteneklerine ve kapasitesine olan güvenini zayıflatarak, zorlu ve stresli durumlar karşısında direncini kırmaktadır. Bu durum, diğer risk faktörleriyle birleştiğinde öğrencilerin uyum ve psikolojik süreçlerini olumsuz etkileyebilmektedir. Bu noktada, öğrencilerin benlik saygılarını güçlendirmeye

yönelik müdahaleler, psikolojik sağlamlığın inşası ve korunması açısından stratejik bir gereklilik olarak değerlendirilmektedir.

3.1.6. Bağımlılık Eğilimleri

Latince "*addicere*" kelimesinden Türkçeye çevrilmiş olan "bağımlılık" kavramı, bir kişiye ya da nesneye kendini esir etmek anlamına gelmektedir. Genel olarak bağımlılık, bireyin olumsuz sonuçlarına rağmen bir maddeyi veya aracı tekrar tekrar kullanma isteği ve bu nesneyi arama eğilimi olarak tanımlanmaktadır (Maraş, 2021, s. 19; Tarhan, 2016, s. 19; Uzbay, 2009, s. 26). Türkiye'de üniversite öğrencileri arasında yapılan araştırmalar, bağımlılıkların farklı türlerde görüldüğünü ortaya koymaktadır. Özellikle akıllı telefon (%25), madde kullanımı (%15) ve oyun bağımlılığı (%5) en sık rastlanan bağımlılıklar arasındadır (Akpınar Aslan ve ark., 2021, ss. 39–42). Akıllı telefon bağımlılığının eğitim durumuna göre değerlendirilmesi yapılan bir çalışmada ise üniversite öğrencilerinin aşırı kullanım ve günlük yaşam bozuklukları boyutunda en yüksek ortalamaya sahip olduğu görülmektedir (Çetinkaya Bozkurt ve Minaz, 2017, s. 281). Günümüzde gençler arasında dijital cihazların aşırı kullanımı önemli bir sorun hâline gelmiştir. Bu durum gençlerin günlük yaşamını olumsuz etkileyerek bağımlılık riskini artırmaktadır (Balcı ve Kaya, 2023, s. 5). Kontrolsüz dijital kullanım; öğrencilerde dikkat dağınıklığı, uyku düzensizliği, odaklanma güçlüğü, akademik başarı düşüşü ve sosyal uyumsuzluk gibi birçok soruna yol açmaktadır. Buna karşılık psikolojik sağlamlık, bireyin yaşamın zorluklarına uyum sağlama, stresle baş etme ve kişisel gelişimini sürdürme kapasitesiyle bu olumsuzluklara karşı bir denge unsuru olarak işlev görür (Arslankoç ve ark., 2023; Öğüt ve Karakoç, 2024, s. 475). Kaya (2019) yaptığı araştırmada, bağımlılığın ortaya çıkmasında bireyin psikolojik dayanıklılığı, stresle başa çıkma becerileri ve tolerans düzeyinin düşük olmasının belirleyici olduğunu vurgulamıştır (s. 46). Bu bağlamda, psikolojik dayanıklılık stres karşısında bir tampon işlevi görürken stres yönetiminde yetersiz kalan bireyler ise bağımlılığa daha yatkın hâle gelmektedir (Maraş, 2021, s. 50). Bu durum, bağımlılığın hem sağlamlığı gerileten bir neden hem de bir sonuç olduğu döngüsünü desteklemektedir.

Öğrencilerde bağımlılık eğilimleri, özellikle psikolojik sağlamlık düzeyi düşük olan bireylerde daha sık görülmekte ve stresle baş etme becerilerinin yetersizliği bu riski artırmaktadır. Bu nedenle, öğrencilerin dayanıklılıklarını güçlendirmeye dönük rehberlik çalışmaları, farkındalık uygulamaları ve sosyal destek programları gibi önleyici ve destekleyici yaklaşımlar, bağımlılık riskini azaltmada önemli bir rol oynamaktadır.

4. SONUÇ VE ÖNERİLER

Çalışma, düşük öz-yeterlik algısı, geçmiş travmalar, yoğun duygusal yük, işlevsiz baş etme stratejileri, belirsizliğe tahammülsüzlük, düşük benlik saygısı ve bağımlılık eğilimlerinin, öğrencilerin uyum sağlama ve stresle başa çıkma kapasitelerini olumsuz yönde etkileyebileceğini göstermektedir. Bu risk faktörleri, öğrencilerin zorluklarla karşılaştıklarında olumsuz duygular deneyimleme olasılığını artırarak psikolojik sağlamlık düzeylerinin düşmesine yol açmaktadır.

Elde edilen sonuçlar, literatürde yer alan önceki çalışmalarla paralellik göstermektedir. Benlik saygısı ve öz-yeterlik algısının yüksek olduğu bireylerin, akademik başarı, yaşam doyumu ve sosyal uyum gibi alanlarda daha olumlu sonuçlar elde ettikleri görülmektedir. Öte yandan, dijital bağımlılık ve riskli davranışlar, öğrencilerin işlevselliğini olumsuz etkilemekte, psikolojik sağlamlıklarını zayıflatmaktadır. Elde edilen veriler, psikolojik sağlamlık sürecinde bireysel becerilerin ve destekleyici mekanizmaların kritik önemini vurgulamaktadır. Aynı zamanda risk faktörlerinin sağlamlığı zayıflattığı, daha da önemlisi zayıflayan sağlamlığın ise bireyi risklere daha açık hale getirdiği karşılıklı bir döngüyü ortaya koymaktadır.

Bireysel risk faktörleri kapsam olarak oldukça geniş olduğundan, tüm faktörler bu çalışma kapsamında ele alınmamıştır. Ayrıca doküman analizi yöntemi ile yürütülen çalışma, verileri nicel ölçümlerden veya doğrudan gözlem yoluyla elde etmediğinden sonuçlar kavramsal düzeyde yorumlanmıştır.

Sonuç olarak, üniversite öğrencilerinde psikolojik sağlamlığı desteklemek için stresle başa çıkma becerilerinin geliştirilmesi, benlik saygısı ve öz-yeterlik algısının güçlendirilmesi, bağımlılık eğilimlerinin azaltılması önemlidir.

Bu çalışmanın sonuçları doğrultusunda aşağıdaki öneriler geliştirilebilir:

- Üniversite ortamında öğrencilerin psikolojik sağlamlıklarını artırmaya yönelik rehberlik ve eğitim programlarının yaygınlaştırılması önemlidir.
- Öğrencilerin benlik saygısı ve öz-yeterlik algısını destekleyecek grup çalışmaları ve kişisel gelişim etkinlikleri planlanabilir.
- Dijital bağımlılık ve diğer riskli davranışlarla başa çıkma becerilerini geliştirmeyi amaçlayan farkındalık ve önleyici programlar uygulanabilir.
- Öğrencilerin stresle başa çıkma, duygusal düzenleme ve kriz yönetimi becerilerini geliştirecek etkinlikler düzenlenebilir.

- Üniversite yönetimi, akademik ve idari kadro, öğrencilerin sosyal uyum süreçlerini güçlendirecek ortamlar oluşturmalıdır (öğrenci kulüpleri, danışmanlık hizmetleri).
- Özellikle risk altındaki öğrenciler için bireysel psikolojik danışmanlık ve bilişsel-davranışçı müdahaleler planlanabilir.
- Müdahale ve destek programları, yalnızca bağımlılık gibi sonuca odaklanan sorunlara değil; bu sorunları besleyen düşük benlik saygısı ve yetersiz baş etme becerileri gibi kaynak faktörlere de aynı zamanda odaklanarak olumsuz etkileşim döngüsünü kırmayı amaçlamalıdır.
- Gelecek çalışmalarda bireysel risk faktörlerinin daha kapsamlı şekilde ele alınması; bu doğrultuda nitel ve nicel yöntemlerin birlikte kullanıldığı karma desenlerin tercih edilmesi önerilmektedir.

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AHŞAP-BETON KOMPOZİT SİSTEMLERDE LVL VE CLT'NİN KARŞILAŞTIRMALI İNCELENMESİ

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ÖZET

Ahşap-beton kompozit sistemler, ahşabın hafifliği ve yüksek çekme dayanımı ile betonun basınç dayanımı ve rijitliğini bir araya getirerek, özellikle döşeme ve kiriş sistemlerinde yapısal verimliliği artıran yenilikçi çözümler sunmaktadır. Bu bağlamda, Laminated Veneer Lumber (LVL) ve Cross-Laminated Timber (CLT), mühendislik ahşap ürünleri arasında ahşap-beton kompozit sistemlerde yaygın olarak kullanılan iki önemli malzeme türüdür. Ancak, LVL ve CLT'nin beton ile birlikte kullanıldığı kompozit sistemlerin yapısal davranışları arasındaki farklılıklar henüz yeterince kapsamlı bir şekilde ortaya konulamamıştır. Bu çalışmada, literatürde bugüne kadar gerçekleştirilen LVL-beton ve CLT-beton kompozit sistemlere yönelik deneysel, analitik ve sayısal çalışmalar karşılaştırmalı olarak incelenmiştir. İnceleme kapsamında, her iki sistem için ara yüzey etkileşimi, kayma bağlantı elemanlarının türü ve etkinliği, kompozit davranış derecesi, eğilme rijitliği, yük taşıma kapasitesi, süneklik ve göçme mekanizmaları gibi temel yapısal parametreler değerlendirilmiştir. Ayrıca, LVL ve CLT'nin malzeme özelliklerinden kaynaklanan farklılıkların kompozit sistem performansı üzerindeki etkileri tartışılmıştır. Literatür incelemesi sonuçları, LVL-beton kompozit sistemlerin lif yönünde daha yüksek eğilme dayanımı ve rijitlik sunduğunu, CLT-beton kompozit sistemlerin ise çok yönlü yük taşıma kapasitesi ve daha iyi levha davranışı sergilediğini göstermektedir. Bununla birlikte, her iki sistemde de ara yüzey kayması, uzun süreli davranış ve nem etkileri önemli tasarım kriterleri olarak öne çıkmaktadır. Bu çalışmanın, ahşap–beton kompozit sistemler için malzeme seçimi ve tasarım sürecine katkı sağlaması amaçlanmaktadır.

Anahtar Kelimeler: Ahşap-beton kompozitler, LVL, CLT, yapısal davranış, karşılaştırmalı inceleme

COMPARATIVE RESEARCH OF LVL AND CLT IN WOOD-CONCRETE COMPOSITE SYSTEMS

ABSTRACT

Timber-concrete composite systems provide innovative structural solutions by combining the lightweight and high tensile strength of timber with the compressive strength and stiffness of concrete, particularly in floor and beam applications. In this context, Laminated Veneer Lumber (LVL) and Cross-Laminated Timber (CLT) are two widely used engineered wood products in

timber-concrete composite systems. However, the differences in structural behavior between LVL-concrete and CLT-concrete composite systems have not yet been comprehensively clarified in the existing literature. This paper presents a comparative review of experimental, analytical, and numerical studies conducted to date on LVL-concrete and CLT-concrete composite systems. The comparison focuses on key structural aspects, including interface interaction, types and effectiveness of shear connectors, degree of composite action, flexural stiffness, load-carrying capacity, ductility, and failure mechanisms. In addition, the influence of material-related characteristics of LVL and CLT on the overall composite performance is discussed. The reviewed studies indicate that LVL-concrete composite systems generally exhibit higher flexural strength and stiffness along the grain direction, while CLT-concrete composite systems demonstrate superior bidirectional load distribution and enhanced plate behavior. Nevertheless, interface slip, long-term performance, and moisture-related effects remain critical design considerations for both systems. The findings of this study aim to support material selection and structural design decisions for timber-concrete composite systems and to identify key aspects requiring further research.

Keywords: Timber-concrete composites, LVL, CLT, structural behavior, comparative study

1. INTRODUCTION

In recent years, sustainability, reduction of environmental impact, and efficient use of natural resources have become key objectives in the construction sector. In this context, timber, as a renewable material with a low carbon footprint, has attracted increasing attention in modern structural engineering applications (Gustavsson, 2018). Nevertheless, the relatively low stiffness of timber, its serviceability limitations, and its long-term behavior under sustained loading restrict its use as a standalone structural material, particularly in large-span and multi-story buildings. To overcome these limitations, timber-concrete composite (TCC) systems have been developed by combining timber with concrete, which exhibits high compressive strength and stiffness (Ceccotti, 2002).

Timber-concrete composite systems leverage the tensile strength and lightweight nature of timber, combined with the compressive strength and rigidity of concrete, making them particularly suitable for floor and beam applications (Yeoh, 2011). In typical TCC configurations, the concrete slab is placed in the compression zone, while the timber element resists tensile stresses. Load transfer between the two materials is ensured through various shear connection systems. The degree of composite action achieved has a direct influence on the flexural stiffness, load-carrying capacity, and ductility of the system (Fragiacomo, 2013).

With the advancement of engineered wood products, Laminated Veneer Lumber (LVL) and Cross-Laminated Timber (CLT) have become widely used in timber-concrete composite systems due to their more uniform and predictable mechanical properties compared to solid timber (Brandner, 2016). LVL is characterized by veneers predominantly oriented in the same direction, resulting in a high modulus of elasticity and bending strength along the grain. In contrast, CLT consists of cross-laminated layers, providing load-bearing capacity in two orthogonal directions and enhanced plate behavior (Blass, 2014).

Experimental and analytical studies on LVL-concrete composite systems have shown that these systems generally exhibit high flexural stiffness and load-carrying capacity, particularly along the grain direction of the timber element (Ceccotti, 2006; Frangi, 2009). The homogeneous and directionally aligned structure of LVL allows shear connectors to perform more efficiently, often resulting in reduced interface slip between timber and concrete (Dias, 2016). These characteristics make LVL-concrete composite systems an attractive solution for applications requiring long spans and high structural efficiency.

On the other hand, CLT-concrete composite systems offer significant advantages in floor applications due to their bidirectional load distribution capability and plate-like structural behavior (Gagnon, 2019). The cross-laminated configuration of CLT panels contributes to a more uniform stress distribution and improved vibration performance under service loads (Brandner, 2016). However, shear deformations between CLT layers and the interaction at the timber-concrete interface may limit the overall stiffness of the composite system (Blass, 2014; Schänzlin, 2019).

One of the most critical aspects governing the structural performance of timber–concrete composite systems is the interface behavior between timber and concrete, which is strongly influenced by the type and stiffness of the shear connectors used. Various connection systems, including screws, notched connections, steel connectors, and adhesive-based solutions, have been extensively investigated in the literature (Ceccotti, 2002; Fragiacomo, 2013). The choice of connector significantly affects the degree of composite action, governing both strength and deformation characteristics of the system (Dias, 2018).

In addition to short-term behavior, the long-term performance of TCC systems is affected by creep, concrete shrinkage, and moisture-induced deformations of timber (Fragiacomo, 2013; Yeoh, 2011). Due to the hygroscopic nature of timber, variations in moisture content may lead to changes in interface behavior and connector performance over time, which must be carefully considered in design (Gustavsson, 2018).

Although numerous experimental, analytical, and numerical studies have been conducted on LVL-concrete and CLT-concrete composite systems, direct comparative assessments of their structural behavior remain limited (Dias, 2016; Gagnon, 2019). Most existing studies focus on a single timber product, and differences in test setups, materials, and connection details often hinder direct comparison of results. This lack of comprehensive comparison complicates material selection and system optimization in engineering practice. The present study aims to provide a comparative review of existing experimental, analytical, and numerical research on LVL-concrete and CLT-concrete composite systems. The comparison focuses on key structural aspects, including interface interaction, types and effectiveness of shear connectors, degree of composite action, flexural stiffness, load-carrying capacity, ductility, and failure mechanisms. Furthermore, the influence of the material characteristics of LVL and CLT on the overall performance of timber-concrete composite systems is discussed, and key topics requiring further research are identified.

2. EVALUATION OF EXISTING STUDIES ON LVL-CONCRETE AND CLT-CONCRETE COMPOSITE STRUCTURES

Siddika et al. (2021) conducted a comprehensive review on CLT-concrete composite floor systems, examining their structural behaviour, connection types, and overall performance. The study highlighted that the addition of a concrete topping significantly enhances the load-carrying capacity and stiffness of CLT panels, and that, when properly designed, CLT-concrete composite systems can outperform conventional timber-only or concrete-only floor solutions. Xu et al. (2024) experimentally and numerically investigated the behaviour of prestressed CLT-concrete composite systems under reversed cyclic loading, demonstrating that prestressing improves both stiffness and load-bearing capacity, while potentially limiting ductility. He et al. (2025) focused on the punching shear behaviour of CLT and CLT-concrete composite slabs, showing through experimental testing that the concrete layer substantially increases the punching shear resistance of CLT panels and contributes to a safer structural response. Shahnewaz et al. (2023) evaluated the stiffness and strength of reinforced CLT-concrete composite floor systems using different shear connection solutions and found that steel plate and screw-based connectors significantly improved composite action and overall structural performance. Taken together, these studies indicate that CLT-concrete composite systems offer high load-carrying capacity, improved vibration performance, and effective two-way load distribution in floor applications, while the design and detailing of shear connections remain critical factors governing system behaviour. Yeoh et al. (2011a) conducted an experimental

investigation into the shear behaviour of notched and toothed metal plate connectors employed in LVL-concrete composite floor systems. Symmetrical push-out tests were used to determine the characteristic shear strength and slip modulus of three connector configurations, namely rectangular and triangular notches reinforced with lag screws, as well as toothed metal plate connectors. Detailed shear force-slip relationships were obtained, and analytical models describing both pre-peak and post-peak behaviour were proposed for use in nonlinear finite element analyses. The observed failure modes of the notched connections were thoroughly examined, and design expressions based on New Zealand Standards and Eurocodes were formulated. The results demonstrated that rectangular notches provided the most favourable performance, and that minor adjustments to existing Eurocode equations resulted in good agreement with experimental data. Deam et al. (2008) examined the stiffness and strength characteristics of prestressed LVL-concrete composite beams developed for long-span floor applications. The experimental programme included four full-scale T-shaped composite beams with a length of 6 m, which were tested under quasi-static bending and impact loading. The influence of prestressing tendons, shear connection stiffness, and lightweight concrete panels on the overall structural response was assessed. The findings indicated that a composite beam with a rigid shear connection achieved a flexural stiffness nearly three times greater than that of an uncomposited LVL beam, while the corresponding increase in strength was limited to approximately 74%. Although prestressing tendons had little effect on stiffness and ultimate strength, they were shown to significantly reduce long-term deflections, particularly when draped tendon configurations were adopted. In contrast, the contribution of lightweight concrete panels to structural performance was found to be minimal. Yeoh et al. (2011b) focused on the short-term ultimate behaviour of LVL-concrete composite floor beams at the strength limit state. In this study, eleven full-scale T-beams with spans of 8 m and 10 m were tested under four-point bending. Various parameters, including connector type, concrete properties, and design level, were investigated. The experimental programme covered rectangular and triangular notched connections reinforced with screws, as well as modified toothed metal plate connectors. The results showed that properly designed composite beams were able to achieve more than 95% composite action despite the use of a limited number of connectors. Furthermore, both ultimate and serviceability live load capacities reached approximately 90% of those corresponding to fully composite systems. Among the tested solutions, rectangular notches with a length of 300 mm exhibited the most balanced performance in terms of stiffness, strength, and connector efficiency. Khorsandnia et al. (2012) presented a combined

experimental and analytical study on the short-term behaviour of LVL-concrete composite connections and beams. Push-out tests were performed on three connector types-conventional screws, SFS screws, and bird-mouth connections characterizing their load–slip behaviour and determining slip moduli at serviceability, ultimate, and near-collapse levels. Additionally, four full-scale composite beams were tested under four-point bending to validate the slip modulus values derived from the connection tests. Based on the experimental findings, nonlinear load-slip relationships were established using regression analysis, allowing their direct implementation in nonlinear finite element modelling of timber-concrete composite beams. Yeoh et al. (2009) carried out preliminary research aimed at the development of a semi-prefabricated LVL-concrete composite floor system intended for the Australasian construction market. The proposed concept consisted of prefabricated LVL joists and plywood panels assembled on site and subsequently connected through an in-situ cast concrete topping. Several shear connection systems, including notches reinforced with coach screws and toothed metal plate connectors, were evaluated through push-out tests and small-scale block tests. The study highlighted the advantages of the proposed system in terms of structural performance, acoustic behaviour, fire resistance, and vibration control when compared to conventional timber-only or concrete-only floor solutions. Based on these results, the four most effective connector systems were selected for further investigation through full-scale beam tests with spans ranging from 8 m to 10 m.

Jaaranen and Fink (2022) investigated the experimental and numerical behaviour of two-way LVL-concrete composite plates subjected to different support conditions. The study aimed to enhance vibration serviceability by introducing a dovetail joint to connect adjacent LVL panels. Experimental modal analysis and static loading tests revealed pronounced two-way action, with the fundamental natural frequency increasing by approximately 45% when support was provided along all four edges. In addition, central deflections under point loading were reduced by about 9%. A numerical model was developed and validated against experimental results, confirming that the proposed dovetail joint ensured sufficient stiffness and continuity of the LVL layer. Boccadoro et al. (2017) proposed an analytical model for evaluating the structural behaviour of LVL-concrete composite members incorporating ductile notched connections. The model was formulated based on equilibrium considerations and aimed to facilitate a reliable design approach governed by yielding within the notch region. The authors demonstrated that notched connections could provide high stiffness while promoting ductile compressive failure in the timber component. However, the study also showed that excessive local deformations of

the LVL within the notches could trigger premature failure if not adequately controlled. This issue was shown to be effectively mitigated with vertical reinforcement. The proposed analytical approach was validated using full-scale bending tests on composite members constructed from beech LVL plates. Abd Ghafar and Sahban (2017) conducted a numerical study to evaluate the influence of concrete topping thickness on the vibration behaviour of LVL-concrete composite floors using SAP2000 software. A 2 m long composite floor system was modelled with concrete topping thicknesses varying between 20 mm and 200 mm. The numerical results indicated that an optimum topping thickness of approximately 65 mm yielded the most favourable vibration performance. For thinner concrete layers, the response was governed primarily by mass effects, whereas increased thickness led to stiffness-dominated behaviour. The study emphasized the importance of optimizing the concrete topping thickness to improve vibration serviceability while avoiding unnecessary increases in self-weight.

3. RESULTS AND DISCUSSION

The reviewed studies collectively demonstrate that timber-concrete composite systems incorporating CLT and LVL elements benefit significantly from the addition of a concrete layer, which enhances stiffness, load-carrying capacity, and serviceability performance. Across the literature, the effectiveness of composite action is shown to be highly dependent on the interface behaviour between timber and concrete, with the type and stiffness of shear connectors playing a decisive role in governing structural response.

For CLT-concrete composite systems, previous research consistently indicates that concrete toppings substantially improve global structural performance. Siddika et al. (2021) reported that CLT-concrete composite floors exhibit markedly higher stiffness and strength than CLT-only systems, enabling their application in longer-span floor structures. Experimental results presented by He et al. (2025) further confirmed that the presence of a concrete layer significantly increases the punching shear resistance of CLT slabs, thereby enhancing structural safety under concentrated loading. In addition, Shahnewaz et al. (2023) showed that the use of effective shear connection solutions leads to improved composite action, resulting in higher stiffness and more efficient load distribution across the floor system. The experimental and numerical investigations by Xu et al. (2024) demonstrated that prestressing techniques can further enhance stiffness and load-bearing capacity, although a reduction in ductility was observed, highlighting the need for careful consideration of performance trade-offs in design.

In LVL-concrete composite systems, the literature emphasizes the dominant influence of shear connection characteristics on both stiffness and strength. Yeoh et al. (2011a) demonstrated

through push-out testing that notched connections, particularly rectangular notches reinforced with screws, provide superior shear strength and slip stiffness compared to alternative connector types. These findings were further supported by full-scale beam tests reported by Yeoh et al. (2011b), which showed that well-designed LVL-concrete composite beams can achieve more than 95% composite action, even with a limited number of connectors, resulting in load-carrying capacities approaching those of fully composite systems. Deam et al. (2008) similarly observed that the use of a rigid shear connection can increase the flexural stiffness of LVL-concrete composite beams by nearly three times compared to bare LVL beams, although the increase in ultimate strength was less pronounced. The inclusion of prestressing tendons was shown to have a limited effect on short-term strength and stiffness but significantly reduced long-term deflections, particularly when draped tendon configurations were employed.

The importance of accurately characterizing connection behaviour is further highlighted by the work of Khorsandnia et al. (2012), who demonstrated that different connector types exhibit distinct load-slip responses at serviceability and ultimate limit states. The analytical load-slip models developed in that study enable reliable nonlinear finite element modelling of timber-concrete composite members, supporting performance-based design approaches. Analytical investigations by Boccadoro et al. (2017) also showed that ductile notched connections can promote favourable and controlled failure mechanisms governed by yielding within the timber, provided that local deformations within the notch regions are adequately restrained. The use of vertical reinforcement was identified as an effective measure to prevent premature failure associated with excessive local LVL deformation.

Serviceability performance, particularly with respect to vibration behaviour, was addressed in several studies. Jaaranen and Fink (2022) demonstrated that improved continuity between LVL panels, achieved through dovetail joints, leads to pronounced two-way action and significant increases in natural frequencies, thereby enhancing vibration serviceability. Similarly, the numerical study by Abd Ghafar and Sahban (2017) identified an optimal concrete topping thickness that balances mass and stiffness effects to achieve favourable vibration performance without unnecessary increases in self-weight.

When the findings from CLT-concrete and LVL-concrete composite systems are considered together, it becomes evident that LVL-concrete systems generally offer higher flexural stiffness and strength along the primary load-bearing direction, making them particularly suitable for long-span beam applications. In contrast, CLT-concrete systems provide superior bidirectional load distribution and plate behaviour, which are advantageous for floor systems subjected to

distributed loads. Despite these differences, both systems share common challenges related to interface slip, connector detailing, and long-term performance. The reviewed studies collectively highlight the need for an integrated design approach that accounts for material properties, connection behaviour, and serviceability requirements to fully exploit the potential of timber-concrete composite systems.

4. CONCLUSIONS

This study presented a comparative review of LVL-concrete and CLT-concrete composite systems based on existing experimental, analytical, and numerical research. The reviewed literature confirms that timber-concrete composite systems provide an effective structural solution by combining the advantageous mechanical properties of timber and concrete, resulting in enhanced stiffness, load-carrying capacity, and serviceability performance compared to non-composite systems.

The findings indicate that LVL-concrete composite systems generally exhibit superior flexural stiffness and strength along the primary load-bearing direction, particularly when rigid or notched shear connections are employed. Well-designed LVL-concrete composite beams were shown to achieve a high degree of composite action, even with a limited number of connectors, enabling efficient material to use and competitive structural performance in long-span floor applications. The effectiveness of notched connections in providing both high stiffness and ductile failure behaviour highlights their suitability for reliable and performance-based design approaches.

In contrast, CLT-concrete composite systems demonstrate distinct advantages in terms of bidirectional load distribution and plate behaviour. The presence of a concrete topping significantly improves punching shear resistance, vibration performance, and overall floor stiffness, making CLT-concrete composites particularly attractive for floor systems subjected to distributed and dynamic loads. However, the use of prestressing techniques in CLT-concrete systems, while beneficial for increasing stiffness and strength, may lead to reduced ductility and therefore requires careful consideration during design. Across both LVL-concrete and CLT-concrete composite systems, the behaviour of the timber–concrete interface remains a critical factor governing structural performance. The reviewed studies consistently emphasize that shear connector type, stiffness, and detailing directly influence composite action, failure mechanisms, and serviceability performance. In addition, issues related to long-term behaviour, moisture effects, and differential shrinkage between timber and concrete remain key challenges that require further investigation.

Overall, the findings of this review support informed material selection and structural design decisions for timber-concrete composite systems by clarifying the distinct performance characteristics of LVL-concrete and CLT-concrete solutions. Future research should focus on long-term performance, durability under varying environmental conditions, and the development of standardized design guidelines to further promote the safe and efficient application of timber-concrete composite systems in modern construction.

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LVL-BETON KOMPOZİTLERİNİN DAVRANIŞININ İNCELENMESİ

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ÖZET

Laminated Veneer Lumber (LVL), yüksek dayanım-ağırlık oranı, homojen mekanik özellikleri ve çevresel açıdan sürdürülebilir yapısı sayesinde günümüzde mühendislik yapılarında giderek daha fazla tercih edilen bir ahşap kompozit malzemedir. Son yıllarda, LVL'nin beton ile kullanıldığı LVL-beton kompozit yapı sistemleri, özellikle döşeme sistemleri ve taşıyıcı elemanlarda alternatif bir çözüm olarak öne çıkmaktadır. Bu kompozit sistemler, ahşabın hafifliği ve çekme dayanımı ile betonun basınç dayanımı ve rijitliğinin bir araya getirilmesi sayesinde yapısal performansı artırmayı hedeflemektedir. Bu çalışmada, literatürde bugüne kadar gerçekleştirilen LVL-beton kompozit sistemlere yönelik deneysel, analitik ve sayısal çalışmalar kapsamlı bir şekilde incelenmiştir. İnceleme kapsamında, LVL-beton ara yüzeyindeki etkileşim mekanizmaları, kayma bağlantı elemanlarının türleri ve yerleşimi, kompozit davranış derecesi, yük taşıma kapasitesi, eğilme rijitliği, süneklik ve göçme modları gibi temel yapısal parametreler ele alınmıştır. Ayrıca, farklı bağlantı sistemlerinin (vida, çelik çubuk, çentik, yapıştırıcı vb.) ve malzeme özelliklerinin kompozit davranış üzerindeki etkileri karşılaştırmalı olarak değerlendirilmiştir. İncelenen çalışmalar, uygun şekilde tasarlanmış bağlantı sistemleri ile LVL-beton kompozit elemanların, geleneksel ahşap veya beton elemanlara kıyasla daha yüksek taşıma kapasitesi ve rijitlik sağlayabildiğini göstermektedir. Bununla birlikte, ara yüzey kayması, uzun süreli davranış, nem ve rötre etkileri gibi konularda hâlen araştırma gereksinimi bulunmaktadır. Bu çalışmanın, LVL-beton kompozit sistemlerin yapısal tasarımına ve gelecekteki araştırmalara ışık tutması amaçlanmaktadır.

Anahtar Kelimeler: LVL, lamine kaplama kereste, LVL-beton kompozitler, kompozit yapı sistemleri

INVESTIGATION OF LVL-CONCRETE COMPOSITES BEHAVIOR

ABSTRACT

Laminated Veneer Lumber (LVL) is an engineered wood product increasingly used in structural applications due to its high strength-to-weight ratio, uniform mechanical properties, and environmental sustainability. In recent years, LVL-concrete composite structural systems have emerged as a promising alternative, particularly in floor systems and load-bearing structural elements. These composite systems aim to enhance structural performance by combining the

tensile strength and light weight of LVL with the high compressive strength and stiffness of concrete. This paper presents a comprehensive review of experimental, analytical, and numerical studies conducted to date on LVL-concrete composite systems. The review focuses on key structural aspects, including the interaction mechanisms at the LVL-concrete interface, types and configurations of shear connection systems, degree of composite action, load-carrying capacity, flexural stiffness, ductility, and failure modes. In addition, the influence of different connection techniques, such as screws, steel rods, notches, and adhesive bonding, as well as material properties, on the overall composite behavior is comparatively discussed. The reviewed studies indicate that LVL-concrete composite members, when equipped with properly designed shear connectors, can achieve significantly higher stiffness and load-bearing capacity compared to conventional timber or concrete elements. However, several challenges remain, particularly regarding interface slip, long-term performance, creep behavior, moisture effects, and shrinkage-related issues. Furthermore, the limited number of design guidelines specifically addressing LVL-concrete composites highlights the need for further research. The findings of this study are expected to contribute to the development, optimization, and structural design of LVL-concrete composite systems and to provide guidance for future experimental and theoretical investigations.

Keywords: LVL, laminated veneer lumber, LVL-concrete composites, composite building systems

1. INTRODUCTION

In recent years, there has been an increasing interest in structural materials and systems that not only meet environmental sustainability goals but also provide high structural performance. In this context, engineered wood products, particularly Laminated Veneer Lumber (LVL) have emerged as strong alternatives to conventional construction materials due to their high strength-to-weight ratio, homogeneous mechanical properties, and advantages associated with industrialized production (Buchanan and Levine, 1999; Kollmann et al., 2012). Owing to its high tensile and flexural strength along the grain direction, LVL is widely used in load-bearing structural elements such as beams, columns, and floor systems (Aicher and Stapf, 2016).

To further enhance the structural performance of LVL, LVL-concrete composite systems have been developed in recent years. These systems aim to combine the high compressive strength and stiffness of concrete with the lightweight and tensile capacity of LVL, offering more efficient solutions, particularly for floor systems and load-bearing structural components (Ceccotti, 2002; Dias et al., 2016). Compared to conventional reinforced concrete or pure

timber systems, LVL-concrete composite members can provide significantly higher flexural stiffness, increased load-carrying capacity, and improved serviceability performance (Yeoh et al., 2011).

One of the most critical factors governing the structural behavior of these composite systems is the interaction at the LVL-concrete interface. Shear deformations occurring at the interface directly influence the degree of composite action and play a decisive role in determining the overall stiffness and load-bearing capacity of the member (Ceccotti and Fragiacomo, 2006). To achieve full composite behavior, effective shear transfer between the LVL and concrete layers is essential. For this reason, various shear connection systems have been extensively investigated in the literature (Dias et al., 2018).

The main connection techniques used in LVL-concrete composite systems include self-tapping screws, steel rods, notched (grooved) connections, and adhesive-based bonding methods. Screw connections are commonly preferred due to their ease of installation and cost-effectiveness; however, their relatively low stiffness may lead to interface slip and partial composite action (Van der Linden, 1999; Yeoh et al., 2011). In contrast, notched connections-especially when combined with additional reinforcement been reported to provide higher shear strength and stiffness, thereby significantly enhancing the degree of composite action (Dias et al., 2016; Fragiacomo et al., 2011).

Experimental studies have demonstrated that the flexural behavior of LVL-concrete composite beams is highly dependent on the stiffness of the shear connection system. Insufficient connection stiffness leads to increased interface slip, resulting in partial composite behavior, reduced flexural stiffness, and larger deflections under serviceability limit state conditions (Ceccotti, 2002; Yeoh et al., 2011). Conversely, properly designed shear connectors can substantially increase both the load-carrying capacity and stiffness of LVL-concrete composite members (Dias et al., 2018).

Another important research topic related to LVL-concrete composite systems is ductility and failure mechanisms. The combination of the brittle behavior of concrete and the relatively ductile behavior of timber results in complex failure modes. Previous studies have shown that when appropriate connection details are employed, composite members can exhibit more controlled and ductile failure behavior (Fragiacomo et al., 2011; Aicher and Stapf, 2016). This aspect is particularly important for ensuring structural safety under seismic loading conditions.

In addition to short-term performance, long-term behavior is a critical factor influencing the practical applicability of LVL-concrete composite systems. Differences in the creep characteristics of timber and concrete may lead to additional interface slip over time (Ceccotti and Fragiacomo, 2006). Furthermore, concrete shrinkage and the sensitivity of wood to moisture variations can adversely affect the long-term composite action (Dias et al., 2018).

Numerical and analytical studies have been conducted to better understand the behavior of LVL-concrete composite members and to support structural design procedures. These models incorporate connection stiffness, material nonlinearity, and time-dependent effects, providing predictions that are in good agreement with experimental results (Yeoh et al., 2011; Fragiacomo et al., 2011). However, the limited availability of design approaches specifically developed for LVL-concrete composite systems indicates that further research is still required.

In conclusion, LVL-concrete composite structural systems offer significant potential in structural engineering due to their high load-bearing capacity, enhanced stiffness, and sustainability benefits. Nevertheless, issues related to interface behavior, long-term performance, environmental effects, and the development of standardized design methodologies remain open research areas. This study aims to systematically review the existing literature on LVL-concrete composite systems, present current knowledge on their structural behavior, and contribute to future experimental and theoretical research efforts.

2. EVALUATION OF EXISTING STUDIES ON LVL-CONCRETE COMPOSITE STRUCTURES

Yeoh et al. (2011a) conducted an experimental study on the shear behaviour of notched and toothed metal plate connectors used in LVL-concrete composite floor systems. Symmetrical push-out tests were performed to evaluate the characteristic shear strength and slip modulus of three different connector types, including rectangular and triangular notches reinforced with lag screws, as well as toothed metal plates. The study presented detailed shear force-slip relationships and proposed analytical pre-peak and post-peak models suitable for nonlinear finite element analyses. The failure mechanisms of notched connections were identified, and design equations based on New Zealand Standards and Eurocodes were developed. It was concluded that rectangular notches exhibited superior performance and that slight modifications to Eurocode formulas led to good agreement with experimental results. Deam et al. (2008) investigated the stiffness and strength of prestressed LVL-concrete composite beams intended for long-span floor applications. Four full-scale, 6 m long T-shaped composite beams were tested under quasi-static bending and impact loading. The effects of prestressing tendons, shear

connection stiffness, and the use of lightweight concrete panels were examined. The results showed that the stiffness of the composite beam with a strong shear connection was nearly three times that of a bare LVL beam, while the increase in strength was limited to approximately 74%. Prestressing tendons were found to have minimal influence on stiffness and ultimate strength, but they significantly reduced long-term deflections, particularly when draped tendons were used. Lightweight concrete panels were shown to contribute little to the overall structural performance. Yeoh et al. (2011b) experimentally investigated the short-term ultimate behaviour of LVL-concrete composite floor beams at the strength limit state. Eleven full-scale T-beams with spans of 8 m and 10 m were tested under four-point bending, considering various connector types, concrete properties, and design levels. Rectangular and triangular notched connections reinforced with screws, as well as modified toothed metal plate connectors, were evaluated. The results indicated that well-designed beams achieved more than 95% composite action even with a limited number of connectors. The ultimate and serviceability live load capacities reached approximately 90% of those of fully composite beams. Rectangular notches with a length of 300 mm provided the best overall performance, combining high stiffness and strength with reduced connector demand. Khorsandnia et al. (2012) presented an experimental and analytical investigation of the short-term behaviour of LVL-concrete composite connections and beams. Push-out tests were conducted on three types of connectors, namely normal screws, SFS screws, and bird-mouth connections, to determine their load-slip behaviour and slip moduli at serviceability, ultimate, and near-collapse conditions. In addition, four full-scale composite beams were tested under four-point bending to validate the slip modulus values obtained from push-out tests. Based on the experimental results, analytical load-slip models were developed using nonlinear regression, enabling their direct implementation in nonlinear finite element analyses of timber-concrete composite beams. Yeoh et al. (2009) carried out preliminary research aimed at developing a semi-prefabricated LVL-concrete composite floor system for the Australasian market. The proposed system consisted of prefabricated LVL joists and plywood panels assembled on-site and connected by an in-situ cast concrete topping. Various connector types, including notches reinforced with coach screws and toothed metal plates, were experimentally evaluated through push-out tests and small-scale block tests. The study highlighted the advantages of the proposed system in terms of structural performance, acoustic insulation, fire resistance, and vibration control compared to traditional timber-only or concrete-only floor systems. The four most effective connection systems were subsequently selected for full-scale beam tests with spans ranging from 8 m to 10 m. Jaaranen and Fink

(2022) investigated the experimental and numerical behaviour of two-way LVL-concrete composite plates under different support conditions. The study focused on improving vibration serviceability through the development of a dovetail joint used to connect adjacent LVL panels. Experimental modal analysis and static load tests demonstrated a significant two-way action, with the fundamental natural frequency increasing by approximately 45% when all four edges were supported. Central deflections under point loading were reduced by about 9%. A numerical model was developed and showed good agreement with experimental results, confirming that the dovetail joint provided sufficient stiffness to ensure continuity of the LVL layer. Boccadoro et al. (2017) developed an analytical model to assess the structural behaviour of LVL-concrete composite members with ductile notched connections. The model was based on equilibrium formulations and aimed to enable a reliable and ductile design approach governed by notch yielding. The study highlighted the advantages of notched connections in achieving high stiffness and ductile compressive failure in the timber component. It was shown that local LVL deformations within the notches could lead to premature failure if not properly controlled; however, this issue could be mitigated using vertical reinforcement. The analytical model was validated against full-scale bending tests on composite members made of beech LVL plates. Abd Ghafar and Sahban (2017) numerically investigated the effect of concrete topping thickness on the vibration behaviour of LVL-concrete composite floors using SAP2000 software. A 2 m long composite floor system was modelled with concrete topping thicknesses ranging from 20 mm to 200 mm. The results indicated that an optimum topping thickness of approximately 65 mm provided the best vibration performance. For topping thicknesses below this value, floor behaviour was dominated by mass effects, whereas for greater thicknesses, stiffness became the governing factor. The study demonstrated the importance of optimizing concrete thickness to achieve improved vibration serviceability without unnecessary increases in self-weight.

3. RESULTS AND DISCUSSION

The reviewed experimental, analytical, and numerical studies demonstrate that LVL-concrete composite systems exhibit significantly improved structural performance compared to non-composite LVL or concrete members, provided that an efficient shear connection is employed. One of the most critical outcomes consistently reported in the literature is the substantial increase in flexural stiffness achieved through composite action. Experimental results from full-scale beam tests indicate that well-designed LVL-concrete composite beams can achieve more than 90-95% of full composite behaviour, even with a relatively limited number of shear

connectors (Yeoh et al., 2011a; Yeoh et al., 2011b). This confirms that an optimized connection layout can effectively mobilize the mechanical advantages of both materials.

The results further highlight that the type and geometry of the shear connection play a decisive role in determining both stiffness and load-carrying capacity. Among the investigated connection systems, rectangular notched connections reinforced with screws consistently provide the highest shear stiffness and strength. These connectors were shown to maintain stable load-slip behaviour beyond the ultimate limit state, resulting in enhanced ductility and reduced sensitivity to localized damage (Yeoh et al., 2011b; Boccadoro et al., 2017). Triangular notches, while slightly less stiff, offer a viable alternative due to their ease of fabrication and satisfactory structural performance. In contrast, toothed metal plate connectors, although practical from a construction standpoint, tend to experience rapid stiffness degradation after reaching the ultimate load level. Another important finding concerns the relationship between shear connection stiffness and global structural behaviour. Several studies reported that increases in composite beam stiffness were primarily governed by the slip modulus of the connection rather than by the material strength of LVL or concrete alone (Deam et al., 2008; Khorsandnia et al., 2012). This observation underscores the necessity of accurately characterizing connection behaviour through push-out tests and incorporating realistic load-slip relationships into analytical and numerical models. Analytical formulations calibrated against experimental data were found to provide reliable predictions of both serviceability and ultimate limit state behaviour when appropriate correction factors were applied.

From a serviceability perspective, LVL-concrete composite systems show clear advantages in terms of deflection control and vibration performance. Full-scale bending tests demonstrated that composite beams could exhibit stiffness values up to three times greater than those of bare LVL beams, although the corresponding increase in ultimate strength is comparatively more modest (Deam et al., 2008). Numerical investigations into vibration behaviour further revealed that parameters such as concrete topping thickness and floor continuity significantly influence dynamic performance. An optimal concrete topping thickness of approximately 60-70 mm was identified as providing a balanced contribution of mass and stiffness, leading to improved vibration serviceability without excessive self-weight (Abd Ghafar & Sahban, 2017).

The results also indicate that the development of two-way action in LVL-concrete composite floor systems can further enhance structural efficiency. Experimental and numerical studies on two-way composite plates showed notable increases in natural frequencies and reductions in central deflections when appropriate edge support and inter-panel connections were provided

(Jaaranen & Fink, 2022). These findings suggest that future LVL-concrete composite floor designs may benefit from moving beyond traditional one-way beam behaviour toward plate-based systems.

Despite the demonstrated advantages, several challenges remain evident from the reviewed results. Long-term performance issues, including creep, concrete shrinkage, and moisture-induced effects in LVL, were identified as potential sources of increased interface slip and reduced composite efficiency over time (Yeoh et al., 2009; Khorsandnia et al., 2012). While some analytical models incorporate time-dependent behaviour, experimental validation under realistic environmental conditions remains limited. This highlights the need for extended-duration testing and refined modelling approaches to ensure the reliability of LVL-concrete composite systems throughout their service life. Overall, the results discussed in this study confirm that LVL-concrete composite systems represent a structurally efficient and sustainable solution for modern building applications. When equipped with properly designed shear connectors, these systems can achieve high levels of composite action, enhanced stiffness, and satisfactory ductility. However, the variability in connection performance and the limited availability of dedicated design guidelines indicate that further research is required to fully standardize design procedures and promote wider practical implementation.

4. CONCLUSIONS

This study has presented a comprehensive review and evaluation of existing experimental, analytical, and numerical research on LVL-concrete composite structural systems. The findings clearly demonstrate that LVL-concrete composites constitute an efficient and sustainable structural solution by effectively combining the high tensile strength and lightweight characteristics of laminated veneer lumber with the high compressive strength and stiffness of concrete. When appropriately designed, these hybrid systems significantly outperform non-composite LVL or concrete elements in terms of flexural stiffness, load-carrying capacity, and serviceability performance. One of the primary conclusions drawn from the reviewed studies is that the overall structural behaviour of LVL-concrete composite members is predominantly governed by the performance of the shear connection system. Properly designed connectors, particularly rectangular notched connections reinforced with screws, were shown to provide high shear stiffness and strength, enabling composite action levels exceeding 90-95% of full composite behaviour. Such connection systems also contribute to improved ductility and more stable post-ultimate response, which are critical for ensuring structural safety and robustness. The results further indicate that increases in flexural stiffness achieved through composite

action are often more pronounced than corresponding gains in ultimate strength. This highlights the importance of considering serviceability limit states, such as deflection and vibration control, as key design drivers for LVL-concrete composite systems. Optimized concrete topping thickness and effective floor continuity were found to play an essential role in enhancing vibration performance, particularly in long-span and multi-storey floor applications. Despite the demonstrated advantages, several challenges remain that limit the widespread implementation of LVL-concrete composite systems in practice. Long-term effects, including creep, concrete shrinkage, moisture-induced behaviour of LVL, and time-dependent degradation of connection stiffness, require further investigation through extended experimental programs and refined analytical models. Moreover, the limited availability of standardized design guidelines specifically addressing LVL-concrete composite members highlights a critical gap between research findings and practical engineering application. In conclusion, LVL-concrete composite systems offer considerable potential for modern, high-performance, and sustainable construction. Future research should focus on long-term performance assessment, environmental effects, and the development of unified design methodologies to facilitate broader adoption of these systems in structural engineering practice. The findings presented in this study are expected to contribute to ongoing research efforts and support the advancement of reliable and optimized LVL-concrete composite design solutions.

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MONTHLY STREAMFLOW PREDICTION USING ERA5-LAND REANALYSIS DATA IN DATA-SCARCE BASINS

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ABSTRACT

Accurate monthly streamflow forecasting is essential for effective reservoir management, water resource allocation, and flood preparedness. However, reliable predictions remain challenging in data-scarce catchments where continuous in-situ hydro-meteorological observations are limited. Gridded reanalysis datasets provide spatially and temporally consistent information, offering a viable alternative for developing predictive frameworks independent of extensive ground-based monitoring networks. This study presents a machine learning-based monthly streamflow prediction framework utilizing ERA5-Land reanalysis data spanning 1985–2024 for a semi-arid catchment in the Ceyhan River Basin, Turkey. The predictor set comprises four meteorological variables: 2-meter air temperature, total precipitation, surface net solar radiation, and surface pressure. To capture hydrological memory and delayed watershed response, autocorrelation analysis was conducted to identify significant lag structures, resulting in the incorporation of antecedent streamflow conditions at 1, 2, 11, and 12 months. Three machine learning algorithms representing distinct modeling paradigms were evaluated: Ridge Regression as a regularized linear baseline, Support Vector Regression (SVR) with radial basis function kernels, and Extreme Gradient Boosting (XGBoost) as an ensemble tree-based approach. Models were calibrated using the 1985–2012 period and validated on an independent test set spanning 2013–2024. XGBoost demonstrated superior predictive performance, achieving an NSE of 0.72, RMSE of 0.64 mm/month, and MAE of 0.31 mm/month, substantially outperforming both Ridge Regression (R^2=0.34) and SVR (R^2=0.56). Feature importance analysis revealed that antecedent streamflow at one-month lags (30.7%) and net solar radiation (20.7%), along with twelve-month (17.9%) lags, were the dominant predictors, emphasizing the critical role of hydrological persistence and seasonal memory in monthly streamflow dynamics. These findings demonstrate that reanalysis-driven, lag-informed machine learning frameworks offer a robust and transferable approach for operational streamflow forecasting in observation-limited basins, with potential applications in climate impact assessment and water resources planning.

Keywords: ERA5-Land reanalysis data; Monthly streamflow prediction, Data-scarce basins, Machine Learning; XGBoost

VERİ KISITLI HAVZALARDA ERA5-LAND YENİDEN ANALİZ VERİLERİ KULLANILARAK AYLIK AKIM TAHMİNİ

ÖZET

Aylık akım tahmininin doğru biçimde yapılması; etkin rezervuar işletmesi, su kaynaklarının tahsisi ve taşkına hazırlık açısından temel öneme sahiptir. Bununla birlikte, sürekli ve uzun dönemli yerinde (in-situ) hidro-meteorolojik gözlemlerin sınırlı olduğu veri kısıtlı havzalarda güvenilir tahminler üretmek güçleşmektedir. Izgara tabanlı yeniden analiz (reanalysis) veri setleri, mekânsal ve zamansal olarak tutarlı bilgi sağlayarak, yer gözlem ağlarına bağımlılığı azaltan kestirim çerçevelerinin geliştirilmesi için uygulanabilir bir alternatif sunmaktadır. Bu çalışma, Türkiye'de Ceyhan Nehri Havzası'nda yer alan yarı kurak bir havza için 1985–2024 dönemini kapsayan ERA5-Land yeniden analiz verilerini kullanarak makine öğrenmesi tabanlı bir aylık akım tahmin çerçevesi ortaya koymaktadır. Tahminleyici seti dört meteorolojik değişkenden oluşmaktadır: 2 m hava sıcaklığı, toplam yağış, yüzey net güneş radyasyonu ve yüzey basıncı. Hidrolojik bellek ve gecikmeli havza tepkisini yakalayabilmek amacıyla otokorelasyon analizi ile anlamlı gecikme yapıları belirlenmiş ve buna bağlı olarak 1, 2, 11 ve 12 aylık gecikmelerdeki önceki akım koşulları modele dâhil edilmiştir. Farklı modelleme paradigmalarını temsil eden üç makine öğrenmesi algoritması değerlendirilmiştir: düzenlileştirilmiş doğrusal bir temel model olarak Ridge Regresyonu, radyal tabanlı fonksiyon (RBF) çekirdekli Destek Vektör Regresyonu (SVR) ve topluluk (ensemble) ağaç tabanlı bir yaklaşım olarak Aşırı Gradyan Artırma (XGBoost). Modeller 1986–2012 döneminde kalibre edilmiş, 2013–2024 dönemini kapsayan bağımsız bir test seti üzerinde doğrulanmıştır. XGBoost, NSE=0.72, RMSE=0.64 mm/ay ve MAE=0.31 mm/ay değerleriyle en yüksek tahmin başarımını göstererek Ridge Regresyonu (R^2=0.34) ve SVR (R^2=0.56) modellerini geride bırakmıştır. Özellik önem analizi, 1 aylık (%30.7) ve 12 aylık (%17.9) gecikmeli akım ile net güneş radyasyonunun (%20.7) baskın belirleyiciler olduğunu ortaya koymuş ve aylık akım dinamiklerinde hidrolojik sürekliliğin ve mevsimsel belleğin kritik rolünü vurgulamıştır. Bulgular, yeniden analiz güdümlü ve gecikme bilgisiyle zenginleştirilmiş makine öğrenmesi çerçevelerinin, gözlem verilerinin sınırlı olduğu havzalarda operasyonel akım tahmini için sağlam ve farklı bölgelere aktarılabilir bir yaklaşım sunduğunu göstermektedir.

Keywords: ERA5-Land yeniden analiz verileri, Aylık akım tahmini, Veri kısıtlı havzalar, Makine Öğrenmesi; XGBoost

1. INTRODUCTION

Accurate streamflow prediction is fundamental to effective water resources management, supporting critical applications including reservoir operation, irrigation scheduling, hydropower generation, flood early warning, and environmental flow allocation (Yaseen et al., 2015). In the context of accelerating climate change and increasing anthropogenic pressures on water resources, the ability to reliably forecast streamflow at various temporal scales has become increasingly important for sustainable water management and climate adaptation planning (Blöschl et al., 2019). Monthly streamflow forecasting, in particular, provides essential information for medium-term operational decisions such as seasonal water allocation, drought preparedness, and agricultural planning in water-limited regions. The emergence of machine learning (ML) techniques has opened new avenues for hydrological prediction by offering data-driven alternatives that can capture complex nonlinear relationships without explicit representation of physical processes (Solomatine and Ostfeld, 2008). More recently, ensemble tree-based methods, particularly Random Forests and gradient boosting algorithms, have emerged as powerful tools for hydrological prediction (Tyralis et al., 2019). Among these, Extreme Gradient Boosting (XGBoost) has demonstrated exceptional performance across a wide range of environmental modeling applications due to its ability to capture complex feature interactions, inherent regularization mechanisms, and computational efficiency (Chen and Guestrin, 2016). Comparative studies have consistently shown that XGBoost outperforms traditional ML algorithms for streamflow prediction, particularly in catchments with nonlinear rainfall-runoff relationships (Gauch et al., 2021). Additionally, deep learning approaches, especially Long Short-Term Memory (LSTM) networks, have shown remarkable success in learning temporal dependencies in hydrological time series (Kratzert et al., 2018). However, the substantial data requirements and computational costs associated with deep learning may limit their applicability in data-scarce environments.

ERA5-Land, produced by the European Centre for Medium-Range Weather Forecasts (ECMWF), represents the current state-of-the-art in land surface reanalysis, providing global coverage at approximately 9 km spatial resolution and hourly temporal resolution from 1950 to present (Muñoz-Sabater et al., 2021). The dataset incorporates an advanced land surface model driven by atmospheric forcing from ERA5 reanalysis, generating consistent estimates of land surface variables including precipitation, temperature, radiation, and simulated runoff. Several studies have demonstrated the utility of ERA5-Land for hydrological applications, including drought monitoring, water balance assessment, and streamflow simulation in data-limited

regions (Tarek et al., 2020). The combination of ERA5-Land reanalysis with machine learning algorithms offers particular promise for developing transferable prediction frameworks applicable to ungauged or poorly gauged catchments. The concept of hydrological memory, encompassing both short-term persistence from recent antecedent conditions and longer-term seasonal patterns, is fundamental to understanding and predicting streamflow dynamics. Autocorrelation analysis of streamflow time series provides a systematic approach to identifying significant lag structures that can be incorporated as predictor variables, thereby encoding persistence and cyclicity into the ML input space (Tongal and Booij, 2018). This lag-informed approach has been shown to substantially improve prediction accuracy compared to models relying solely on contemporaneous meteorological inputs. Despite the growing body of literature on ML-based streamflow prediction, several knowledge gaps remain. First, most studies rely on in-situ observations for both predictor and target variables, limiting their transferability to ungauged catchments. Second, systematic comparisons of ML algorithms across different modeling paradigms (linear, kernel-based, and ensemble methods) using entirely reanalysis-derived datasets are scarce. Third, the relative importance of meteorological forcing versus hydrological memory in controlling monthly streamflow variability in semi-arid Mediterranean catchments has not been comprehensively investigated. Addressing these gaps is essential for developing robust, transferable prediction frameworks suitable for operational applications in data-limited environments.

This study presents a machine learning-based monthly streamflow prediction framework utilizing exclusively ERA5-Land reanalysis data for a semi-arid catchment in the Ceyhan River Basin, Turkey. The specific objectives are: (1) to develop and compare the predictive performance of three ML algorithms Ridge Regression as a regularized linear baseline, Support Vector Regression (SVR) with radial basis function kernels as a kernel-based nonlinear approach, and XGBoost as an ensemble tree-based method; (2) to evaluate model generalization capability through rigorous temporal validation on an independent testing period spanning over a decade; (3) to identify the dominant predictors controlling monthly streamflow variability through feature importance analysis; and (4) to demonstrate the feasibility of reanalysis-driven, observation-free prediction frameworks for operational streamflow forecasting in data-sparse regions. The findings contribute to the growing evidence base supporting the integration of gridded reanalysis products with machine learning techniques for water resources applications in the context of declining monitoring networks and increasing data demands.

2. MATERIAL AND METHODS

2.1. Study Area and ERA5-Land Dataset

The study focuses on a semi-arid catchment within the Ceyhan River Basin in southern Türkiye,

The Ceyhan Basin is characterized by a Mediterranean climate regime with pronounced seasonality, where precipitation is concentrated in the winter months while summers experience prolonged drought conditions. In contrast to conventional gauge-based modeling that relies on extensive in-situ monitoring networks, this study employs an entirely observation-free workflow where both predictor variables and the target variable are derived exclusively from ERA5-Land reanalysis data. ERA5-Land is a global land-surface dataset produced by the European Centre for Medium-Range Weather Forecasts (ECMWF) at approximately 9 km (0.1° × 0.1°) spatial resolution and hourly temporal resolution (Muñoz-Sabater et al., 2021). The dataset combines land surface model simulations with atmospheric forcing from ERA5 reanalysis, providing spatially and temporally consistent hydrometeorological fields that are particularly valuable for data-scarse regions where ground-based monitoring is limited or unreliable. This reanalysis-driven approach eliminates dependency on in-situ measurements, enabling the development of transferable prediction frameworks applicable to ungauged or poorly gauged catchments. Monthly time series covering the period 1985–2024 were extracted for the grid cells corresponding to the study catchment and aggregated to basin-representative values following standard reanalysis post-processing practices. Four hydrometeorological predictor variables were selected based on their physical relevance to runoff generation processes: total precipitation (mm), 2-meter air temperature (°C), surface pressure (hPa), and surface net solar radiation (W/m²). Flux variables (precipitation, radiation) were aggregated by monthly summation, while state variables (temperature, pressure) were aggregated by monthly averaging, yielding a consistent predictor dataset. The target variable, monthly runoff depth (mm/month), was derived from ERA5-Land total runoff, which represents the sum of surface and subsurface runoff simulated by the land surface model.

To ensure rigorous evaluation of model generalization capability under potentially changing hydroclimatic conditions, the dataset was split chronologically into a training period (1985–2012; 336 months) and an independent testing period (2013–2024; 144 months). This temporal separation prevents information leakage that could occur with random cross-validation splits, providing a realistic assessment of predictive skill under potential nonstationarity. The statistical characteristics of predictors and target variable for both periods are summarized in Table 1.

Table 1. Statistical characteristics of ERA5-Land predictors and runoff for training and testing periods.

Period	Variable	Mean	Max	Min	Std	Median	Skewness
Training	Temperature (°C)	11.22	27.30	-7.41	9.50	11.94	-0.09
	Precipitation (mm)	2.44	10.12	0.00	2.15	2.00	1.04
	Radiation (W/m²)	159.13	286.66	18.78	84.80	163.83	-0.13
	Pressure (hPa)	885.08	892.20	877.93	2.94	885.04	0.11
	Runoff (mm/month)	0.89	14.27	0.03	1.43	0.37	4.25
Testing	Temperature (°C)	12.85	27.24	-3.80	8.94	13.75	-0.05
	Precipitation (mm)	2.08	10.43	0.02	2.07	1.51	1.52
	Radiation (W/m²)	159.13	285.42	21.89	81.67	160.56	-0.11
	Pressure (hPa)	885.43	892.82	877.89	3.05	885.36	0.02
	Runoff (mm/month)	0.66	9.42	0.02	1.21	0.22	3.99

The statistical comparison between training and testing periods reveals notable differences that reflect potential hydroclimatic variability. Mean temperature increased from 11.22°C to 12.85°C between periods, consistent with regional warming trends observed across the Eastern Mediterranean. Mean runoff decreased from 0.89 mm/month to 0.66 mm/month, accompanied by a reduction in maximum runoff from 14.27 mm/month to 9.42 mm/month. The high positive skewness values (4.25 and 3.99 for training and testing, respectively) confirm the strongly right-skewed distribution characteristic of semi-arid runoff regimes, where low-flow conditions dominate and high-flow events occur infrequently. These distributional characteristics present challenges for machine learning models, as extreme events are underrepresented in training data.

2.2. Lag Structure Identification and Feature Engineering

Hydrological persistence and seasonal memory were quantified through autocorrelation analysis of the monthly ERA5-Land runoff series. The autocorrelation function (ACF) and partial autocorrelation function (PACF) were computed to identify statistically significant lag structures that could enhance predictive capability. The ACF measures the correlation between a time series and its lagged values, capturing both direct and indirect temporal dependencies, while the PACF isolates the direct correlation at each lag after removing the effects of intermediate lags. The ACF analysis (Figure 1) reveals strong short-term dependence at lags of 1–2 months, reflecting the persistence of watershed storage and baseflow recession dynamics simulated in the ERA5-Land land surface model. The PACF shows significant direct effects at lag-1 and lag-2, indicating that runoff at these antecedent time steps provides independent predictive information beyond what is captured by more recent values. Additionally, both ACF and PACF exhibit pronounced peaks around 11–12 months, reflecting the strong annual cycle

inherent to the Mediterranean climate regime. This annual-scale autocorrelation captures the tendency for similar runoff conditions to recur in corresponding months across consecutive years, driven by the seasonality of precipitation and evapotranspiration. Based on these diagnostics, four lagged runoff predictors were selected: t−1 and t−2 to capture short-term hydrological persistence, and t−11 and t−12 to encode annual cyclicity and seasonal memory. These lagged variables were combined with the four contemporaneous meteorological predictors (temperature, precipitation, radiation, and pressure), yielding a total of eight input features. This parsimonious feature set balances predictive power with model interpretability, avoiding the curse of dimensionality while embedding both persistence and seasonality into the machine learning input space.

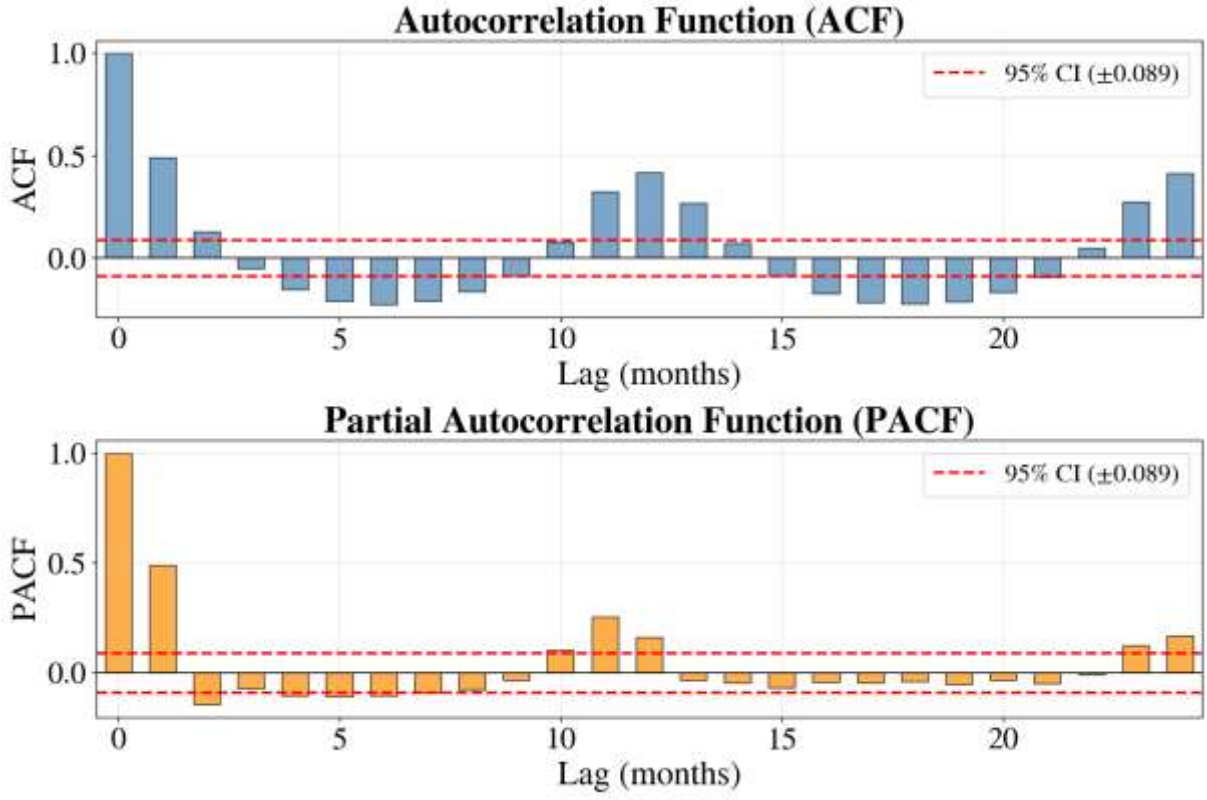


Fig. 1. Autocorrelation function (ACF) and partial autocorrelation function (PACF) analysis for monthly ERA5-Land runoff

Figure 2 illustrates the temporal distribution of monthly ERA5-Land runoff and the chronological split between training and testing periods. The chronological separation ensures that model evaluation reflects genuine predictive skill on temporally independent data, rather than interpolation performance that would result from random data splitting. This design is critical for assessing model transferability under potential hydroclimatic shifts and nonstationarity, which are particularly relevant concerns given the observed differences in mean temperature and runoff between the two periods.

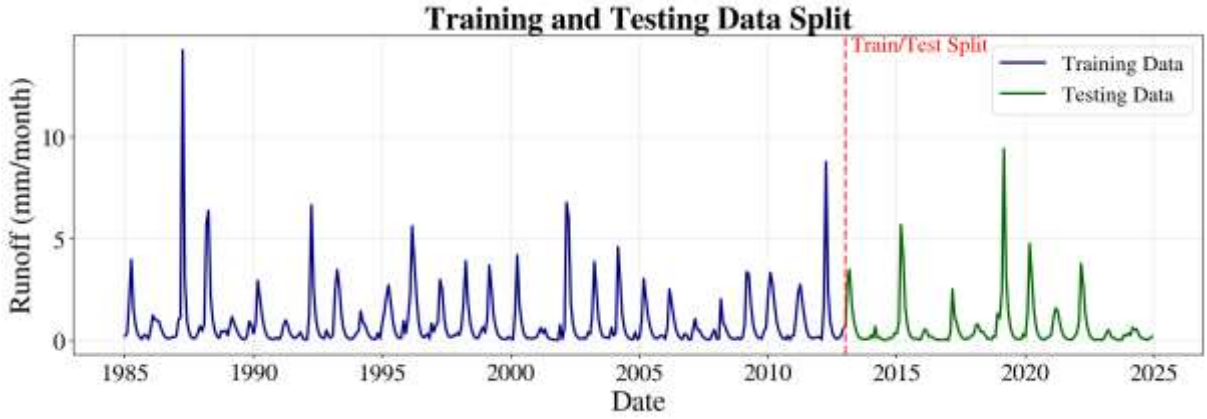


Fig. 2. Monthly ERA5-Land runoff Chronological training (1985–2012) and testing (2013–2024)

2.3. Machine Learning Models

Three machine learning algorithms representing distinct modeling paradigms were implemented to predict monthly streamflow: Ridge Regression as a regularized linear baseline, Support Vector Regression (SVR) as a kernel-based nonlinear approach, and Extreme Gradient Boosting (XGBoost) as an ensemble tree-based method. This selection enables systematic comparison across fundamentally different algorithmic architectures while maintaining computational efficiency suitable for operational applications.

Ridge Regression is a regularized linear regression technique that addresses multicollinearity and overfitting through L2 penalty regularization (Hoerl and Kennard, 1970). The method minimizes the penalized residual sum of squares:

$$\hat{\beta}^{ridge} = \text{argmin } \{\Sigma(y_i - \beta_0 - \Sigma\beta_j x_{ij})^2 + \lambda\Sigma\beta_j^2\} \quad (1)$$

where λ is the regularization parameter controlling the trade-off between bias and variance. The L2 penalty shrinks coefficient estimates toward zero without eliminating predictors entirely, making it particularly suitable when predictor variables exhibit correlation, as is typical with lagged hydrometeorological variables. Unlike ordinary least squares, Ridge Regression produces biased but lower-variance estimates, often improving predictive performance on independent test data. The regularization parameter was optimized through 5-fold cross-validation within the training period. Despite its simplicity, Ridge Regression serves as an important baseline representing the performance achievable under linear assumptions, providing a benchmark against which nonlinear methods can be evaluated.

Support Vector Regression (SVR) extends the support vector machine framework to regression problems by fitting a function within a specified margin of tolerance (Vapnik, 1999;

Smola and Schölkopf, 2004). SVR employs the ε-insensitive loss function, which ignores errors smaller than a threshold ε while penalizing larger deviations:

$$L(y, f(x)) = \max(0, |y - f(x)| - \varepsilon) \quad (2)$$

The optimization problem seeks to minimize model complexity while maintaining prediction errors within the ε-tube. The radial basis function (RBF) kernel was employed to capture nonlinear relationships:

$$K(x_i, x_j) = \exp(-\gamma||x_i - x_j||^2) \quad (3)$$

where γ controls the kernel width and consequently the model's capacity to fit complex patterns. The RBF kernel implicitly maps input features into a high-dimensional space where nonlinear relationships become linearly separable. Three hyperparameters require optimization: the regularization parameter C (controlling the trade-off between margin maximization and training error minimization), the kernel coefficient γ, and the ε-tube width. These parameters were tuned using grid search with 5-fold cross-validation. SVR has demonstrated strong performance in hydrological applications due to its theoretical foundation in statistical learning theory and its effectiveness with limited training samples (Asefa et al., 2006; Guo et al., 2011).

Extreme Gradient Boosting (XGBoost) is an optimized implementation of gradient boosting that constructs an ensemble of decision trees sequentially, with each tree correcting the residual errors of its predecessors (Chen and Guestrin, 2016). The model prediction is the sum of contributions from K trees:

$$\hat{y}_i = \Sigma_k f_k(x_i), f_k \in F \quad (4)$$

where F represents the space of regression trees. XGBoost minimizes a regularized objective function combining a differentiable loss function and penalty terms controlling tree complexity:

$$L(\varphi) = \Sigma_i l(y_i, \hat{y}_i) + \Sigma_k \Omega(f_k) \quad (5)$$

where l is the training loss (mean squared error for regression) and Ω penalizes tree complexity through the number of leaves and L2 regularization of leaf weights. The algorithm employs second-order Taylor expansion of the loss function for efficient optimization and incorporates several computational enhancements including column block structure for parallel learning, cache-aware access patterns, and out-of-core computation for large datasets.

2.4. Evaluation Metrics

Model performance was quantified using complementary goodness-of-fit and error-based metrics that are commonly used in hydrological modelling. Coefficient of determination (R^2) summarizes explained variance, while Nash–Sutcliffe efficiency (NSE) evaluates predictive skill relative to the mean benchmark (Nash & Sutcliffe, 1970). Kling–Gupta efficiency (KGE)

jointly assesses correlation, bias, and variability to provide a balanced diagnostic of hydrological realism (Gupta et al., 2009). Error magnitudes were evaluated using RMSE and MAE, and the ratio of RMSE to the standard deviation of observations (RSR) provides a normalized residual dispersion measure (Moriasi et al., 2007). Throughout the manuscript, the term "reference runoff" denotes the ERA5-Land runoff series used as the target; this is not an in-situ observed discharge record.

3. RESULTS AND DISCUSSION

The predictive capabilities of Ridge Regression, SVM, and XGBoost algorithms were evaluated through multiple complementary approaches during the independent testing period (2013–2024). The scatter plots depicting observed versus predicted monthly runoff values provide intuitive visual diagnostics where the degree of scatter around the 1:1 reference line indicates prediction accuracy (Figure 3).

The XGBoost model ($R^2 = 0.721$) demonstrated the tightest clustering around the 1:1 line across the entire range of observed streamflow values. Particularly noteworthy is the model's performance in the low-flow regime (0–2 mm/month), where predictions closely tracked observations with minimal dispersion. This accurate reproduction of baseflow conditions is critical for water resource management applications, as low-flow periods often coincide with peak water demand and ecological stress. However, a tendency toward underestimation was observed for extreme high-flow events exceeding 6 mm/month, with the most pronounced deviation occurring at the highest recorded value (approximately 9.5 mm/month), where the model predicted only around 6 mm/month. This systematic underestimation of peak flows is a well-documented limitation of machine learning models trained on datasets with positively skewed distributions, where extreme events are inherently underrepresented in the training sample. In contrast, the Ridge Regression scatter plot ($R^2 = 0.346$) exhibited substantially greater dispersion around the 1:1 line, with pronounced systematic bias across all flow magnitudes. The model demonstrated a clear tendency to overestimate low flows while severely underestimating high flows. Most critically, the extreme flow event of approximately 9.5 mm/month was predicted as merely 1.4 mm/month, representing a relative error exceeding 85%. This behavior reflects the fundamental inability of linear models to capture the nonlinear, threshold-dependent processes that govern runoff generation during extreme precipitation events in semi-arid catchments. The SVM model ($R^2 = 0.560$) displayed intermediate scatter characteristics, with improved clustering relative to Ridge Regression but notably greater dispersion compared to XGBoost. While the radial basis function kernel enabled partial capture

of nonlinear relationships within the 0–4 mm/month range, the model exhibited substantial underestimation of flows exceeding 4 mm/month, indicating persistent challenges in reproducing extreme hydrological events.

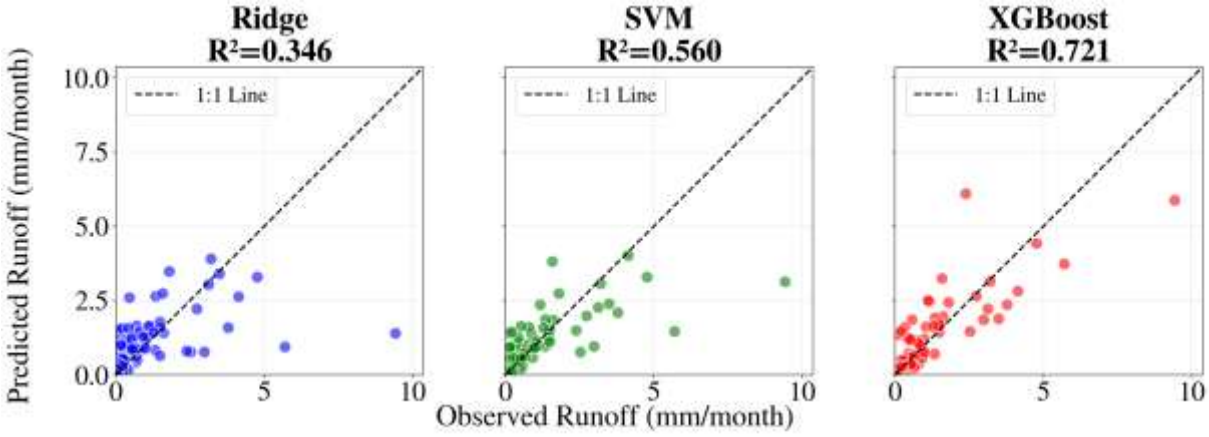


Fig. 3. Scatter plots of observed versus predicted monthly runoff during the testing period

The quantitative assessment using multiple performance metrics confirms these visual observations (Table 2). XGBoost achieved an NSE of 0.721 and KGE of 0.796, substantially outperforming both Ridge Regression (NSE = 0.346, KGE = 0.485) and SVM (NSE = 0.56, KGE = 0.583). According to the performance classification proposed by Moriasi et al. (2007), NSE values between 0.65 and 0.75 indicate "good" model performance, positioning XGBoost within this acceptable threshold for operational streamflow forecasting applications. The KGE metric provides a more comprehensive assessment by simultaneously evaluating correlation, bias, and variability ratios; XGBoost's KGE of 0.796 approaches the "very good" threshold (KGE > 0.80), suggesting balanced reproduction of streamflow mean, variability, and correlation structure. The RSR values provide additional insight into model reliability. XGBoost achieved the lowest RSR (0.528) during testing, indicating that prediction errors remained well below the standard deviation of observed streamflow. In contrast, Ridge Regression exhibited an RSR of 0.808, approaching the upper threshold of acceptable performance, while SVM achieved an intermediate RSR of 0.663. According to Moriasi et al. (2007), RSR values below 0.50 indicate excellent performance, values between 0.50 and 0.60 indicate good performance, and values between 0.60 and 0.70 indicate satisfactory performance. These benchmarks position XGBoost within the "good" category, SVM within the "satisfactory" category, and Ridge Regression at the margin of acceptable performance. The corresponding RMSE (0.64 mm/month) and MAE (0.311 mm/month) values for XGBoost demonstrate the model's capacity to minimize prediction errors across varying hydrological conditions.

Table 2. ML performance metrics for monthly runoff prediction in testing periods.

Model	NSE	KGE	RMSE	MAE	RSR
Ridge	0.346	0.485	0.979	0.469	0.808
SVM	0.56	0.583	0.803	0.352	0.663
XGBoost	**0.721**	**0.796**	**0.64**	**0.311**	**0.528**

Time series comparison of observed and predicted monthly streamflow during the testing period provides critical insights into the temporal dynamics of model performance (Figure 4). Visual inspection of the hydrographs reveals that all three models successfully captured the fundamental seasonal structure of streamflow in the study catchment, characterized by pronounced wet-season peaks typically occurring in late winter to early spring, followed by extended low-flow periods during summer months. This seasonal pattern reflects the Mediterranean climate regime of the Ceyhan River Basin, where precipitation is concentrated in the cooler months while summer experiences prolonged drought conditions. The incorporation of 11- and 12-month lagged streamflow variables in the predictor set appears to have effectively encoded this annual cyclicity, enabling even the simplest model (Ridge Regression) to reproduce the general seasonal template. The XGBoost model demonstrated superior fidelity in reproducing both the timing and magnitude of seasonal peak flows. Notably, the model accurately captured the major flow events occurring in early 2013 (≈3.5 mm/month), early 2015 (≈5.7 mm/month), early 2020 (≈4.8 mm/month), and early 2022 (≈3.8 mm/month), with predicted peaks closely tracking observed values in both timing and amplitude. The rising and recession limbs of the hydrograph were generally well reproduced, indicating that the model successfully learned the characteristic response dynamics of the catchment. During the extended low-flow periods (particularly 2014, 2016, and 2023–2024), XGBoost maintained predictions close to zero without substantial bias, demonstrating robust performance across the full range of hydrological conditions.

In contrast, Ridge Regression exhibited systematic deficiencies in hydrograph reproduction. While the model captured the general seasonal timing of peak flows, it consistently underestimated peak magnitudes while simultaneously overestimating baseflow conditions. The SVM model displayed intermediate temporal performance, with improved peak flow reproduction relative to Ridge Regression but persistent underestimation of extreme events. A common pattern across all three models is the substantial underestimation of the exceptional flow event of early 2019, where the observed peak of approximately 9.5 mm/month—the

highest recorded during the testing period—was predicted as approximately 6.1 mm/month by XGBoost, 3.1 mm/month by SVM, and merely 3.3 mm/month by Ridge Regression. Such unprecedented events pose fundamental challenges for data-driven models, which inherently extrapolate poorly beyond their training domain.

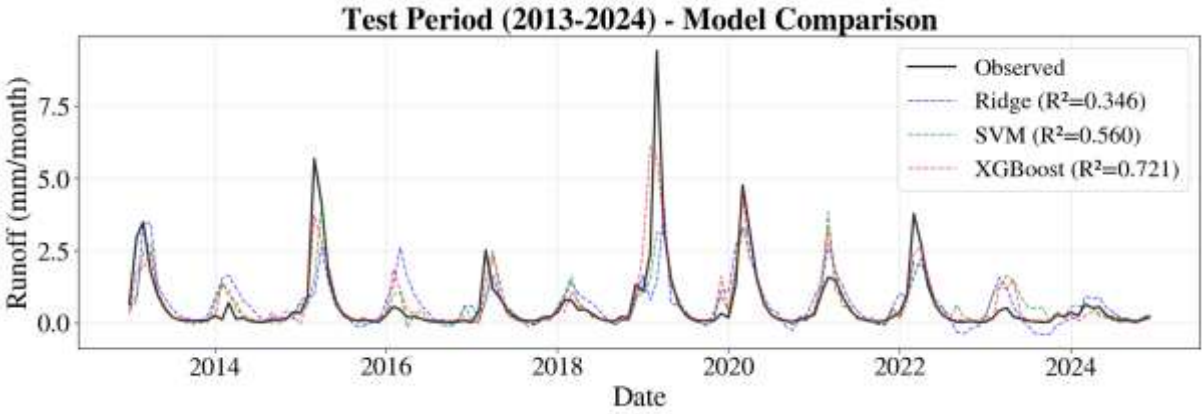


Fig. 4. Time series comparison of observed and predicted monthly runoff for all models during the testing period

The Taylor diagram (Figure 5) provides a comprehensive synthesis of model performance by simultaneously displaying correlation coefficient (angular position), normalized standard deviation (radial distance from origin), and centered root-mean-square difference (distance from the reference point) within a single polar coordinate framework. The reference point representing observed streamflow is positioned at a normalized standard deviation of 1.0, serving as the benchmark against which model predictions are evaluated. XGBoost (red triangle) demonstrated the closest approach to the observed reference point, positioned at approximately 0.75 normalized standard deviation with a correlation coefficient exceeding 0.85. This positioning indicates that XGBoost not only achieved strong linear agreement with observations but also reproduced approximately 75% of the observed streamflow variability. The slight underestimation of variability (normalized standard deviation < 1.0) is consistent with the previously noted tendency to underestimate extreme flow events, which contribute disproportionately to overall variance. SVM (green square) occupied an intermediate position, with a normalized standard deviation of approximately 0.45 and a correlation coefficient around 0.75. While the model achieved reasonable correlation with observations, it substantially underestimated streamflow variability, reproducing less than half of the observed standard deviation. This compression of the predicted dynamic range reflects the model's tendency to dampen both high and low extremes, resulting in predictions that cluster more tightly around mean conditions than observations. Ridge Regression (blue circle) exhibited the poorest performance in the Taylor diagram framework, positioned at approximately 0.55 normalized

standard deviation with the lowest correlation coefficient (approximately 0.60) among the evaluated models. The model's position furthest from the reference point indicates systematic deficiencies in reproducing both the correlation structure and variability magnitude of observed streamflow.

The violin plot comparison (Figure 6) reveals distributional properties of observed and predicted streamflow. The observed distribution exhibits the characteristic positively skewed structure typical of semi-arid hydrology, with the bulk of values concentrated in the low-flow regime (0–2 mm/month), a median near 0.3 mm/month, and an extended upper tail reaching approximately 10 mm/month. This asymmetric distribution reflects the episodic nature of runoff generation in Mediterranean climates, where prolonged dry periods are punctuated by intense wet-season events. XGBoost most faithfully reproduced this distributional structure, with predictions extending to approximately 7 mm/month. In contrast, Ridge Regression produced a substantially different distributional shape with concerning extension into negative values (physically implausible for streamflow), while its upper tail was severely truncated at approximately 4.5 mm/month. The SVM distribution displayed intermediate characteristics with reduced variability compared to observations.

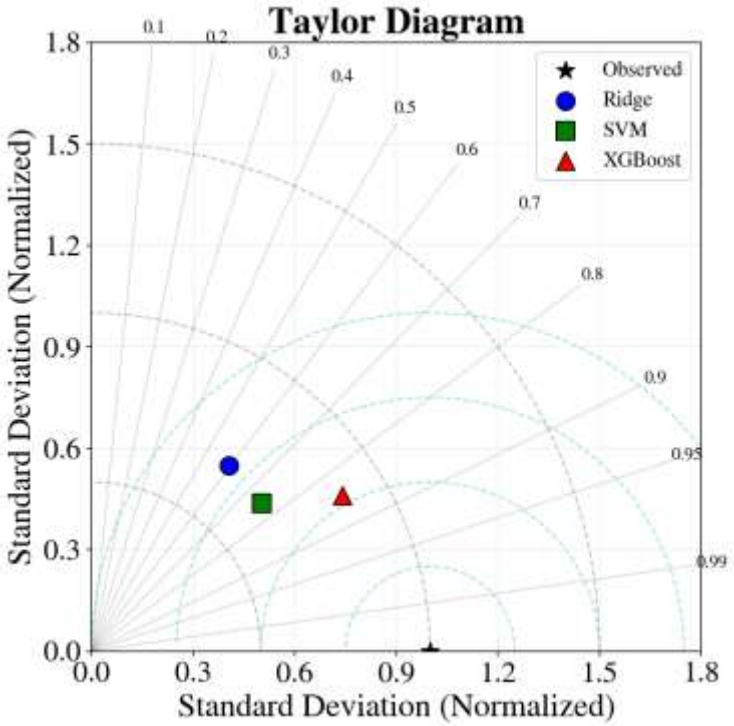


Fig. 5. Taylor diagram of observed and predicted monthly runoff distributions during the testing period.

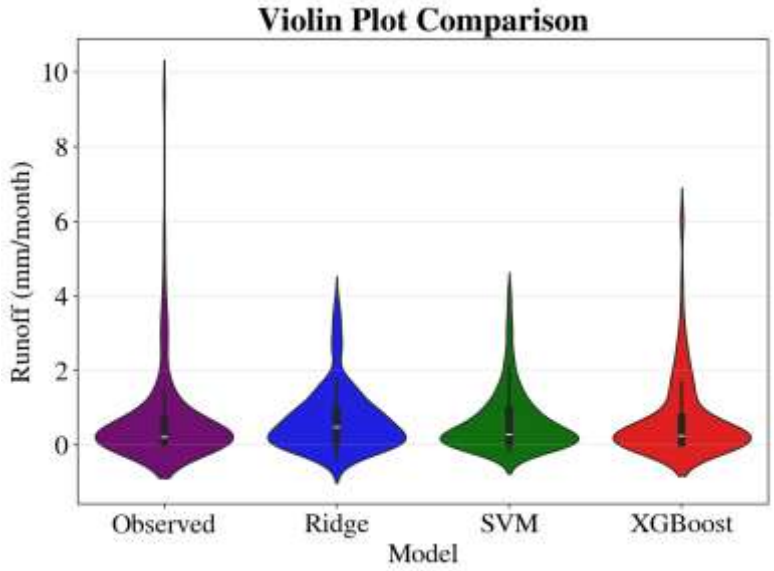


Fig. 6. Violin plot comparison of observed and predicted monthly runoff distributions during the testing period.

Understanding the relative contribution of predictor variables to model predictions provides valuable insights into the dominant physical processes governing streamflow dynamics in the study catchment. The feature importance analysis derived from the XGBoost model, based on the cumulative gain metric across all decision trees, reveals a clear hierarchical structure among the input variables (Figure 7). The one-month lagged streamflow (Lag-1) emerged as the most influential predictor, contributing 30.7% to the overall model importance. This dominant role of antecedent discharge reflects the strong hydrological persistence characteristic of semi-arid catchments, where baseflow recession dynamics and soil moisture memory create substantial month-to-month autocorrelation in streamflow. From a physical standpoint, the previous month's discharge encapsulates the integrated watershed state, including groundwater storage, soil moisture conditions, and antecedent precipitation effects, providing a powerful proxy for the catchment's hydrological status. Surface net solar radiation ranked second in importance (20.7%), highlighting the critical role of energy balance components in controlling monthly streamflow variability. In semi-arid Mediterranean environments, radiation serves as a primary driver of actual evapotranspiration, directly influencing the partitioning of precipitation between runoff generation and atmospheric losses. During high-radiation periods (typically summer months), enhanced evaporative demand substantially reduces the fraction of precipitation available for runoff, while lower radiation in winter months permits greater runoff coefficients. The prominence of radiation over direct precipitation in the importance ranking suggests that evapotranspiration losses represent a dominant control on monthly streamflow variability in the study catchment, consistent with the water-limited conditions prevalent in

semi-arid regions. The twelve-month lagged streamflow (Lag-12) contributed 17.9% to model importance, representing the third most influential predictor. This annual-scale memory effect reflects the strong seasonality of Mediterranean climate systems and the inter-annual persistence of watershed storage conditions. Total precipitation contributed 9.3% to model importance, ranking fourth among all predictors. While precipitation is the fundamental driver of runoff generation, its relatively modest importance ranking compared to lagged streamflow variables reflects several characteristics of semi-arid hydrology: the highly nonlinear and threshold-dependent relationship between precipitation and runoff, the temporal aggregation to monthly values that may obscure event-scale relationships, and potential systematic biases in ERA5-Land precipitation. Air temperature (8.9%) demonstrated comparable importance, reflecting its dual role in controlling evapotranspiration rates and precipitation phase partitioning. The intermediate lagged variables (Lag-2 and Lag-11) each contributed 5.0%, while surface pressure exhibited the lowest importance (2.5%).

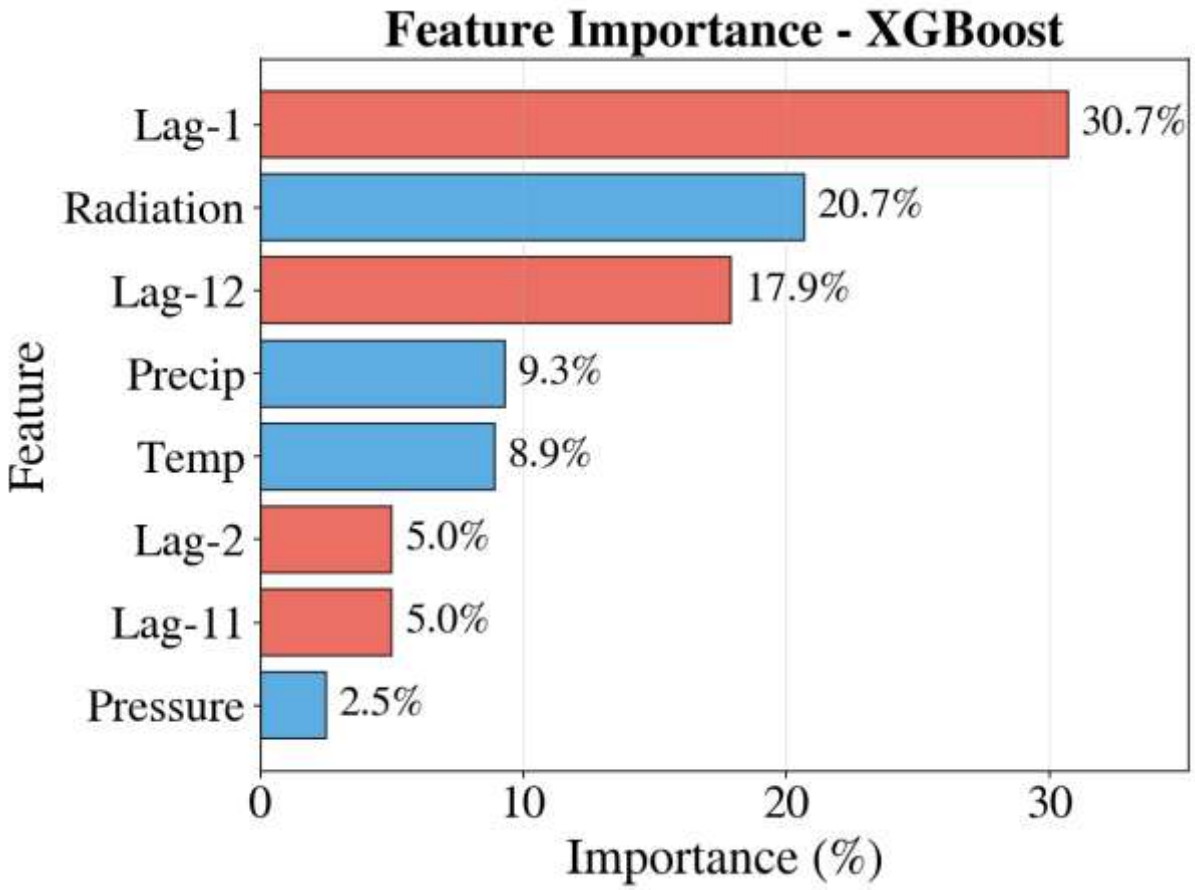


Fig. 7. Feature importance analysis for the XGBoost model.

The superior performance of XGBoost can be attributed to several algorithmic advantages, including its ensemble learning architecture, gradient-based optimization, and inherent regularization mechanisms. The tree-based ensemble approach effectively captures the

nonlinear, threshold-dependent relationships characteristic of rainfall-runoff processes in semi-arid environments, where linear models fundamentally fail. These findings align with previous studies highlighting the efficacy of gradient boosting methods for hydrological prediction in data-limited environments. The systematic underestimation of extreme events observed across all models represents an inherent limitation of data-driven approaches trained on positively skewed distributions, suggesting that hybrid physically-informed machine learning frameworks or specialized extreme value modeling may be warranted for flood forecasting applications. Nevertheless, the demonstrated performance of the reanalysis-driven, lag-informed XGBoost framework offers a robust and transferable approach for operational monthly streamflow forecasting in observation-limited basins, with potential applications in climate impact assessment and water resources planning.

4. CONCLUSION

This study developed a machine learning-based monthly streamflow prediction framework using exclusively ERA5-Land reanalysis data for a semi-arid catchment in the Ceyhan River Basin, Turkey. Among the three evaluated algorithms, XGBoost demonstrated superior predictive performance with NSE of 0.721 and KGE of 0.796, substantially outperforming Ridge Regression (NSE = 0.346) and SVR (NSE = 0.560). Feature importance analysis revealed that hydrological memory variables contributed 58.6% to model performance, with the one-month lagged runoff (30.7%) and surface net solar radiation (20.7%) emerging as dominant predictors. This highlights the critical role of antecedent conditions and evapotranspiration dynamics in controlling monthly streamflow variability in semi-arid environments. The observation-free workflow presented herein demonstrates the feasibility of developing robust prediction frameworks independent of in-situ monitoring networks, offering transferability to ungauged catchments. However, all models exhibited systematic underestimation of extreme high-flow events, reflecting inherent limitations of data-driven approaches trained on positively skewed distributions. Future research should focus on hybrid physically-informed approaches to improve extreme event prediction and extension to multiple catchments across diverse hydroclimatic settings. In conclusion, reanalysis-driven, lag-informed machine learning frameworks offer a robust approach for operational monthly streamflow forecasting in data-sparse regions, with potential applications in climate impact assessment and water resources planning.

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MONTHLY PRECIPITATION PREDICTION USING MERRA-2 REANALYSIS DATA IN DATA-SCARCE BASINS

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ABSTRACT

Monthly precipitation information is fundamental for drought monitoring, flood risk assessment, irrigation planning, and as forcing input to hydrological models. However, the scarcity of dense and continuous rain-gauge networks in many regions limits the development of reliable precipitation products and constrains subsequent water resources assessments. Gridded reanalysis datasets offer a practical alternative by providing spatially and temporally consistent atmospheric information independent of ground-based observations. This study proposes a machine learning-based monthly precipitation prediction framework utilizing MERRA-2 reanalysis data spanning 1985–2024 for a semi-arid region in the Ceyhan River Basin, Turkey. Rather than relying on measured precipitation as input, the predictive model infers monthly precipitation from physically meaningful atmospheric drivers: 2-meter air temperature, surface net solar radiation, and surface pressure. To capture temporal persistence and seasonal precipitation patterns, autocorrelation analysis was performed to determine optimal lag structures, leading to the incorporation of antecedent precipitation values at 1, 5, 11, and 12 months. Three machine learning algorithms representing different modeling paradigms were compared: Ridge Regression as a regularized linear baseline, Deep Neural Network (DNN) with multi-layer architecture, and LightGBM as a gradient boosting ensemble method. Models were trained on the 1986–2012 period and evaluated on an independent test set covering 2013–2024. The DNN model achieved the best predictive performance with an R^2 of 0.68, RMSE of 25.52 mm/month, and MAE of 16.92 mm/month, outperforming both Ridge Regression (R^2=0.57) and LightGBM (R^2=0.67). Coefficient analysis from the linear model indicated that net solar radiation exhibited the strongest negative influence, reflecting the inverse relationship between incoming radiation and precipitation occurrence in semi-arid climates. These results demonstrate that MERRA-2 reanalysis variables, combined with lag-informed deep learning approaches, can support scalable monthly precipitation estimation in observation-limited basins, providing valuable input for water resources management and climate impact studies.

Keywords: ERA5-Land reanalysis data; Monthly precipitation prediction, Data-scarce basins, Machine Learning; DNN

VERİ KISITLI HAVZALARDA MERRA-2 YENİDEN ANALİZ VERİLERİ KULLANILARAK AYLIK YAĞIŞ TAHMİNİ

ÖZET

Aylık yağış bilgisi; kuraklık izleme, taşkın risk değerlendirmesi, sulama planlaması ve hidrolojik modellerde zorlayıcı (forcing) girdi olarak kullanılma açısından temel bir bileşendir. Ancak birçok bölgede yoğun ve süreklilik gösteren yağış gözlem istasyonu ağlarının yetersizliği, güvenilir yağış ürünlerinin geliştirilmesini sınırlandırmakta ve buna bağlı su kaynakları değerlendirmelerini kısıtlamaktadır. Izgara tabanlı yeniden analiz (reanalysis) veri setleri, yer gözlemlerinden bağımsız olarak mekânsal ve zamansal tutarlılığa sahip atmosferik bilgi sağlayarak pratik bir alternatif sunmaktadır. Bu çalışma, Türkiye'de Ceyhan Nehri Havzası'nda yer alan yarı kurak bir bölge için 1985–2024 dönemini kapsayan MERRA-2 yeniden analiz verilerini kullanarak makine öğrenmesi tabanlı bir aylık yağış tahmin çerçevesi önermektedir. Yaklaşımda, ölçülen yağışın doğrudan girdi olarak kullanılmasına dayanmaksızın, aylık toplam yağış; fiziksel açıdan anlamlı atmosferik sürücüler olan 2 m hava sıcaklığı, yüzey net güneş radyasyonu ve yüzey basıncından kestirilmektedir. Zamansal sürekliliği ve mevsimsel yağış örüntülerini yakalayabilmek amacıyla otokorelasyon analizi ile optimal gecikme yapıları belirlenmiş; buna bağlı olarak 1, 5, 11 ve 12 aylık gecikmelerdeki önceki yağış değerleri modele dâhil edilmiştir. Farklı modelleme paradigmalarını temsil eden üç makine öğrenmesi algoritması karşılaştırılmıştır: düzenlileştirilmiş doğrusal bir temel model olarak Ridge Regresyonu, çok katmanlı mimariye sahip Derin Sinir Ağı (DNN) ve gradyan artırma temelli bir topluluk (ensemble) yöntemi olarak LightGBM. Modeller 1985–2012 döneminde eğitilmiş ve 2013–2024 dönemini kapsayan bağımsız bir test seti üzerinde değerlendirilmiştir. DNN modeli, R^2=0.68, RMSE=25.52 mm/ay ve MAE=16.92 mm/ay değerleriyle en yüksek tahmin başarımını elde ederek Ridge Regresyonu (R^2=0.57) ve LightGBM (R^2=0.67) modellerini geride bırakmıştır. Doğrusal modelden elde edilen katsayı analizi, net güneş radyasyonunun en güçlü negatif etkiye sahip olduğunu göstermiştir. Sonuçlar, MERRA-2 yeniden analiz değişkenlerinin gecikme bilgisiyle zenginleştirilmiş derin öğrenme yaklaşımlarıyla birleştirilmesi sayesinde, gözlem verilerinin sınırlı olduğu havzalarda ölçeklenebilir aylık yağış kestirimi yapılabileceğini ortaya koymaktadır.

Keywords: MERRA-2 yeniden analiz verileri, Aylık yağış tahmini, Veri kısıtlı havzalar, Makine Öğrenmesi; DNN

1. INTRODUCTION

Accurate precipitation estimation is fundamental to water resources management, supporting critical applications including flood forecasting, drought monitoring, agricultural water

management, and climate change impact assessment (Kidd and Huffman, 2011). In the context of accelerating climate variability and increasing anthropogenic pressures on water resources, the ability to reliably estimate and predict precipitation at various temporal scales has become increasingly important for sustainable water management and climate adaptation planning. Monthly precipitation forecasting, in particular, provides essential information for medium-term operational decisions such as seasonal water allocation, irrigation scheduling, and drought preparedness in water-limited regions (Mishra and Singh, 2010). The emergence of machine learning (ML) techniques has opened new avenues for hydrometeorological prediction by offering data-driven alternatives that can capture complex nonlinear relationships without explicit representation of physical processes (Solomatine and Ostfeld, 2008). Traditional statistical methods for precipitation estimation, such as geostatistical interpolation and regression-based approaches, often struggle to capture the inherent nonlinearity and spatial heterogeneity of precipitation fields, particularly in complex terrain and semi-arid environments where precipitation exhibits high spatiotemporal variability. More recently, deep learning approaches have shown remarkable success in learning complex patterns from atmospheric and climate data (Reichstein et al., 2019). Deep Neural Networks (DNNs) with multiple hidden layers can automatically learn hierarchical feature representations, potentially capturing nonlinear relationships between atmospheric drivers and precipitation that simpler models cannot represent. Additionally, gradient boosting methods such as LightGBM have emerged as powerful tools for environmental modeling due to their computational efficiency, handling of heterogeneous features, and inherent regularization mechanisms (Ke et al., 2017).

The Modern-Era Retrospective analysis for Research and Applications, Version 2 (MERRA-2), produced by NASA's Global Modeling and Assimilation Office, represents a state-of-the-art atmospheric reanalysis providing global coverage from 1980 to present at approximately 50 km spatial resolution and hourly temporal resolution (Gelaro et al., 2017). MERRA-2 assimilates a comprehensive set of satellite and conventional observations using the Goddard Earth Observing System atmospheric model, generating consistent estimates of atmospheric variables including temperature, humidity, radiation, and surface pressure. Several studies have demonstrated the utility of MERRA-2 for hydroclimatic applications, including precipitation downscaling, drought assessment, and hydrological modeling in data-limited regions (Reichle et al., 2017). The concept of temporal persistence in precipitation, encompassing both short-term autocorrelation and longer-term seasonal patterns, is fundamental to understanding and predicting precipitation dynamics. Autocorrelation analysis of precipitation time series

provides a systematic approach to identifying significant lag structures that can be incorporated as predictor variables, thereby encoding persistence and cyclicity into the ML input space. This lag-informed approach has been shown to substantially improve prediction accuracy compared to models relying solely on contemporaneous atmospheric inputs (Tongal and Booij, 2018).

Despite the growing body of literature on ML-based hydrometeorological prediction, several knowledge gaps remain. First, most precipitation estimation studies rely on gauge observations for both training and validation, limiting their applicability to regions with sparse monitoring networks. Second, systematic comparisons of ML algorithms across different modeling linear, neural network-based, and ensemble tree methods—using entirely reanalysis-derived datasets are scarce. Third, the relative importance of different atmospheric drivers versus temporal memory in controlling monthly precipitation variability in semi-arid Mediterranean catchments has not been comprehensively investigated.

This study presents a machine learning-based monthly precipitation prediction framework utilizing exclusively MERRA-2 reanalysis data for a semi-arid region in the Ceyhan River Basin, Turkey. The specific objectives are: (1) to develop and compare the predictive performance of three ML algorithms representing distinct modeling paradigms—Ridge Regression as a regularized linear baseline, Deep Neural Network (DNN) as a multi-layer nonlinear approach, and LightGBM as a gradient boosting ensemble method; (2) to evaluate model generalization capability through rigorous temporal validation on an independent testing period spanning over a decade; (3) to identify the dominant predictors controlling monthly precipitation variability through feature importance and coefficient analysis; and (4) to demonstrate the feasibility of reanalysis-driven, observation-free prediction frameworks for operational precipitation estimation in data-sparse regions.

2. MATERIAL AND METHODS

2.1. Study Area and ERA5-Land Dataset

The study focuses on a semi-arid region within the Ceyhan River Basin in southern Türkiye, with the location of the State Hydraulic Works General Directorate D20A054 gauging station. The Ceyhan Basin is characterized by a Mediterranean climate regime with pronounced seasonality, where precipitation is concentrated in the winter months while summers experience prolonged drought conditions. In contrast to conventional gauge-based modeling that relies on extensive in-situ monitoring networks, this study employs an entirely observation-free workflow where both predictor variables and the target variable are derived exclusively from MERRA-2 reanalysis data. MERRA-2 (Modern-Era Retrospective analysis for Research and

Applications, Version 2) is a global atmospheric reanalysis produced by NASA's Global Modeling and Assimilation Office at approximately 0.5° × 0.625° spatial resolution and hourly temporal resolution (Gelaro et al., 2017). The dataset assimilates satellite and conventional observations using the GEOS-5 atmospheric model, providing spatially and temporally consistent hydrometeorological fields that are particularly valuable for data-sparse regions where ground-based monitoring is limited or unreliable. Monthly time series covering the period 1985–2024 were extracted for the grid cells corresponding to the study region and aggregated to area-representative values following standard reanalysis post-processing practices. Three atmospheric predictor variables were selected based on their physical relevance to precipitation processes: 2-meter air temperature (°C), surface net solar radiation (W/m²), and surface pressure (hPa). The target variable, monthly precipitation (mm/month), was derived from MERRA-2 total precipitation product. To ensure rigorous evaluation of model generalization capability under potentially changing hydroclimatic conditions, the dataset was split chronologically into a training period (1985–2012; 336 months) and an independent testing period (2013–2024; 144 months). This temporal separation prevents information leakage that could occur with random cross-validation splits, providing a realistic assessment of predictive skill under potential nonstationarity. The statistical characteristics of predictors and target variable for both periods are summarized in Table 1.

The statistical comparison between training and testing periods reveals comparable distributional characteristics, indicating relative hydroclimatic stability across the study period. Mean temperature increased slightly from 9.44°C to 10.56°C between periods, consistent with regional warming trends observed across the Eastern Mediterranean. Mean precipitation remained relatively stable at approximately 51–52 mm/month, with similar variability (standard deviation ~45 mm) in both periods. The moderate positive skewness values (0.67 and 0.77 for training and testing, respectively) confirm the expected right-skewed distribution characteristic of semi-arid precipitation regimes, where low-precipitation months are common and high-precipitation events occur less frequently. These distributional characteristics present challenges for machine learning models, as extreme events are underrepresented in training data.

Table 1. Statistical characteristics of MERRA-2 predictors and precipitation for training and testing periods.

Period	Variable	Mean	Max	Min	Std	Median	Skewness
Training	Temperature (°C)	9.44	25.36	-9.11	9.19	9.77	-0.01
	Radiation (W/m²)	184.86	316.55	40.96	81.93	189.60	-0.02
	Pressure (hPa)	846.34	851.88	839.58	2.14	846.06	0.15
	Precipitation (mm)	52.03	186.78	0.00	45.48	46.24	0.67
Testing	Temperature (°C)	10.56	25.62	-5.95	9.17	10.92	0.02
	Radiation (W/m²)	185.59	307.18	47.49	80.08	187.66	-0.05
	Pressure (hPa)	846.88	851.77	843.29	2.08	846.54	0.38
	Precipitation (mm)	51.17	182.28	0.00	45.04	44.64	0.77

2.2. Lag Structure Identification and Feature Engineering

Temporal persistence and seasonal memory in precipitation were quantified through autocorrelation analysis of the monthly MERRA-2 precipitation series. The autocorrelation function (ACF) and partial autocorrelation function (PACF) were computed to identify statistically significant lag structures that could enhance predictive capability. The ACF measures the correlation between a time series and its lagged values, capturing both direct and indirect temporal dependencies, while the PACF isolates the direct correlation at each lag after removing the effects of intermediate lags. The ACF analysis (Figure 1) reveals strong short-term dependence at lag-1, reflecting the persistence of atmospheric circulation patterns that influence precipitation occurrence across consecutive months. The PACF shows significant direct effects at lag-1 and lag-5, indicating that precipitation at these antecedent time steps provides independent predictive information. Additionally, both ACF and PACF exhibit pronounced peaks around 11–12 months, reflecting the strong annual cycle inherent to the Mediterranean climate regime. This annual-scale autocorrelation captures the tendency for similar precipitation conditions to recur in corresponding months across consecutive years, driven by the seasonality of large-scale atmospheric circulation patterns. Based on these diagnostics, four lagged precipitation predictors were selected: $t-1$ to capture short-term persistence, $t-5$ to encode intermediate-scale memory, and $t-11$ and $t-12$ to represent annual cyclicity and seasonal memory. These lagged variables were combined with the three contemporaneous atmospheric predictors (temperature, radiation, and pressure), yielding a total of seven input features. This parsimonious feature set balances predictive power with model interpretability, avoiding the curse of dimensionality while embedding both persistence and seasonality into the machine learning input space.

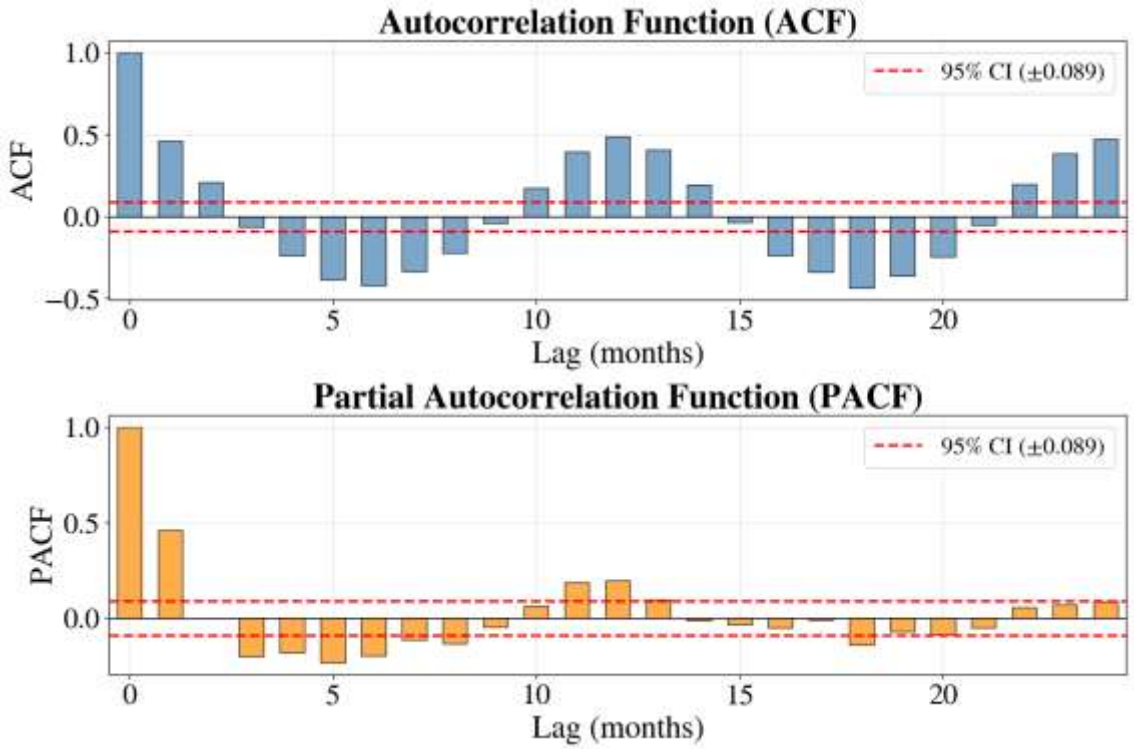


Fig. 1. Autocorrelation function (ACF) and partial autocorrelation function (PACF) analysis for monthly MERRA-2 precpitation

Figure 2 illustrates the temporal distribution of monthly MERRA-2 precipitation and the chronological split between training and testing periods. The time series exhibits strong seasonality with elevated precipitation during winter months, corresponding to the wet season in the Mediterranean climate, and reduced precipitation throughout summer months. The chronological separation ensures that model evaluation reflects genuine predictive skill on temporally independent data, rather than interpolation performance that would result from random data splitting.

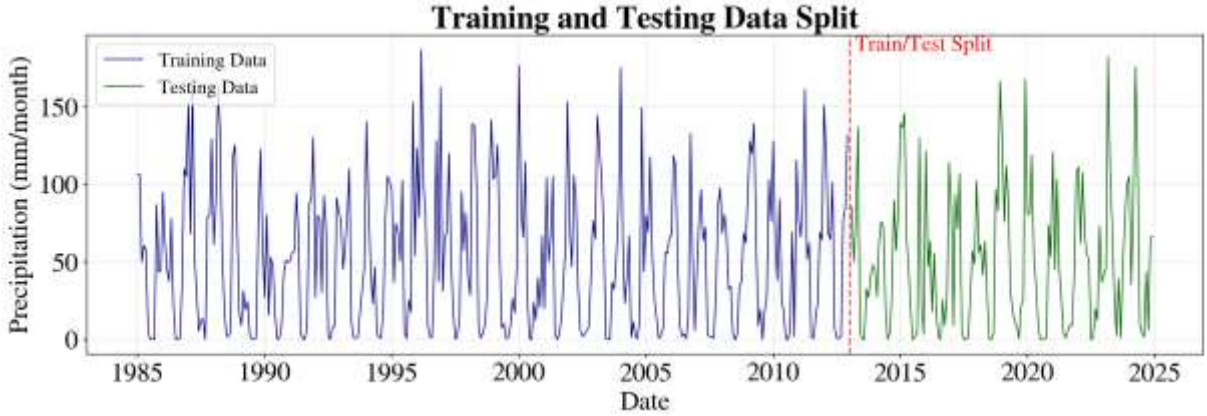


Fig. 2. Monthly MERRA-2 precipitation Chronological training (1985–2012) and testing (2013–2024)

2.3. Machine Learning Models

Three machine learning algorithms representing distinct modeling paradigms were implemented to predict monthly precipitation: Ridge Regression as a regularized linear baseline, Deep Neural Network (DNN) as a multi-layer nonlinear approach, and LightGBM as a gradient boosting ensemble method. This selection enables systematic comparison across fundamentally different algorithmic architectures while maintaining computational efficiency suitable for operational applications.

Ridge Regression is a regularized linear regression technique that addresses multicollinearity and overfitting through L2 penalty regularization (Hoerl and Kennard, 1970). The method minimizes the penalized residual sum of squares with a regularization parameter λ controlling the trade-off between bias and variance. The L2 penalty shrinks coefficient estimates toward zero without eliminating predictors entirely, making it particularly suitable when predictor variables exhibit correlation, as is typical with lagged hydrometeorological variables. Despite its simplicity, Ridge Regression serves as an important baseline representing the performance achievable under linear assumptions.

Deep Neural Network (DNN) is a multi-layer feedforward network architecture consisting of an input layer, multiple hidden layers with nonlinear activation functions, and an output layer. DNNs can approximate complex nonlinear functions through the composition of simple transformations across layers, learning hierarchical feature representations from raw inputs. The architecture employed in this study consists of three hidden layers with ReLU (Rectified Linear Unit) activation functions and dropout regularization to prevent overfitting. The network was trained using the Adam optimizer with early stopping based on validation loss. DNNs have demonstrated strong performance in environmental prediction tasks due to their flexibility in capturing complex nonlinear relationships (Reichstein et al., 2019).

Light Gradient Boosting Machine (LightGBM) is a highly efficient gradient boosting framework that uses histogram-based decision tree learning algorithms (Ke et al., 2017). Unlike traditional gradient boosting methods that grow trees level-wise, LightGBM uses a leaf-wise growth strategy that reduces loss more efficiently. The algorithm incorporates Gradient-based One-Side Sampling (GOSS) to focus on instances with larger gradients and Exclusive Feature Bundling (EFB) to reduce feature dimensionality, resulting in substantially faster training with comparable accuracy. LightGBM has demonstrated state-of-the-art performance across a wide range of prediction tasks due to its computational efficiency, handling of categorical features, and built-in regularization mechanisms.

2.4. Evaluation Metrics

Model performance was quantified using complementary goodness-of-fit and error-based metrics that are commonly used in hydrological modelling. Coefficient of determination (R^2) summarizes explained variance, while Nash–Sutcliffe efficiency (NSE) evaluates predictive skill relative to the mean benchmark (Nash & Sutcliffe, 1970). Kling–Gupta efficiency (KGE) jointly assesses correlation, bias, and variability to provide a balanced diagnostic of hydrological realism (Gupta et al., 2009). Error magnitudes were evaluated using RMSE and MAE, and the ratio of RMSE to the standard deviation of observations (RSR) provides a normalized residual dispersion measure (Moriasi et al., 2007).

3. RESULTS AND DISCUSSION

The predictive capabilities of Ridge Regression, DNN, and LightGBM algorithms were evaluated through multiple complementary approaches during the independent testing period (2013–2024). The scatter plots depicting observed versus predicted monthly precipitation values provide intuitive visual diagnostics where the degree of scatter around the 1:1 reference line indicates prediction accuracy (Figure 3). The DNN model (R^2 = 0.677) demonstrated the tightest clustering around the 1:1 line across the majority of observed precipitation values. The model performed well in the moderate precipitation range (25–100 mm/month), where predictions closely tracked observations with acceptable dispersion. However, a tendency toward underestimation was observed for extreme high-precipitation events exceeding 150 mm/month, with the most pronounced deviation occurring at the highest recorded values. This systematic underestimation of peak precipitation is a well-documented limitation of machine learning models trained on datasets with moderately skewed distributions, where extreme events are inherently underrepresented in the training sample. The Ridge Regression scatter plot (R^2 = 0.571) exhibited greater dispersion around the 1:1 line, with some systematic bias across different precipitation magnitudes. The model demonstrated a tendency to overestimate low precipitation values while underestimating high precipitation events, reflecting the fundamental constraints of linear models in capturing the nonlinear relationships that govern precipitation variability in semi-arid environments. The LightGBM model (R^2 = 0.675) displayed comparable scatter characteristics to DNN, with similar clustering patterns and underestimation tendencies for extreme events.

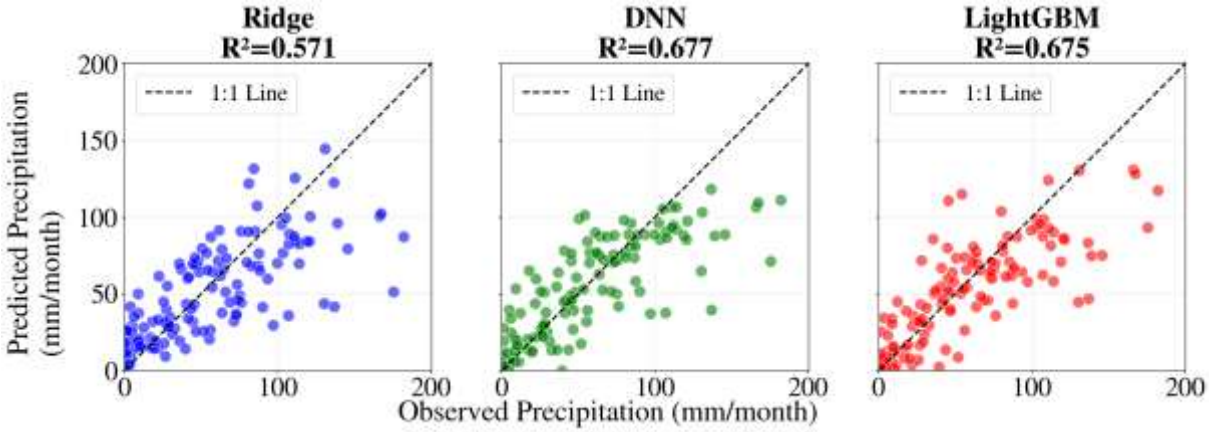


Fig. 3. Scatter plots of observed versus predicted monthly precipitation during the testing period

The quantitative assessment using multiple performance metrics confirms these visual observations (Table 2). DNN achieved an NSE of 0.677 and KGE of 0.711, marginally outperforming both Ridge Regression (NSE = 0.571, KGE = 0.616) and LightGBM (NSE = 0.675, KGE = 0.702). According to the performance classification proposed by Moriasi et al. (2007), NSE values between 0.65 and 0.75 indicate "good" model performance, positioning DNN at the lower boundary of this acceptable threshold for operational precipitation forecasting applications. The RSR values provide additional insight into model reliability. DNN achieved the lowest RSR (0.569) during testing, indicating that prediction errors remained below the standard deviation of observed precipitation. According to Moriasi et al. (2007), RSR values between 0.50 and 0.60 indicate good performance. The corresponding RMSE (25.52 mm/month) and MAE (16.92 mm/month) values for DNN demonstrate the model's capacity to minimize prediction errors across varying precipitation conditions.

Table 2. ML performance metrics for monthly precipitation prediction in testing periods.

Model	**NSE**	**KGE**	**RMSE**	**MAE**	**RSR**
Ridge	0.571	0.616	29.414	21.824	0.655
DNN	**0.677**	**0.711**	**25.516**	**16.918**	**0.569**
LightGBM	0.675	0.702	25.596	17.358	0.570

Time series comparison of observed and predicted monthly precipitation during the testing period provides critical insights into the temporal dynamics of model performance (Figure 4). Visual inspection of the hyetographs reveals that all three models successfully captured the fundamental seasonal structure of precipitation in the study region, characterized by pronounced wet-season peaks typically occurring in winter months, followed by reduced precipitation during summer months. The DNN model demonstrated superior fidelity in

reproducing both the timing and magnitude of seasonal precipitation peaks. The model accurately captured the major precipitation events, with predicted peaks closely tracking observed values in both timing and amplitude. During the extended dry periods, DNN maintained predictions close to observed values without substantial bias, demonstrating robust performance across the full range of precipitation conditions. A common pattern across all three models is the underestimation of exceptional precipitation events, such as the peak exceeding 180 mm/month in early 2023. Such unprecedented events pose fundamental challenges for data-driven models, which inherently extrapolate poorly beyond their training domain.

The Taylor diagram (Figure 5) provides a comprehensive synthesis of model performance by simultaneously displaying correlation coefficient, normalized standard deviation, and centered root-mean-square difference within a single polar coordinate framework. DNN (green square) and LightGBM (red triangle) demonstrated the closest approach to the observed reference point, positioned at approximately 0.70 normalized standard deviation with correlation coefficients around 0.82.

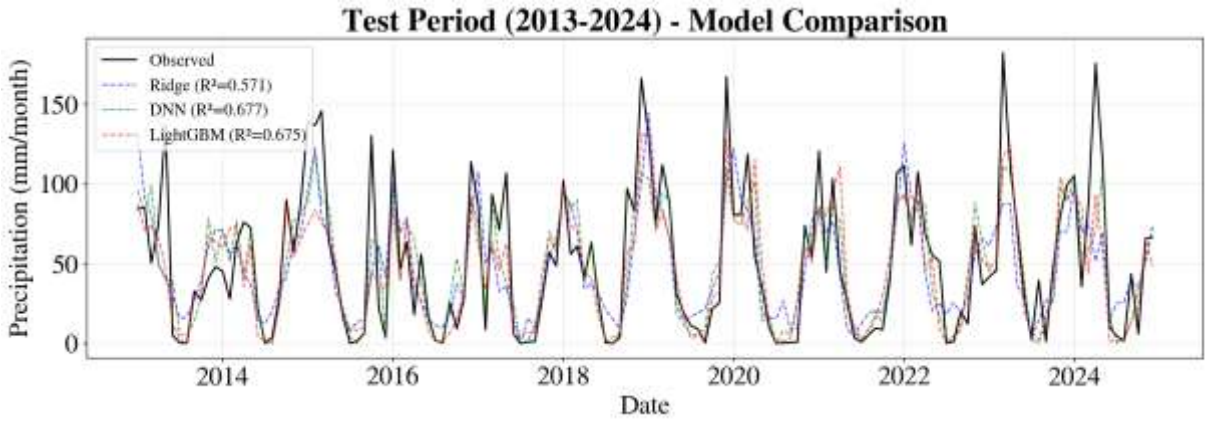


Fig. 4. Time series comparison of observed and predicted monthly precipitation for all models during the testing period

Ridge Regression (blue circle) exhibited slightly lower performance, with a normalized standard deviation of approximately 0.55 and correlation coefficient around 0.75.

The violin plot comparison (Figure 6) reveals distributional properties of observed and predicted precipitation. The observed distribution exhibits the characteristic moderately skewed structure typical of semi-arid precipitation, with values ranging from 0 to approximately 180 mm/month. DNN and LightGBM most faithfully reproduced this distributional structure, though with somewhat compressed upper tails reflecting the tendency to underestimate extreme events. Ridge Regression produced a distribution with concerning extension into negative values, which is physically implausible for precipitation.

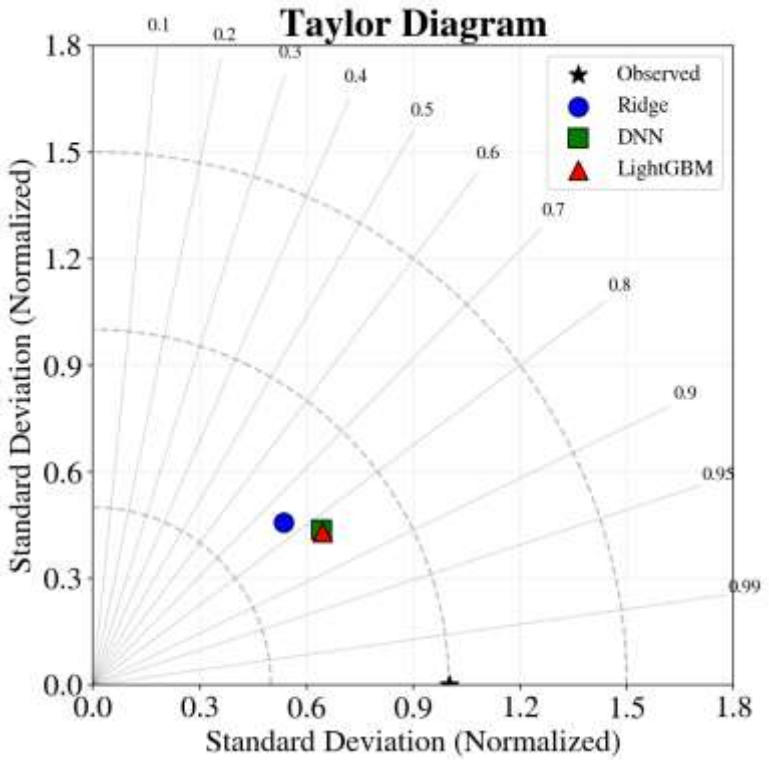


Fig. 5. Taylor diagram of observed and predicted monthly precipitation distributions during the testing period.

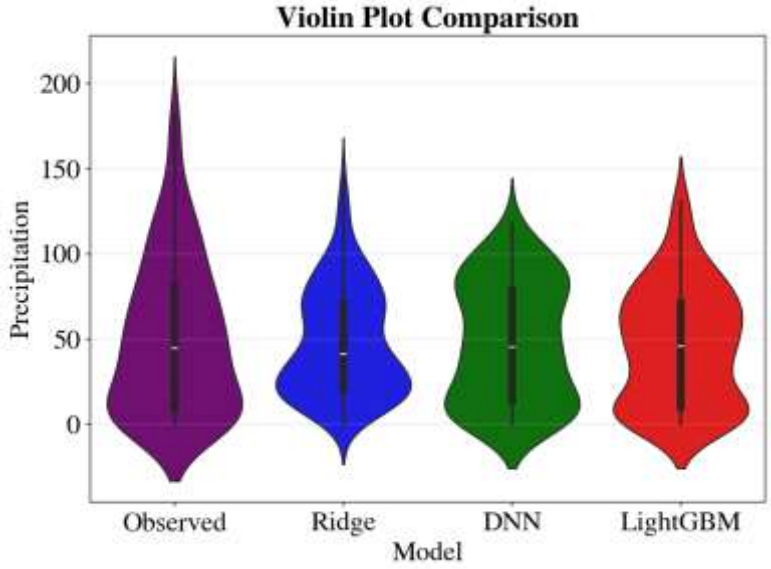


Fig. 6. Violin plot comparison of observed and predicted monthly precipitation distributions during the testing period.

Understanding the relative contribution of predictor variables to model predictions provides valuable insights into the dominant physical processes governing precipitation dynamics in the study region. The feature importance analysis derived from the LightGBM model reveals a clear hierarchical structure among the input variables (Figure 7). Air temperature emerged as the most influential predictor, contributing 41.7% to the overall model importance. This

dominant role of temperature reflects its strong inverse correlation with precipitation in Mediterranean climates, where warm temperatures are associated with dry summer conditions and cool temperatures coincide with the wet winter season.

Surface net solar radiation ranked second in importance (29.2%), highlighting the critical role of energy balance components in controlling precipitation occurrence. In semi-arid Mediterranean environments, high radiation is inversely associated with precipitation, as clear-sky conditions produce high radiation while cloudy, precipitating conditions reduce surface radiation. Surface pressure contributed 26.7% to model importance, reflecting its association with synoptic-scale weather patterns that drive precipitation variability. The lagged precipitation variables contributed relatively little importance in the LightGBM framework (Lag-1: 3.2%), suggesting that contemporaneous atmospheric conditions dominate over persistence effects in this gradient boosting approach.

The Ridge Regression coefficient analysis (Figure 8) provides complementary insights into the linear relationships between predictors and precipitation. Net solar radiation exhibited the strongest negative coefficient (-0.69), confirming the inverse relationship between radiation and precipitation in the study region. Surface pressure also showed a negative coefficient (-0.36), consistent with the meteorological understanding that low pressure systems are associated with increased precipitation. Among the lagged variables, Lag-1 showed the strongest positive coefficient (0.17), indicating that precipitation persistence contributes to prediction even in the linear framework. The annual-scale lags (Lag-11 and Lag-12) showed smaller positive coefficients, reflecting seasonal memory effects.

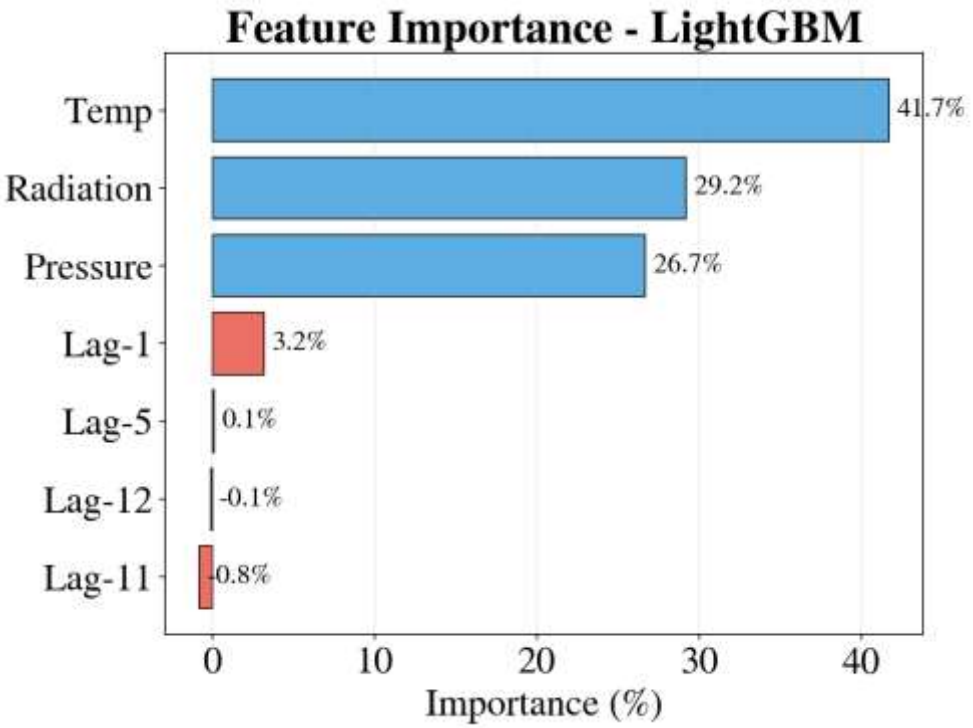


Fig. 7. Feature importance analysis for the LightGBM model.

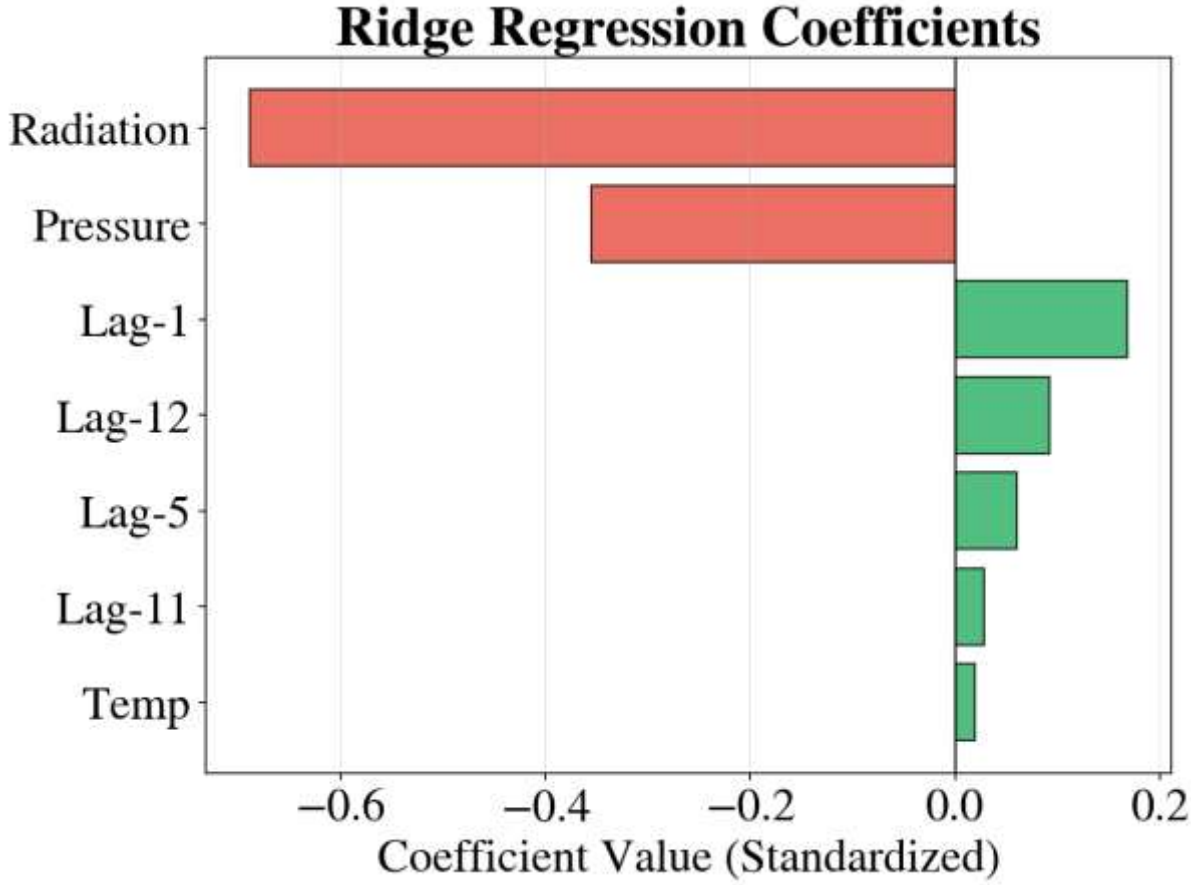


Fig. 8. Ridge Regression coefficient analysis

The superior performance of DNN can be attributed to its ability to capture nonlinear relationships between atmospheric drivers and precipitation through multiple hidden layers

with nonlinear activation functions. The comparable performance of LightGBM demonstrates that gradient boosting methods can achieve similar accuracy with potentially less hyperparameter tuning. The systematic underestimation of extreme events observed across all models represents an inherent limitation of data-driven approaches, suggesting that hybrid physically-informed machine learning frameworks may be warranted for extreme precipitation estimation applications.

4. CONCLUSION

This study developed a machine learning-based monthly precipitation prediction framework using exclusively MERRA-2 reanalysis data for a semi-arid region in the Ceyhan River Basin, Turkey. Among the three evaluated algorithms, DNN demonstrated superior predictive performance with R^2 of 0.677 and KGE of 0.711, marginally outperforming Ridge Regression and LightGBM. Feature importance analysis revealed that atmospheric variables temperature (41.7%), radiation (29.2%), and pressure (26.7%) dominated model predictions, with lagged precipitation contributing relatively minor importance in the gradient boosting framework. Coefficient analysis from the Ridge Regression model highlighted the strong negative influence of solar radiation on precipitation, consistent with the physical understanding that high radiation corresponds to clear-sky, non-precipitating conditions in Mediterranean climates. The observation-free workflow presented herein demonstrates the feasibility of developing robust precipitation prediction frameworks independent of in-situ monitoring networks, offering transferability to ungauged regions. However, all models exhibited systematic underestimation of extreme high-precipitation events, reflecting inherent limitations of data-driven approaches trained on moderately skewed distributions. Future research should focus on hybrid physically-informed approaches to improve extreme event prediction, integration of additional atmospheric predictors such as humidity and geopotential height, and extension to multiple regions across diverse hydroclimatic settings. In conclusion, reanalysis-driven, lag-informed machine learning frameworks offer a promising approach for operational monthly precipitation estimation in data-sparse regions, with potential applications in drought monitoring, agricultural planning, and water resources management.

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HONEYCOMB İÇ YAPIYA SAHİP FDM PARÇALARIN SONLU ELEMANLAR YÖNTEMİYLE STATİK YAPISAL ANALİZİ

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ÖZET

Bu çalışmada, Fused Deposition Modeling (FDM) yöntemiyle üretilen parçaların iç doluluk oranının yapısal performansa etkisi sonlu elemanlar analizi (FEA) kullanılarak incelenmiştir. Aynı dış geometriye bant tutucu modeli, SolidWorks ortamında %30 honeycomb (bal peteği) infill yapısında tasarlanmış ve ANSYS Workbench yazılımında statik yükleme altında değerlendirilmiştir. Malzeme olarak, boyutsal kararlılığı ve mekanik dayanımı nedeniyle Akrilonitril Bütadien Stiren (ABS) tercih edilmiştir. Analiz sonuçları, infill oranının artmasıyla parçanın rijitliğinin belirgin şekilde yükseldiğini ve gerilme yoğunluklarının azaldığını göstermektedir. %30 infill oranına sahip modelde maksimum toplam yer değiştirme 3.108 mm ve maksimum von-Mises gerilmesi 30.75 MPa olarak hesaplanmış; bu değer ABS'nin akma dayanımı sınırına oldukça yakın bulunmuştur. Elde edilen bulgular, FDM parçalarının mekanik davranışının infill yoğunluğuna yüksek derecede duyarlı olduğunu ve iç yapının doğru modellenerek FEM analizine aktarılmasının yapısal tasarımda önemli avantajlar sağladığını ortaya koymaktadır. Bu çalışma, katmanlı imalatta infill optimizasyonuna yönelik mühendislik tasarımlarına katkı sunmayı amaçlamaktadır.

Anahtar Kelimeler: Katmanlı İmalat, FDM, Bal Peteği Dolgu, Sonlu Elemanlar Yöntemi, ABS, Yapısal Analiz

STATIC STRUCTURAL ANALYSIS OF FDM PARTS WITH HONEYCOMB INTERNAL STRUCTURE USING FINITE ELEMENT METHOD

ABSTRACT

In this study, the effect of internal infill density on the structural performance of parts produced by the Fused Deposition Modelling (FDM) method was investigated using finite element analysis (FEA). The band holder model with the same external geometry was designed in SolidWorks with a 30% honeycomb infill structure and evaluated under static loading in ANSYS Workbench software. As a material, Acrylonitrile Butadiene Styrene (ABS) was chosen for its dimensional stability and mechanical strength. The analysis results show that the stiffness of the part significantly increased and stress intensities decreased with an increase in the infill ratio. In a model with a 30% infill rate, the maximum total displacement was calculated to be 3.108 mm and the maximum von-Mises stress was 30.75 MPa; this value was found to be

quite close to the yield strength limit of ABS. The findings reveal that the mechanical behaviour of FDM parts is highly sensitive to infill density, and accurately modelling the internal structure and incorporating it into FEM analysis provides significant advantages in structural design. This study aims to contribute to engineering designs for infill optimisation in additive manufacturing.

Keywords: Fused Deposition Modelling, Honeycomb Infill, Finite Element Method, ABS, Additive Manufacturing, Structural Analysis

1. INTRODUCTION

Today, engineering applications are turning towards methods that allow for the rapid, economical, and functional production of complex designs. In this direction, the development of additive manufacturing (AM) technologies has led to significant changes in the understanding of production, thanks to the design freedom, material efficiency, and cost advantages they offer compared to traditional manufacturing methods [1,2]. Among the commonly used additive manufacturing methods, Fused Deposition Modelling (FDM) is based on the principle of melting thermoplastic filaments and laying them down layer by layer. Although FDM parts are preferred in academic and industrial applications due to low equipment cost and wide material compatibility, they exhibit an anisotropic structure. Therefore, production parameters such as infill density, infill pattern, and layer orientation play a decisive role in mechanical performance [3].

Studies in the literature focus on evaluating the mechanical behaviour of FDM parts using experimental and numerical methods. Żur and his colleagues reported that there was only a 1.7% difference between the FEM results and the three-point bending tests performed on PLA samples with a 25% infill ratio, demonstrating the reliability of numerical analyses with appropriate modelling. Wu and his colleagues, on the other hand, found that the strength decreased as the infill ratio decreased, but patterns like honeycomb could limit this loss [4]. Zhang and Chou's work successfully predicted the effect of production orientation and thermal distribution on part deformations using FEM [4].

Performing FEM-supported analyses on CAD models makes it possible to precisely evaluate parts with complex internal structures. Thanks to this approach, different infill rates can be compared on the same external geometry, and the strength-to-weight ratio can be optimised. In the literature, it is reported that part weight can be reduced by up to 50% and mechanical performance improved by 30-60% using patterns such as honeycomb, grid, and triangular designs [4,5].

2. MATERIAL AND METHODS

2.1. Materials

In this study, Acrylonitrile Butadiene Styrene (ABS) thermoplastic was selected as the material due to its suitability for production using the Fused Deposition Modelling (FDM) method, its high impact resistance, thermal stability, and dimensional accuracy. ABS is widely used in additive manufacturing applications and, thanks to its ductile behaviour, allows for reliable results in finite element analyses. It was assumed that the material's elastic behaviour is isotropic and linear, and the analysis was based on the mechanical properties commonly used in the literature.

2.2. Geometric Modelling and Internal Structure Design

Within the scope of this study, a tape holder part with the same external geometry was modelled using SolidWorks CAD software. The outer geometry of the part was kept constant; the inner structure, however, was designed with two different infill ratios using a honeycomb pattern: Model with 30% infill ratio This approach aimed to isolate and compare the effect of the inner infill ratio on structural behaviour. The honeycomb pattern was chosen because it offers a high stiffness-to-weight ratio and is widely preferred in FDM manufacturing. The created three-dimensional models were exported in STEP format for use in the analyses.

2.3. Finite Element Model and Analysis Environment

Numerical analyses were performed using ANSYS Workbench software. Models prepared in a CAD environment were transferred to ANSYS, and the same analysis procedure was applied to both structures. When creating the finite element mesh, fine element sizes were chosen to accurately represent the complex honeycomb internal structure. The average element size was determined to be approximately 1.5 mm, and the mesh density was set to the "Fine" level. Three-dimensional solid elements were used in the analyses, and care was taken to ensure a homogeneous distribution of the mesh structure in order to minimise the impact of mesh quality on the results.

3. RESULTS AND DISCUSSION

100 N Force application point on the part. The aim of the analyses performed is to evaluate the effect of different filler ratios on structural behaviour using numerical methods and to determine how accurately this difference can be predicted in an FEM environment. In this context, 3D models created using SolidWorks software were transferred to the ANSYS Workbench environment in STEP format, where a vertical force of 100 N was applied to each model to analyse deformation and stress distributions. Under the same boundary conditions and the same

load, the structural response of two models that differ only in their internal structure clearly demonstrates the effect of the fill ratio on the FEM outputs.

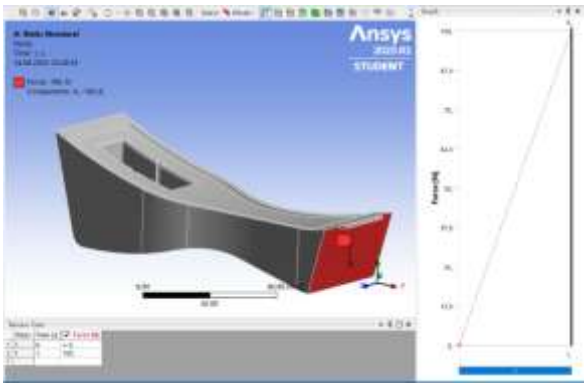


Figure 1. Location Where the 100 N Force is Applied to the Part

Figure 1 shows 100 N force is applied to the modelling part. The material used in the study is Acrylonitrile Butadiene Styrene (ABS), which is widely preferred in FDM production and is known for its high impact resistance, heat resistance, and dimensional stability. ABS is a suitable choice because it has sufficient mechanical performance for engineering applications and allows for comparative analysis in an FEM environment using numerical data obtained from experimental studies. Due to these properties, analyses on ABS, although not as widespread in the literature as PLA, are important both for practical applications and academic comparisons. Another important aspect of the study is that these analyses were performed on the actual internal structural geometries. While the internal structure is typically modelled as homogeneous or simplified in traditional FEM analyses, in this study, honeycomb patterns were physically modelled directly in the CAD environment and transferred to ANSYS. This has made it possible to analyse models with geometry perfectly aligned with the actual production, and parameters such as mesh quality and element size have been optimised based on this detailed internal structure. The aim of the analyses performed is to evaluate the effect of different filling ratios on structural behaviour using numerical methods and to determine how accurately this difference can be predicted in an FEM environment. In this context, 3D models created using SolidWorks software were transferred to the ANSYS Workbench environment in STEP format, where a vertical force of 100 N was applied to each model to analyse deformation and stress distributions. Under the same boundary conditions and the same load, the structural response of two models that differ only in their internal structure clearly demonstrates the effect of the fill ratio on the FEM

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4. CONCLUSIONS

The analysis results have shown that the infill ratio directly affects not only the weight of the part, but also its load-bearing capacity, deformation amount, and safe operating range. The maximum total displacement value obtained in the model with 30% infill rate was found to be 3.108 mm, and the maximum stress in the 30% infill model was found to be 30.75 MPa. The direct transfer of advanced patterns like honeycomb into the FEM environment is extremely valuable for design optimisation. This study has shown that this approach is effective and feasible.

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EKLEMELİ İMALAT İLE ÜRETİLEN POLY(LAKTİK ASİTİN) FARKLI SICAKLIKLARDA TAVLANMASININ MEKANİK ve ISIL ÖZELLİKLERİNE ETKİSİ

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ÖZET

Bu çalışmada, filament formundaki polilaktik asit (PLA) malzemenin eritilerek 3 boyutlu yazıcı ile mekanik ve termal analiz numunelerinin üretilmesi ve farklı tavlama sıcaklıklarının malzeme özelliklerine etkilerinin incelenmesi amaçlanmıştır. Üretilen PLA numuneleri, 45 °C ve 90 °C sıcaklıklarda 30 ve 60 dakika süreyle kutu fırında tavlanmıştır. Tavlama sıcaklığı ve süresinin numunelerin mekanik ve ısıl özellikleri üzerindeki etkileri değerlendirilmiştir. Mekanik performans için numunelere 5 mm/dk hızla tek yönlü eksenel yükleme uygulanarak çekme testleri gerçekleştirilmiş, ayrıca 15 J darbe enerjisine sahip çekiç ile Izod darbe testi yapılmıştır. Termal özelliklerdeki değişimleri incelemek amacıyla diferansiyel taramalı kalorimetre (DSC) analizi ile kristalite oranları belirlenmiştir. Elde edilen sonuçlara göre, 90 °C sıcaklıkta 30 dakika tavlanan numunelerde elastiklik modülü, yüzde uzama ve darbe dayanımında belirgin artış gözlenmiştir. En yüksek çekme dayanımı ise 90 °C'de 60 dakika tavlanan numunelerde elde edilmiştir. Ayrıca, 90 °C'de tavlanan numunelerin saf PLA'ya kıyasla daha yüksek kristalite oranına sahip olduğu görülmüştür. Bu bulgular, PLA malzemenin tavlama işlemi ile mekanik ve termal özelliklerinin iyileştirilebileceğini göstermektedir.

Anahtar Kelimeler: PLA, Eklemeli İmalat, Mekanik Özellikler, Tavlama

THE EFFECT OF ANNEALING POLY(LACTIC ACID) PRODUCED BY ADDITIVE MANUFACTURING AT DIFFERENT TEMPERATURES ON ITS MECHANICAL PROPERTIES

ABSTRACT

This study aims to melt filament-form polylactic acid (PLA) material to produce mechanical and thermal analysis samples using a 3D printer and to investigate the effects of different annealing temperatures on material properties. The produced PLA samples were annealed in a box furnace at temperatures of 45 °C and 90 °C for durations of 30 and 60 minutes. The effects of annealing temperature and time on the mechanical and thermal properties of the samples have been evaluated. Tensile tests were performed on the specimens by applying unidirectional axial loading at a speed of 5 mm/min for mechanical performance, and Izod impact tests were conducted using a hammer with an impact energy of 15 J. Crystallinity ratios were determined

using differential scanning calorimetry (DSC) analysis to examine changes in thermal properties. According to the results obtained, a significant increase was observed in the elastic modulus, percentage elongation, and impact strength of the samples annealed at 90°C for 30 minutes. The highest tensile strength was obtained in samples annealed at 90°C for 60 minutes. Additionally, it was observed that samples annealed at 90°C had a higher crystallinity ratio compared to pure PLA. These findings indicate that the mechanical and thermal properties of PLA material can be improved through the annealing process.

Keywords: PLA, 3D printing, mechanical properties, Thermal Annealing

INTRODUCTION

PLA has a range of common uses, including medical and food applications. It is also widely used as a 3D printing raw material for desktop fused filament fabrication 3D printers. PLA is popular for 3D printing because it can be easily sanded, painted, or post-processed. This plastic, which is a user-friendly material, operates at low extrusion temperatures and does not require a heated bed, printer chamber, or reinforced nozzle. Another benefit is that PLA behaves better than many hard plastics and also doesn't emit smoke or bad odours. It is easy to store and can be produced in various colours, and it can be used as a base for various composites with additional features [1, 2].

Additive manufacturing (AM) is an innovative computer-aided technology that has gained increasing attention in both the academic and industrial worlds in recent years due to its numerous advantages compared to other technologies. Due to its low cost, high reliability, and simple operation, FDM and 3D printers have gained increasing popularity in both industry and among home users, and have begun to be used in many fields, from manufacturing to biomedicine and education. Although PLA filaments have been successfully applied to the FDM process, there are still very few reports on the detailed extrusion process of PLA filaments [3]. Given the expanding application of FDM technology and the consideration of both environmental protection and material usage during production, researching and examining the process parameters to be used and their effects has become increasingly important. In this experimental study, the aim was to determine the effects of surface roughness, infill pattern, and infill layer parameters on PLA filaments in 3D printers [4].

2. MATERIAL AND METHOD

2.1 Mechanical Tests

In this study on determining 3D printer parameters when using PLA filament, two parameters deemed suitable were selected as a result of a literature review. These are the infill pattern and

layer thickness. For the infill pattern, Line was selected, and for the pattern and layer thickness, 0.2mm-0.25mm-0.3mm were chosen. During the parameter determination phase, a reliable brand in the market was researched and BASF was chosen. BASF Ultrafuse Grey PLA Filament 1.75mm was used as the PLA filament material, and the values given in the technical data sheet and other parameters were determined. These parameters are Nozzle Temperature, Nozzle diameter, printing speed, and bed temperature. In addition to these parameters, the fill density was set to 60% to avoid long pressing times. The selected parameters are listed in Table 1. Figures 1a shows images of the devices used in the 3D printing method.

Table 1. Printing Speed

Printing Speed	60 mm/s
Nozzle diameter	0.4 mm
Nozzle Temperature	220 °C
Bearing Temperature	60 °C
Fill Density	60%

Tensile tests were performed under ASTM D638–08 to ascertain the tensile strength (TS) and Young's Modulus (YM) of the specimens. Type IV dog-bone-shaped specimens with a diameter of 3.8 mm and a gauge length of 25 mm were utilized. The experiments were performed under typical laboratory settings at 23°C and 50% relative humidity, with a crosshead speed of 15 mm/min.

Impact resistance was assessed following EN ISO 179, utilizing notched specimens of Type A configuration. Experiments were conducted at ambient temperature with a pendulum velocity of 3.8 m s^{-1}. The energy absorbed during fracture was measured, and the impact strength was determined using Equation (1), as specified in the standard.

$$a_{cN} = (w10^3)/(hb_N) \quad (1)$$

2.2. Thermal Tests

Differential Scanning Calorimetry (DSC) is a thermo-analytical technique applied for the thermal assessment of materials. DSC quantifies the energy received or released as a sample undergoes heating, cooling, or is maintained at a constant temperature. This technique illustrates the variation in heat transfer to or from the reference and the sample as a function of temperature or time. Thermal evaluations of specimens were conducted using the Setaram Instruments DSC 131 Differential Scanning Calorimeter. The starting temperature was 25°C. Initially, the specimens were heated to 250°C; thereafter, they were cooled back to 25°C. The apparatus was heated at a rate of 10°C per minute.

2.3 Termal Annealing

To improve the mechanical and thermal properties of PLA samples produced by additive manufacturing, a post-production thermal annealing process was applied. The annealing process was carried out with the aim of reducing internal stresses in the samples, improving interlayer bonding, and promoting the development of crystalline structure. The produced samples were annealed in a pre-calibrated box furnace at different temperature and time combinations. The annealing temperatures were set at 45 °C and 90 °C, and the annealing times were set at 30 and 60 minutes. The selected temperature ranges were chosen to allow for the rearrangement of polymer chains without thermal degradation, taking into account the glass transition temperature (Tg) of PLA.

3. RESULTS AND CONCLUSIONS

3.1. Thermal Analysis Results

Differential scanning calorimetry (DSC) analyses revealed the effects of different annealing temperatures and durations on the thermal behaviour and crystalline structure of PLA samples. Compared to neat PLA samples, significant changes were observed in the glass transition temperature (Tg), cold crystallisation behaviour, and melting enthalpies of the annealed samples. The DSC results are shown in Figure 1. It was determined that especially in samples annealed at 90 °C, the cold crystallisation peak shifted to lower temperatures and the enthalpy of fusion increased. This situation indicates that during the annealing process, the polymer chains rearrange to form more ordered and stable crystalline regions. Increasing the annealing time to 60 minutes resulted in an additional increase in crystallinity, but this increase was found to be more limited compared to the temperature. In samples annealed at 45°C, the increase in crystallinity was limited, and it was assessed that this temperature was too low for the PLA chains to gain sufficient segmental mobility. The obtained DSC results indicate that annealing temperature is a more dominant parameter than time in improving the thermal structure of PLA.

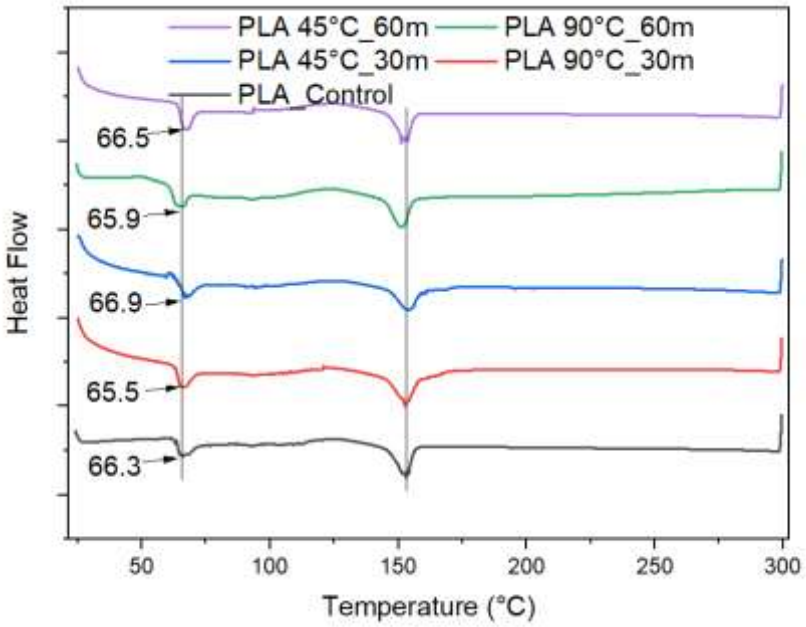


Figure 1. DSC results

3.2.1. Tensile Properties

The results of tensile tests showed that the annealing process had a significant impact on the mechanical performance of the PLA samples. In samples annealed at 90°C for 30 minutes, significant increases were observed in the values of elastic modulus and percentage elongation. This situation can be attributed to a decrease in internal stresses in the amorphous regions, along with an increase in the crystalline phase ratio. The highest tensile strength was obtained in samples annealed at 90°C for 60 minutes. Extending the annealing time improved the load transfer mechanism by strengthening interchain interactions. However, a limited decrease in elongation values was observed in some samples, indicating that excessive crystallisation can partially reduce ductility. In samples annealed at 45°C, the improvement in mechanical properties was limited, and it was estimated that chain mobility did not increase sufficiently at this temperature.

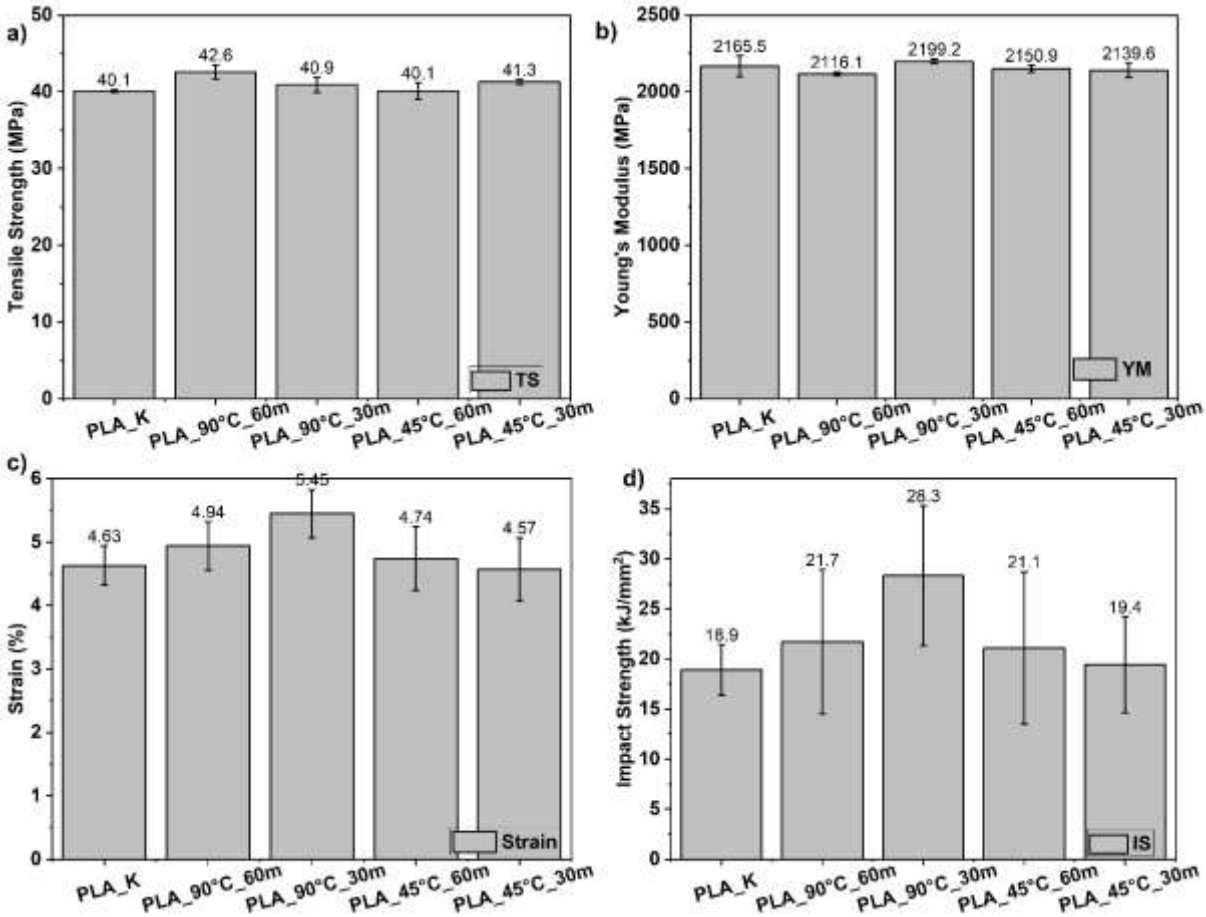


Figure 2. Mechanical Test Results; a) Tensile Strength, b) Young's Modulus, c) Strain Values, and d) Impact Strength

3.2.2. Impact Resistance

The results of Izod impact tests showed that the annealing process had a positive effect on impact resistance. A significant increase in impact resistance was achieved, especially in samples annealed at 90°C for 30 minutes (Figure 2). This increase can be attributed to the strengthening of interlayer bonding and the partial reduction of internal voids. While the impact resistance of samples annealed for 60 minutes was maintained at a high level, the increase rate was observed to be limited compared to annealing for 30 minutes. This situation highlights the importance of the concept of optimal annealing time and temperature for mechanical properties. When the obtained thermal and mechanical results are evaluated together, it is clear that the annealing process directly affects both the crystalline structure and the mechanical performance of PLA. As the annealing temperature increases, the ability of the polymer chains to rearrange increases, resulting in higher crystallinity ratios. Increased crystallinity leads to improvements in tensile strength and elastic modulus, while also positively impacting impact resistance when combined with appropriate time and temperature. However, excessive increase in annealing time can lead to saturation or limited regression in some mechanical properties. Therefore,

determining the optimal annealing conditions for PLA is becoming a critical design parameter depending on the application area.

4. CONCLUSION

In this study, the mechanical and thermal behavior of FDM-fabricated PLA samples was systematically evaluated under different annealing temperatures and durations. The results demonstrate that thermal annealing enhances the thermal stability of PLA by increasing its crystallinity. An annealing temperature of 90 °C was identified as a critical threshold for effective molecular rearrangement, leading to the most pronounced improvements in both mechanical and thermal properties. The highest tensile strength was achieved at 90 °C for 60 minutes, whereas the optimal balance between stiffness, ductility, and impact resistance was obtained at 90 °C for 30 minutes. Annealing at lower temperatures (45 °C) showed limited effectiveness, indicating insufficient chain mobility. Although annealing duration influenced mechanical performance, temperature was found to be the dominant parameter. Overall, controlled thermal annealing is a practical and efficient post-processing method for enhancing the performance of additively manufactured PLA, contributing to its reliable use in engineering applications.

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AÇIK OCAK MADENLERİNDE PALETLİ VE KAMYON ÜSTÜ SONDAJ MAKİNELERİNİN AVANTAJ VE DEZAVANTAJ YÖNÜNDEN İNCELENMESİ

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ÖZET

Açık ocak madenciliğinde sondaj faaliyetleri, üretim verimliliği ve patlatma süreçlerinin optimizasyonu açısından kritik öneme sahiptir. Bu çalışma, sektörde yaygın olarak kullanılan paletli (crawler) ve kamyon üstü (truck-mounted) sondaj makinelerini teknik, operasyonel ve ekonomik kriterler bakımından karşılaştırarak, farklı arazi koşullarında uygun ekipman seçimine yönelik bütüncül bir değerlendirme sunmayı amaçlamaktadır. Sondaj ekipmanının arazi özelliklerine uygun seçimi; karot verimliliği, iş güvenliği, yakıt tüketimi ve toplam işletme maliyetleri üzerinde doğrudan etkili olduğundan, doğru makine tipinin belirlenmesi saha performansı için belirleyicidir.

Kamyon üstü sondaj makineleri, mevcut yol altyapısının bulunduğu ve zeminin düz veya orta sertlikte olduğu alanlarda yüksek mobilite, hızlı saha değiştirme, düşük bakım maliyetleri ve kısa hazırlık süreleri gibi önemli avantajlar sağlamaktadır. Ancak eğimli, gevşek ya da bloklu zeminlerde stabilite kaybı, kayma riski ve sınırlı çekiş gücü nedeniyle performans azalması görülebilmektedir. Paletli sondaj makineleri ise zorlu arazi koşullarında yüksek çekiş gücü, geniş temas yüzeyi, gelişmiş stabilite ve eğimli yüzeylerde güvenli çalışma gibi üstünlükleriyle öne çıkmaktadır. Bununla birlikte, karayolu taşımacılığı için ek ekipman gerektirmeleri, yavaş nakliye süreçleri ve nispeten yüksek yakıt ile bakım maliyetleri dezavantaj oluşturmaktadır. Bu karşılaştırmalı çalışma, açık ocak madenciliğinde optimum sondaj ekipmanı seçimine katkı sağlayarak, saha verimliliğini ve operasyon güvenliğini artırmayı hedeflemektedir.

Anahtar Kelimeler: Sondaj Makineleri, Paletli Sondaj, Kamyon Üstü Sondaj, Açık Ocak Madenciliği, Saha Mobilitesi.

EXAMINATION OF THE ADVANTAGES AND DISADVANTAGES OF CRAWLER AND TRUCK-MOUNTED DRILLING RIGS IN OPEN-PIT MINES

ABSTRACT

Drilling operations in open-pit mining play a critical role in ensuring production efficiency and optimizing blasting performance. This study provides a comparative evaluation of two widely used drilling systems crawler-mounted and truck-mounted drilling rigs by examining their technical, operational and economic characteristics under different field conditions. Since the

selection of drilling equipment directly influences core recovery, operational safety, fuel consumption and overall operating costs, identifying the appropriate machine type is essential for achieving high performance in mining operations.

Truck-mounted drilling rigs offer significant advantages such as high mobility, rapid site relocation, reduced maintenance requirements, and short setup times, particularly in open-pit areas with established road infrastructure and relatively firm or level ground. However, in sloped, loose or blocky terrains, these machines may experience performance limitations due to decreased stability, traction loss and increased slip risk. Crawler-mounted drilling rigs, on the other hand, stand out in challenging terrain conditions by providing superior traction, larger ground contact surface, enhanced stability, and safer operation on inclined surfaces. Despite these advantages, crawler systems require additional equipment for road transportation, involve slower mobilization processes and generally entail higher fuel consumption and maintenance costs. The findings of this comparative assessment aim to guide decision-makers in selecting the most suitable drilling system for open-pit mining operations, thereby improving field efficiency, equipment reliability and overall operational safety.

Keywords: Drilling Rigs, Crawler Drilling, Truck-Mounted Drilling, Open-Pit Mining, Equipment Mobility.

1. GİRİŞ

Madencilik faaliyetlerinin temelini oluşturan sondaj, yer kabuğunu oluşturan kayaç formasyonları üzerinde mekanik yöntemlerle silindirik boşluklar açma işlemidir (Güyagüler, 2015). Bu işlem, matkap ucu aracılığıyla uygulanan darbe, dönme veya her iki kuvvetin birleşimi ile kayaç yapısının parçalanması prensibine dayanmaktadır (atlas copcağlu, 2004). Açık ocak madenciliğinde sondaj, cevher üretimi ve dekapaj faaliyetleri için gerekli olan patlatma deliklerinin hazırlanması sürecinin ilk ve en kritik aşamasını temsil eder (Jimeno vd., 1995). Teknik açıdan sondaj, birim derinlik başına en az enerji sarfiyatı ile hedeflenen çap ve doğrultuda delik açma mühendisliğidir (Hustrulid ve Kuchta, 2006).

Açık ocak işletmelerinde sondaj faaliyetleri, operasyonel ihtiyaçlara göre farklı amaçlar doğrultusunda gerçekleştirilmektedir (Kahraman, 2002). Bu amaçların başında, sert kayaçların patlayıcı maddelerle gevşetilmesi için gerekli olan üretim deliklerinin açılması gelmektedir (Güyagüler, 2015). Üretim odaklı sondajların yanı sıra, maden yatağının sınırlarını belirlemek ve tenör dağılımını analiz etmek amacıyla arama sondajları icra edilir (Hustrulid ve Kuchta, 2006). İşletme güvenliği açısından ise, basamakların duraylılığını sağlamak ve şev stabilitesini korumak için ankraj ve drenaj deliklerinin açılması hayati önem taşır (Arıoğlu, 2004). Ayrıca,

yer altı su seviyesinin işletme kotunun altına indirilmesi amacıyla yapılan susuzlaştırma sondajları, maden sahasının kuru ve güvenli kalmasını sağlar (Jimeno vd., 1995). Son olarak, jeoteknik verilerin toplanması ve kaya kütle karakteristiklerinin belirlenmesi amacıyla yapılan karotlu sondajlar, ocağın uzun vadeli planlamasına veri sağlar (Kahraman, 2002).

Sondaj faaliyetlerinin tarihsel gelişimi incelendiğinde, farklı uygarlıkların çeşitli amaçlarla derin ve sığ kuyular açtıkları görülmektedir. Çinliler, Tibet ile Chungkina arasındaki bölgede 1200'lü yıllarda açtıkları kuyularda 500–1000 m derinliğe ulaşan sondajlar gerçekleştirmiştir. Mısırlılar ise M.Ö. 3000 yıllarında taş çıkarımı amacıyla sığ kuyular açmışlardır. Avrupa'nın bilinen en eski sondaj kuyusu, M.S. 1126 yılında Fransa'nın Artois bölgesinde basınçlı akiferlerde açılmıştır. İlk petrol sondajı 1794 yılında Fransa'da gerçekleştirilmiş ve yaklaşık 30 m derinliğe inilmiştir. 1859 yılında Colonel Drake tarafından Pensilvanya'da açılan ve darbeli sondaj yöntemiyle gerçekleştirilen petrol kuyusu, petrol ve sondaj endüstrisi açısından önemli bir dönüm noktası olmuştur. İlk karotlu sondaj 1864 yılında İtalya–Fransa arasında açılan Mt. Lewis Tüneli'nde gerçekleştirilirken, ilk rotari sondaj 1867 yılında Pensilvanya'da açılan bir kömür madeninde yaklaşık 200 m derinliğe ulaşmıştır (Bourgoyne, 1986).

Sondaj çalışmaları, delme işleminin gerçekleştirildiği ortamın jeolojik özelliklerine, hedef derinliğe ve kullanım amacına bağlı olarak farklı yöntemlerle uygulanmaktadır.

Literatürde sondaj yöntemleri genel olarak darbeli (kablolu) sondaj, döner sondaj, darbeli–döner sondaj, yönlü ve yatay sondaj ile özel amaçlı sondaj yöntemleri şeklinde sınıflandırılmaktadır. (Mitchell ve Miska, 2011).

Darbeli (kablolu) sondaj yöntemi, ağır bir kesici takımın serbest düşme hareketiyle formasyonu kırması esasına dayanır. (Mitchell ve Miska, 2011) Bu yöntem özellikle sert ve bloklu formasyonlarda uygulanmakta olup, günümüzde sınırlı alanlarda kullanılmaktadır.

Döner sondaj yöntemi, matkabın sürekli dönme hareketi ile formasyonun parçalanması prensibine dayanmaktadır. (National Research Council, 1994) Sondaj çamuru kullanılarak kesintilerin yüzeye taşınması ve kuyu stabilitesinin sağlanması mümkün olmaktadır. Bu yöntem, petrol, doğalgaz ve derin su sondajlarında en yaygın kullanılan tekniktir.

Darbeli–döner sondaj yöntemi, dönme ve darbe hareketlerinin birlikte uygulanması esasına dayanmakta olup, özellikle sert ve aşındırıcı kayaçlarda yüksek verim sağlamaktadır (Hartman ve Mutmansky, 2002). Jeoteknik ve maden sondajlarında yaygın olarak tercih edilmektedir.

Yönlü ve yatay sondaj yöntemleri, kuyunun belirli bir derinlikten sonra kontrollü olarak yönlendirilmesine olanak tanımaktadır (Hustrulid ve Kuchta, 2006). Bu yöntemler sayesinde

tek bir lokasyondan birden fazla hedefe ulaşılabilmekte, yüzey alanı kullanımı azaltılmakta ve ekonomik verimlilik artırılmaktadır.

Özel amaçlı sondaj yöntemleri ise jeoteknik etütler, çevresel incelemeler ve jeotermal uygulamalar için geliştirilmiş sistemleri kapsamaktadır. Bu yöntemlerde, alınan karot örnekleri ile yeraltı formasyonlarının fiziksel ve mekanik özellikleri detaylı olarak analiz edilebilmektedir.

Açık ocak madenciliğinde sondaj faaliyetlerinin etkinliği, yalnızca kullanılan sondaj yöntemine değil, aynı zamanda tercih edilen sondaj makinesinin hareket sistemi, arazi koşullarına uyumu ve operasyonel kabiliyetlerine de doğrudan bağlıdır. Bu bağlamda, farklı saha koşullarında kullanılan paletli ve kamyon üstü sondaj makinelerinin teknik ve operasyonel performanslarının karşılaştırmalı olarak değerlendirilmesi, optimum ekipman seçimi açısından önem arz etmektedir. Bu çalışmada, açık ocak madenlerinde yaygın olarak kullanılan söz konusu iki sondaj makinesi türü ele alınarak, avantaj ve dezavantajları araştırılmış ve elde edilen bulgular bir sonraki bölümde sunulmuştur.

2. ARAŞTIRMA VE BULGULAR

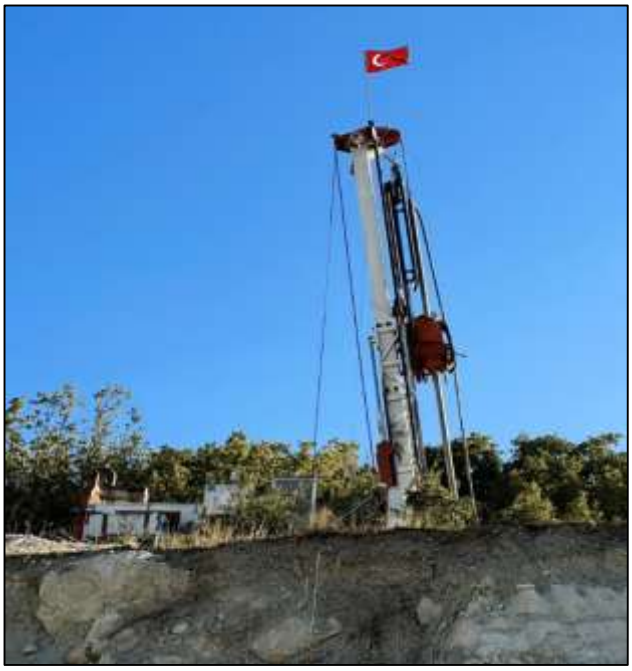
Bu çalışma kapsamında, Tablo 1'de yer alan sondaj makinesi türleri esas alınarak, hareket sistemine göre sınıflandırılan paletli ve kamyon üstü sondaj makineleri karşılaştırılmış; söz konusu makinelerin avantaj ve dezavantajları ortaya konulmuştur (Atlas Copco, 2019).

Tablo 1. Sondaj Makinesi Çeşitleri

SONDAJ MAKİNELERİ ÇEŞİTLERİ			
Hareket Sistemine Göre Sondaj Makineleri	**Uygulanan Sondaj Yöntemine Göre Makineler**	**Kullanım Amacına Göre Sondaj Makineleri**	**Güç Kaynağına Göre Sondaj Makineleri**
Paletli sondaj makineleri	Darbeli sondaj makineleri	Su sondaj makineleri	Dizel motorlu sondaj makineleri
Kamyon üstü sondaj makineleri	Döner sondaj makineleri	Maden ve patlatma sondaj makineleri	Elektrik motorlu sondaj makineleri
	DHT(down-the-hole) sondaj makineleri	Jeoteknik ve zemin etütü sondaj makineleri	Hidrolik tahrikli sondaj makineleri

2.1. Paletli Sondaj Makinesi

Hareket kabiliyeti palet sistemi ile sağlanan ve özellikle açık ocak madenleri**,** yeraltı madenleri taş ocakları, jeoteknik etütler ve patlatma delikleri için kullanılan bir sondaj makinesi türüdür. Paletli yapı sayesinde engebeli, eğimli ve yumuşak zeminlerde yüksek stabilite ve manevra kabiliyeti sağlar. Bu makineler genellikle döner veya darbeli–döner (DTH) sondaj yöntemleriyle çalışmaktadır(Atlas Copco, 2019).



Şekil 1. Paletli sondaj makinesi

Konumlandırma ve stabilizasyon, palet sistemi sayesinde makine delik açılacak noktaya kolaylıkla ilerler. Paletler, makinenin ağırlığını geniş bir alana yayarak zemine batmayı önler ve çalışma sırasında titreşimi azaltır.

Delme Mekanizmasının Devreye Girmesi: Sondaj kulesi hidrolik sistemler yardımıyla dik veya istenen açıda konumlandırılır. Delici uç, döner başlık ve/veya darbe mekanizması ile formasyona nüfuz eder.

Enerji ve Güç Aktarımı: Makine genellikle dizel motorla çalışır. Motor gücü hidrolik pompalar aracılığıyla, dönme hareketine, ilerleme (itme) kuvvetine, darbe mekanizmasına aktarılır. (Atlas Copco, 2019).

Kesinti Uzaklaştırma Sistemi: Delme sırasında oluşan kırıntılar, hava sirkülasyonu veya sondaj çamuru yardımıyla kuyu dışına taşınır. Açık ocak uygulamalarında genellikle basınçlı hava tercih edilir. (Kündem,2019)

Delme Sürecinin Tamamlanması: İstenen derinliğe ulaşıldığında delme işlemi durdurulur ve makine bir sonraki delik noktasına geçer.

Paletli sondaj makineleri; yüksek arazi kabiliyeti, engebeli ve eğimli sahalarda güvenli çalışma imkânı, yüksek stabilite ve düşük devrilme riski ile açık ocak madenciliğine uygun bir yapı sunmakta; patlatma deliklerinde yüksek verim sağlamakta ve DTH ile rotary sistemlerle uyumlu çalışabilmektedir. Bununla birlikte, yüksek ağırlıkları nedeniyle taşıma maliyetlerinin görece yüksek olması önemli bir dezavantaj oluşturmaktadır(Sandvik, 2020).

2.2. Kamyon Üstü Sondaj Makinesi

Kamyon üstü sondaj makineleri, sondaj ekipmanlarının bir kamyon şasisi üzerine entegre edilmesiyle oluşturulan, yüksek mobiliteye sahip sondaj sistemleridir(Özacar, 2016). Bu makineler özellikle açık ocak madenleri**,** yol projeleri**,** şantiye çalışmaları**,** su ve jeoteknik sondajlar ile petrol ve doğalgaz arama faaliyetlerinde tercih edilmektedir. Kamyon şasisinin sağladığı hareket kabiliyeti sayesinde, sondaj noktaları arasında hızlı geçiş imkânı sunmaktadır(Atlas Copco, 2019).



Şekil 2. Kamyon üstü sondaj makinesi

Kamyon üstü sondaj makinelerinde sondaj ünitesi, kamyon kasasına sabitlenmiş bir kule (mast), döndürme ünitesi (rotary head veya darbeli sistem), hidrolik sistem, güç ünitesi ve yardımcı ekipmanlardan oluşmaktadır. Makine çalışma pozisyonuna alındığında, hidrolik denge ayakları (outrigger) açılarak sistem stabilize edilir. (Özacar,2016)

Ardından sondaj kulesi dik konuma getirilir ve seçilen sondaj yöntemine göre delme işlemi başlatılır. Delme sırasında, formasyondan çıkan kesintiler hava, su veya sondaj çamuru yardımıyla yüzeye taşınmaktadır.

Kamyon üstü sondaj makineleri; orta ve yüksek derinliklerde sondaj yapabilme kapasitesine sahip olup, döner (rotary), darbeli (DTH) veya kombine sistemlerle çalışabilmektedir. Genellikle dizel motor destekli hidrolik sistemlerle donatılan bu makineler, yüksek taşıma ve hızlı kurulum avantajı sunmaktadır (Özacar, 2016).

2.3. Paletli Sondaj Makinesinin ve Kamyon Üstü Sondaj Makinesinin Avantaj ve Dezavantaj Yönünden Karşılaştırılması

Açık ocak maden işletmelerinde sondaj makinelerinin seçimi, projenin birim maliyetlerini ve üretim kapasitesini doğrudan etkileyen en kritik kararlardan biridir. Özellikle delme-patlatma operasyonlarında kullanılacak sondaj makinelerinin seçimi; sahanın topografik koşulları, kayaç sertliği, basamak yüksekliği ve operasyonel mobilite ihtiyacı gibi değişkenlere bağlı olarak şekillenmektedir.

Paletli sondaj makineleri zorlu arazi şartlarında üstün tırmanma ve stabilite kabiliyeti ile öne çıkarken, kamyon üstü sondaj makineleri ise yüksek yer değiştirme hızı ve lojistik kolaylıkları

ile tercih edilmektedir. Bu bağlamda, her iki sistemin teknik ve operasyonel kabiliyetlerini analiz etmek, sahanın ihtiyaçlarına en uygun ekipman konfigürasyonunu belirlemek adına büyük önem taşımaktadır.

Aşağıdaki tabloda, paletli ve kamyon üstü sondaj makinelerinin operasyonel verimlilik, mobilite, stabilite ve bakım maliyetleri gibi temel parametreler üzerinden avantaj ve dezavantaj yönünden karşılaştırması sunulmuştur.

Tablo 2. Paletli - Kamyon üstü sondaj makinesi karşılaştırılması

Kriter	Paletli Sondaj Makineleri	Kamyon Üstü Sondaj Makineleri
Hareket Kabiliyeti	Engebeli, yumuşak ve eğimli arazilerde yüksek hareket kabiliyeti sağlar	Düz ve sert zeminlerde yüksek hareket kabiliyeti; engebeli arazide sınırlıdır
Araziye Uyum	Zayıf zemin koşullarında daha stabildir	Zemin taşıma kapasitesine bağımlıdır
Taşıma ve Nakliye	Nakliyesi zor ve maliyetlidir (lowbed gerekir)	Karayolunda kendi başına hareket edebilir
Kurulum Süresi	Çalışma alanında hızlı konumlanır	Sondaj öncesi dengeleme süresi gerekebilir
Çalışma Stabilitesi	Yüksek stabilite sağlar	Hidrolik ayaklara bağlı olarak değişken
Delme Performansı	Sert ve orta sert kayaçlarda yüksek performans	Orta sert formasyonlarda verimlidir
İşletme Maliyeti	Yakıt ve bakım maliyeti yüksektir	İşletme ve bakım maliyeti daha düşüktür
Kullanım Alanı	Büyük ölçekli açık ocaklar, sürekli üretim sahaları	Küçük–orta ölçekli ocaklar ve kısa süreli işler
Esneklik	Saha içinde sınırlı hız	Saha değişimlerinde yüksek esneklik
İlk Yatırım Maliyeti	Yüksek ilk yatırım maliyeti	Paletliye göre daha düşüktür

3. SONUÇ

Bu çalışma kapsamında, açık ocak madenciliğinde yaygın olarak kullanılan paletli ve kamyon üstü sondaj makineleri, teknik, operasyonel ve ekonomik kriterler doğrultusunda karşılaştırmalı olarak incelenmiştir. Yapılan değerlendirmeler sonucunda, sondaj makinesi seçiminde tek bir cevabın bulunmadığı, seçim sürecinin saha koşulları, üretim ölçeği ve işletme hedeflerine bağlı olarak şekillenmesi gerektiği ortaya konulmuştur.

Paletli sondaj makinelerinin; engebeli, eğimli ve zayıf zemin koşullarında yüksek stabilite, güçlü çekiş kabiliyeti ve güvenli çalışma avantajları sunduğu belirlenmiştir.

Ayrıca paletli sondaj makinelerinin en büyük özelliklerinden biri olan eğimli sondaj atabilmesi bu makineyi açık ocak alanlarında daha fazla alan taramasına sebep olacağı için özellik olarak öne çıkarmaktadır. Bu özellikleri sayesinde özellikle büyük ölçekli açık ocaklar, sürekli üretim yapılan sahalar ve zor arazi koşulları için daha uygun bir seçenek oluşturmaktadır. Ancak bu makinelerin yüksek ilk yatırım maliyeti, karayolu taşımacılığında ek ekipman gereksinimi ve nispeten yüksek yakıt ile bakım giderleri önemli dezavantajlar olarak öne çıkmaktadır.

Kamyon üstü sondaj makineleri ise; mevcut yol altyapısının bulunduğu, zeminin düz veya orta sertlikte olduğu alanlarda yüksek mobilite, hızlı saha değiştirme, düşük bakım maliyetleri ve

kısa hazırlık süreleri gibi avantajlar sağlamaktadır. Bu nedenle kısa süreli işler, küçük ve orta ölçekli açık ocaklar ile sık lokasyon değişimi gerektiren projelerde daha ekonomik ve pratik bir çözüm sunmaktadır. Bununla birlikte, eğimli ve gevşek zeminlerde stabilite ve çekiş sınırlamaları nedeniyle performans kaybı yaşanabilmektedir.

Sonuç olarak, açık ocak madenciliğinde sondaj ekipmanı seçimi yapılırken; arazi koşulları, özellikle sondaj atılacak lokasyonun bulunduğu bölge, üretim sürekliliği, ekonomik faktörler ve iş güvenliği kriterleri birlikte değerlendirilmelidir. Bu bildiride sunulan karşılaştırmalı analiz, sahaya özgü koşullar altında en uygun sondaj makinesinin belirlenmesine katkı sağlayarak, operasyonel verimliliğin ve çalışma güvenliğinin artırılmasına yönelik bir rehber niteliği taşımaktadır.

Gelecek çalışmalarda, paletli ve kamyon üstü sondaj makinelerinin farklı kayaç türlerinde delme hızı**,** enerji tüketimi ve karot verimliliği gibi nicel performans parametreleri saha verileriyle karşılaştırılabilir. Bunlarla ilgili veri analizi yaparak bu çalışmayı daha ileriye götürmek mümkündür.

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PLC-CONTROLLED DUAL ROLL FLUTİNG MACHİNE: PERFORMANCE COMPARİSON WİTH CONVENTİONAL SYSTEMS

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ÖZET

Bu çalışma, değirmen sektöründe kullanılan vals silindirlerinin yeniden dişleme (re-fluting) süreçlerinde verimliliği artırmak amacıyla Yenar Döküm tarafından geliştirilen **PLC kontrollü, kremayer tahrikli ve çift vals kapasiteli yeni nesil dişleme makinesinin** performansını incelemektedir. Yeni makine, geleneksel **vidalı mil–somun tahrikli tek tablalı** dişleme makinelerine alternatif bir mimari sunmakta ve aynı tabla üzerinde iki silindirin eşzamanlı işlenmesine olanak sağlamaktadır.

Çalışmada, her iki makine ile aynı kesme parametreleri altında (%8 hatve, 0.65 mm diş derinliği, 30°/60° kesme açıları, 8000 mm/dk kesme hızı ve 8×8 mm karbür lama kullanılarak) diş açma testleri gerçekleştirilmiş ve karşılaştırmalı bir analiz yürütülmüştür. Ölçümler kapsamında **geri dönüş hızı**, **toplam çevrim süresi**, **kesme geometrisinin korunması**, **yüzey doğruluğu** ve **operasyon stabilitesi** değerlendirilmiştir. Ayrıca, yeni makinede elde edilen diş formunun geometrik doğruluğu **lazer profil ölçüm cihazı (Rollcare)** ile analiz edilerek teorik profil ile gerçek profil arasındaki sapmalar bilimsel olarak doğrulanmıştır.

Elde edilen bulgulara göre, yeni nesil kremayer–pinyon tahrik sistemi eski vidalı mil sistemine kıyasla **geri dönüş hızını yaklaşık %65 oranında artırmış** (20 m/dk → 33 m/dk) ve toplam çevrim süresini önemli ölçüde azaltmıştır. Daha da önemlisi, **çift silindir yükü altında dahi** kesme geometrisini belirleyen tüm parametreler—diş derinliği toleransı, hatve doğruluğu ve kesme açısı kararlılığı—eski makineyle tamamen aynı hassasiyet düzeyinde elde edilmiştir. Lazer profil raporunda hatve ve çap değerlerinin tam uyum göstermesi, açısal sapmaların tolerans içinde kalması ve aşınma oranının %8,49 olarak ölçülmesi, yeni makinenin kesme kalitesini koruduğunu doğrulamaktadır.

Sonuç olarak, geliştirilen çift valsli yeni nesil dişleme makinesi, **üretkenliği artıran**, **çevrim süresini kısaltan**, ancak **geometrik kaliteyi değiştirmeyen** yenilikçi bir mühendislik çözümü sunmaktadır. Bu yönüyle değirmen sektöründe bakım sürelerini azaltmakta, proses verimliliğini yükseltmekte ve işletmelere toplam maliyet avantajı sağlamaktadır.

Anahtar Kelimeler: Vals silindiri, dişleme, refluting, kremayer tahrik, PLC kontrol, lazer profil ölçümü, çevrim süresi.

ABSTRACT

This study examines the performance of a newly developed PLC-controlled, rack-and-pinion driven, dual-roll fluting machine designed by Yenar Döküm to enhance efficiency in the re-fluting processes of mill rolls. The new machine offers an alternative architecture to conventional single-table, ball-screw–nut driven fluting machines and enables the simultaneous machining of two rolls on a single table.

In this study, fluting tests were carried out on both machines under identical cutting parameters (8% pitch, 0.65 mm flute depth, 30°/60° cutting angles, 8000 mm/min cutting speed, and an 8×8 mm carbide tool), and a comparative analysis was performed. The evaluation included measurements of return speed, total cycle time, preservation of flute geometry, surface accuracy, and operational stability. Additionally, the geometric accuracy of the flute profile produced by the new machine was analyzed using a Rollcare laser profile measurement system, and deviations between the theoretical and actual profiles were scientifically validated.

According to the findings, the new rack-and-pinion drive system increased the return speed by approximately 65% (from 20 m/min to 33 m/min) compared to the former ball-screw system and significantly reduced the overall cycle time. More importantly, even under the increased load of dual-roll machining, all geometry-defining parameters—flute depth tolerance, pitch accuracy, and cutting-angle stability—were maintained at the same level of precision as in the previous machine. The laser profile report confirmed full conformity in pitch and diameter, angular deviations within acceptable tolerances, and a wear-out value of 8.49%, demonstrating that the new machine preserves cutting quality.

In conclusion, the newly developed dual-roll fluting machine offers an innovative engineering solution that increases productivity and reduces cycle time without compromising geometric quality. In this respect, it reduces maintenance duration, enhances process efficiency, and provides a substantial cost advantage for milling industry operations.

Keywords: Roll cylinder Fluting, Refluting, Rack and Pinion drive, PLC control , Laser profile measurement , cycle time

HAVUZ TERS YIKAMA SUYU GERİ KAZANIMININ DENEYSEL OLARAK İNCELENMESİ

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ÖZET

Bu çalışma, yüzme havuzlarında kum filtrelerinin ters yıkama ve durulama fazı sırasında ortaya çıkan yüksek hacimli su kaybının azaltılmasına yönelik bir geri kazanım düşüncesinin teknik uygulanabilirliğini değerlendirmek amacıyla yürütülmüştür. Araştırma kapsamında, 3×4 m boyutlarında (12 m²) skimmerli polyester bir test havuzu üzerinde deneysel bir arıtma konfigürasyonu oluşturulmuştur. Sistem; 1 Hp ön filtreli termoplastik sirkülasyon pompası, ø620 mm yeni nesil plastik kum filtresi ve filtre çıkış hattına entegre edilen bir vorteks ayırıcıdan oluşmaktadır.

Konvansiyonel havuz işletmeciliğinde ters yıkama ve durulama suyunun doğrudan deşarj verilmesi, yalnızca su israfına değil, aynı zamanda ısı enerjisinin kaybedilmesine ve kimyasal denge gereksinimlerinin artmasına yol açmaktadır. Bu nedenle çalışmada, ters yıkama ve durulama suyunun doğrudan atılması yerine, öncelikle dinlendirilerek vorteks ayırıcı üniteden geçirilmesi ve sonrasında havuza tekrar geri kazandırılması için arıtma prosesi tasarlanmıştır.

Arıtmanın su kalitesi üzerindeki etkileri değerlendirebilmek amacıyla bulanıklık (NTU), pH, serbest klor, elektriksel iletkenlik ve sıcaklık gibi hidro-kimyasal parametreler izlenmiştir. Elde edilen bulgular, vorteks filtrenin, akışın içerisinde oluşturduğu merkezkaç kuvveti sonucu, askıda katı madde (AKM) değerinin yüksek oranda düşürdüğünü göstermektedir. Sedimantasyon prosesi ile birlikte etkisi değerlendirildiğinde, üst fazda optik olarak önemli ölçüde temizliğin sağlandığı ve fiziksel su kalitesinin kademeli biçimde iyileştiği belirlenmiştir. Bu sonuçlar, ters yıkama suyunun ilk yükünün sedimantasyon ile başarıyla azaltılabileceğini ve böylece vorteks filtre ile havuzun mevcut su şartlandırmalarına çok yakın bir su elde edilebildiğini göstermiştir. Bu işlemler, ileri arıtım proseslerinin (koagülasyon–flokülasyon, kartuş filtrasyon, membran ayırma teknolojileri ve dezenfeksiyon modülleri) performansını arttıracak nitelikte bir ön arıtma olarak da değerlendirilebilir. Bu bağlamda çalışma, yüzme havuzu işletmelerinde su ve enerji verimliliği hedefleri doğrultusunda, mekanik ayırma tabanlı geri kazanım protokollerinin operasyonel ve çevresel olarak uygulanabilir olduğunu ortaya koymaktadır. Sonuç olarak, vorteks ayırma teknolojisinin sedimantasyonla birlikte

uygulanması, ters yıkama suyundaki partikül yükünün önemli ölçüde azaltılmasını sağlayarak suyun yeniden kullanımı için uygun bir başlangıç koşulu oluşturmaktadır. Bu durum sürdürülebilir havuz yönetimi konusunda önemli bir bileşen olarak değerlendirilmektedir.

Anahtar kelimeler: Yüzme havuzu, ters yıkama suyu, vorteks filtre, su geri kazanımı.

EXPERIMENTAL INVESTIGATION OF BACKWASH WASTEWATER RECOVERY IN SWIMMING POOLS

ABSTRACT

This study was conducted to evaluate the technical feasibility of a recovery approach aimed at reducing the substantial volume of water lost during the backwashing and rinsing phases of swimming pool sand filters. For this purpose, an experimental treatment configuration was established on a 3×4 m (12 m²) polyester test pool equipped with a skimmer. The hydraulic system consisted of a 1 Hp pre-filtered thermoplastic circulation pump, a ø620 mm diameter next-generation plastic sand filter, and a vortex separator integrated into the filter outlet line, operating based on hydrodynamic principles.

In conventional pool management, the direct discharge of backwash and rinsing water leads not only to water waste but also to heat energy loss and increased chemical balance requirements. Therefore, in this study, instead of directly discharging the backwash and rinsing water, a treatment process was designed whereby the water is first allowed to settle, passed through a vortex separator unit, and then returned to the pool.

To evaluate the effects of the treatment on water quality, hydro-chemical parameters such as turbidity (NTU), pH, free chlorine, electrical conductivity, and temperature were monitored. The findings show that the vortex filter significantly reduces suspended solids (SS) due to the centrifugal force it creates in the flow. When its effect is evaluated together with the sedimentation process, it was determined that a significant optical cleaning is achieved in the upper phase and the physical water quality gradually improves. These results show that the initial load of the backwash water can be successfully reduced with sedimentation, thus achieving water very close to the existing water conditions of the pool with the vortex filter. These processes can also be considered as a pre-treatment that will improve the performance of advanced treatment processes (coagulation-flocculation, cartridge filtration, membrane separation technologies, and disinfection modules). In this context, the study demonstrates that mechanical separation-based recovery protocols are operationally and environmentally feasible in swimming pool operations, in line with water and energy efficiency goals. Consequently, the combination of vortex separation technology and sedimentation is shown to be effective.

Keywords: Swimming pool, backwash water, vortex filter, water recovery

1. INTRODUCTION

Turkey is located within the Mediterranean basin, a region where the impacts of climate change are increasingly pronounced, rendering the country particularly vulnerable to climate-related pressures. Recent scientific studies indicate that climatic variability has begun to exert significant stress on both surface and groundwater resources across the country. Current projections suggest that within the next century, Turkey may experience a reduction of approximately 25% in its available freshwater resources. Such forecasts clearly demonstrate that existing water reserves cannot be sustainably maintained under conventional consumption patterns and underline the necessity for a more efficient, conscious, and long-term approach to water management. The concept of water efficiency is often narrowly interpreted as a reduction in water consumption; however, in practice, it encompasses a broader and more holistic framework. Water efficiency involves not only the quantitative reduction of water use but also the protection of water quality and the consideration of ecosystem integrity. In this context, water management strategies must address not only human demand but also the requirements of natural systems. Consequently, the equitable, rational, and sustainable use of water resources has become increasingly critical across all sectors, including drinking water supply, agriculture, industry, and tourism (Tüpler et al., 2023).

Within tourism accommodation facilities, swimming pools constitute one of the most water-intensive components. In many pool operations, filtration systems are managed according to fixed time schedules or by personnel lacking adequate technical expertise, leading to unnecessary water losses. Excessive backwashing of filters without actual operational need, partial or complete draining of pool water in situations that could be resolved through chemical conditioning, and evaporation-related losses collectively contribute to substantial increases in overall water consumption. Implementing backwashing procedures based on filter pressure differentials rather than predetermined time intervals has been shown to promote water conservation and reduce pool-related water use in tourism facilities (Meade et al., 2011).

In recent years, water management in swimming pools has become a critical issue due to rising water costs, increasing energy demand, and growing environmental concerns. Pool electromechanical systems operate continuously to maintain water quality through filtration, disinfection, and circulation processes. However, among these operational activities, the periodic backwashing and rinsing of sand filter beds represent one of the primary sources of water loss. The literature reports that water losses associated with backwashing may account

for 10–20% of a facility's annual total water consumption, with even higher proportions observed in high-use pool systems(Doménech-Sánchez et al., 2021).

Wolska and Urbańska-Kozłowska (2023) investigated the reuse potential of swimming pool backwash water within the framework of European regulations, with particular emphasis on the DIN 19643 standard. Drawing attention to the intensifying water crisis across Europe and the associated rise in water costs, the study evaluated key water quality parameters, including turbidity, free and combined chlorine, pH, and suspended solids, in selected pool facilities. The findings demonstrated that untreated backwash water is unsuitable for direct reintegration into pool systems; however, when appropriate treatment processes are applied, the water may be safely reclaimed and reused.

The importance of treatment systems in the recovery of backwash water has also been highlighted in other studies. Wyczarska-Kokot (2016) emphasized that backwash water discharged without adequate treatment imposes a significant environmental burden due to its chlorine content and organic load. The study further stressed that the recovery of backwash and rinse waters is essential not only from an environmental perspective but also in terms of energy efficiency.

Water losses associated with backwashing are not limited to volume alone but also involve the loss of thermal energy contained within the discharged water. Swimming pools are typically operated at temperatures ranging between 27 and 30 °C; therefore, water expelled during backwashing represents a considerable loss of heat energy. Recovering backwash water thus offers substantial advantages by simultaneously improving water conservation and enhancing energy efficiency (Studziński et al., 2021).

This study aims to evaluate the recovery potential of backwash water by subjecting settled backwash water from a small-scale test pool to mechanical pre-treatment using a vortex filter. The proposed approach represents a simple, cost-effective, and practical pre-treatment stage that can be applied prior to more complex treatment technologies, such as membrane filtration or ozonation, which are commonly reported in the literature.

2. MATERIALS AND METHODS

2.1. Experimental System

The experimental study was conducted in a skimmer-type polyester test pool with dimensions of 3 × 4 m (12 m²), as shown in Figure 1. A 1 Hp filtration pump and a standard sand filter were used for the pool filtration system. The vortex filter was connected to the sand filter in a series–parallel hybrid configuration.



Figure 1. Skimmer-type 3×4 m polyester test pool

Figure 2 illustrates the flow scheme during the backwashing process, in which the backwash line of the sand filter directly discharges into the IBC A tank. Figure 3 schematically presents the transfer of raw backwash water from IBC A to IBC B after filtration through the vortex filter.

To enable comparison, the vortex-filtered water (in IBC B) and the raw backwash water (in IBC A) were collected separately in two independent 1000-L IBC tanks and allowed to settle for specified durations (at the 1st, 3rd, and 24th hours).

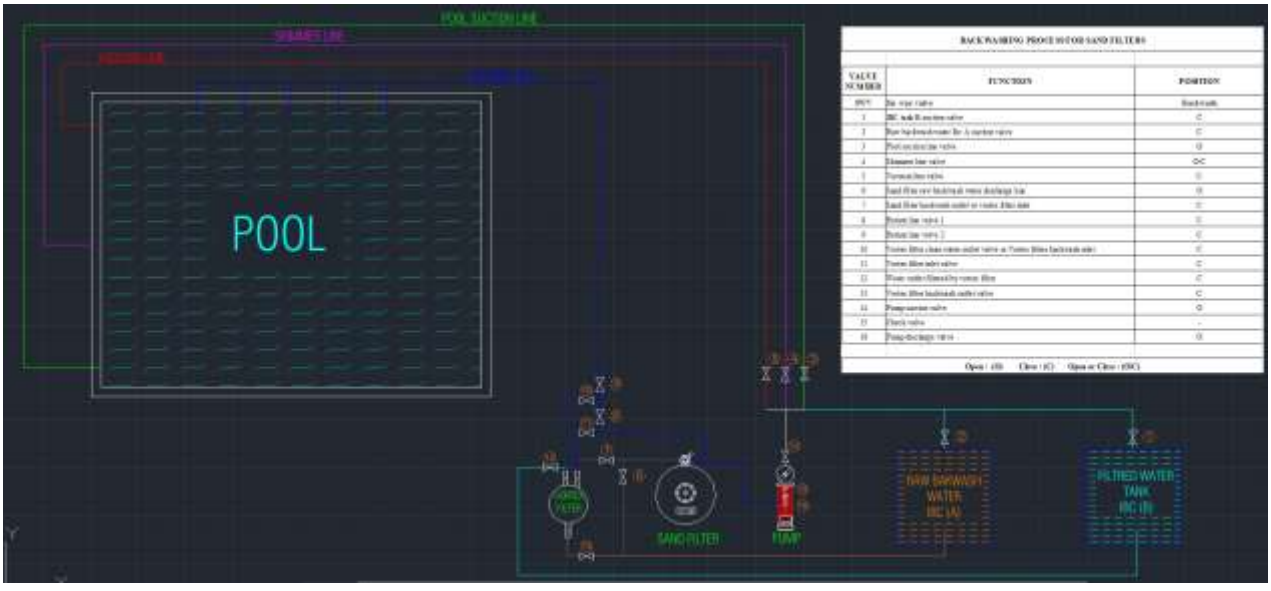


Figure 2. Schematic diagram of the sand filter backwash system

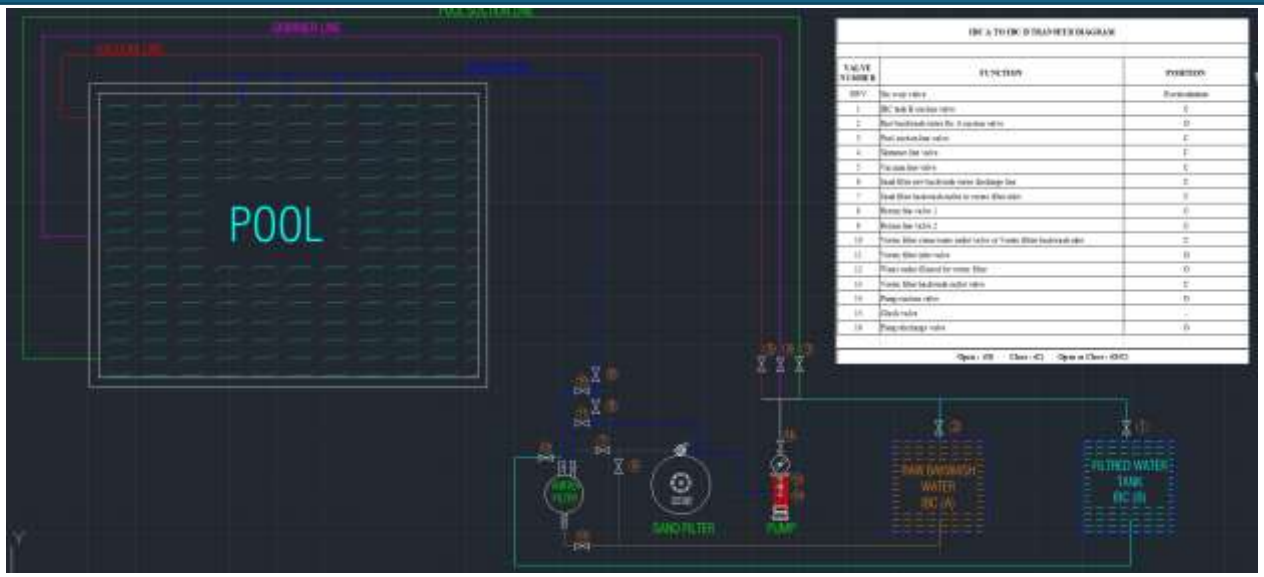


Figure 3. Transfer scheme from IBC A to IBC B

2.2. Experimental Procedure

The study was conducted in two series:

- **Series A:** Raw backwash water discharged from the sand filter (without vortex filtration IBC A)
- **Series B:** Backwash water that was first allowed to settle and then passed through the vortex filter (IBC B)

For both series, samples were collected at predetermined intervals, and measurements were scheduled at the 1st, 3rd, and 24th hours in order to observe the effect of settling.

2.3. Measured Parameters

The following parameters were monitored during the experimental study:

- Turbidity (NTU)
- pH
- Free chlorine (mg/L)
- Conductivity (µS/cm)
- Temperature (°C)

Portable instruments including a turbidimeter, pH meter, photometric chlorine analyzer, and conductivity meter were used for the measurement of these parameters.

3. FINDINGS

Although this study does not present numerical data, the experimental observations revealed the following trends:

The raw backwash water initially exhibited high turbidity and a heavy particulate load, with visible sediment accumulation on both the water surface and the bottom of the tank.

After settling in IBC A, the effluent from the vortex filter showed a noticeable reduction in particulate concentration, and the water appeared visually clearer.

Particularly in the samples taken after settling and subsequent vortex filtration, sedimentation occurred more rapidly and effectively, resulting in a cleaner upper water phase.

No significant deviations were observed in pH or conductivity values; however, free chlorine levels were found to fluctuate more in the raw backwash water and more stable after vortex filtration.

Table 1. List of instruments and measurement standards for the parameters monitored in the experimental study

Parameters	Instrument Used	Measurement Standard
Turbidity	Turbidimeter	ISO 7027
pH	Digital pH meter	APHA 4500-H+
Temperature	Digital temperature probe	-
Free Chlorine	Photometer (DPD 1 method)	APHA 4500-Cl G
Conductivity	EC meter	APHA 2510 B

4. RESULTS, DISCUSSION AND RECOMMENDATIONS

4.1. Results

Observations based on the experimental setup indicate that the vortex filter can serve as an effective pre-treatment unit for swimming pool backwash water. By its operating principle, the vortex filter forces the water into a circular motion, enabling particles with higher density to be separated through centrifugal effects. This mechanism allowed for the removal of a significant portion of sand grains, organic–inorganic particles, and other suspended solids present in the settled backwash water discharged from the sand filter.

Studies in the literature emphasize that direct reuse of backwash water is not feasible; however, with appropriate pre-treatment and advanced treatment steps, it can be reintroduced into the pool circulation system. This study provides a simple, low-cost, and mechanical solution for the first stage of such an advanced treatment chain. When water with reduced particulate load achieved through the vortex filters subsequently directed to processes such as coagulation, cartridge filtration, membrane filtration, and disinfection, a highly efficient recovery system can be established.

4.2 Discussion

In this study, an experimental approach was presented to investigate the pre-treatment of backwash water using a vortex filter in a small-scale test pool and to evaluate its recovery potential. The findings demonstrate the principle-level feasibility of the system. Based on the observations made, the following conclusions were reached:

The vortex filter is an effective mechanical separation unit for reducing the particle load in backwash water.

When used in combination with a settling tank, the physical treatment efficiency increases, resulting in clearer water.

This approach offers a practical and easily implementable solution for achieving water and energy savings in pool operations.

Turbidity measurements showed that, as settling time increased, more pronounced sedimentation occurred, yielding clearer water, and that passage through the vortex filter resulted in significantly clearer and cleaner water in IBC B.

pH, free chlorine, and conductivity values exhibited changes so minimal that they can be considered negligible.

4.3. Recommendations

The vortex filter effluent should be evaluated quantitatively by testing combinations in which it is used together with advanced treatment processes such as coagulation and ultrafiltration to determine the achievable water recovery rate.

The performance of the vortex filter should be compared under different pump flow rates to identify the optimum hydraulic operating conditions.

Pilot-scale applications should be conducted in industrial settings, such as hotel pools or aquaparks, to assess the practical applicability of the method.

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TÜRKİYE'DE ERKEN ÇOCUKLUK DÖNEMİNDE GÖRSEL SANAT ALANIYLA İLGİLİ LİSANSÜSTÜ TEZLER

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ÖZET

Erken çocukluk döneminde bir çocuğun kendini ve çevresini keşfetmesi, anlaması ve ifade etmesini sağlayan araçlar arasında sanat yer alır. Yaratıcılık, okuryazarlık, estetik duyarlılık, görsel algı, motivasyon, duygu, özgünlük, psikomotor beceri, bilişsel, fiziksel ve duygusal yeterlilik gibi birçok bileşenle etkileşimi olan sanatta öne çıkan alanlardan biri görsel sanattır. Okul öncesi eğitim programındaki güncellemelerle daha fazla vurgulandığı düşünülen görsel sanat alanına yönelik çeşitli araştırmalar yapılmaktadır. Bu çalışmada erken çocukluk döneminde görsel sanat alanıyla ilgili lisansüstü tezlerin araştırma soruları kapsamında incelenmesi, ulaşılan sonuçların alanyazın ve okul öncesi eğitim programı doğrultusunda değerlendirilmesi amaçlanmıştır. Amaca yönelik olarak Yükseköğretim Kurulu Ulusal Tez Merkezi veri tabanında "erken çocukluk", "okul öncesi", "görsel sanat" anahtar kelimeleri "içinde geçsin" arama tipi ve "tümü (tez adı, konu, dizin, özet..)" arama kategorisinde taranarak lisansüstü tezlere ulaşılmıştır. Ulaşılan lisansüstü tezlerin çalışma kapsamına alınmasına dahil etme ve hariç tutma (dışlama) kriterleri esas alınarak karar verilmiştir. Çalışma grubunu oluşturan lisansüstü tezler, içerik analizi yöntemlerinden betimsel içerik analizi yaklaşımıyla yayımlandığı yıl, yayımlandığı enstitü/kurum, tez türü, çalışma grubunu oluşturan unsurlar ve çalışılan konulara göre incelenmiştir. Çalışma bulguları sayı (frekans) ve yüzdelik cinsinden ifade edilmiş, sonuçlar alanyazın ve uygulamada olan okul öncesi eğitim programları bağlamında değerlendirilerek önerilere yer verilmiştir.

Anahtar Kelimeler: Erken çocukluk, görsel sanat, okul öncesi, sanat, Türkiye.

GRADUATE THESES RELATED TO THE FIELD OF VISUAL ARTS IN EARLY CHILDHOOD IN TURKIYE

ABSTRACT

Art is among the tools that enable a child in early childhood to discover, understand, and express themselves and their environment. Visual art is one of the prominent fields in art that interacts with many components such as creativity, literacy, aesthetic sensitivity, visual perception, motivation, emotion, originality, psychomotor skills, cognitive, physical, and emotional competence. Various research studies are being conducted on visual arts, which are thought to be more emphasized with updates in the preschool education program. This study aims to examine graduate theses related to visual arts in early childhood within the scope of research

questions, and to evaluate the results in line with the literature and preschool education program. For this purpose, graduate theses were accessed by searching the keywords "early childhood," "preschool," "visual art" in the Higher Education Council National Thesis Center database using the search type "included in" and the search category "all (thesis title, subject, index, abstract...)". The decision to include graduate theses in the scope of the study was based on inclusion and exclusion criteria. The graduate theses forming the study group were analyzed according to publication year, institute/institution, thesis type, elements forming the study group, and studied subjects using the descriptive content analysis approach, one of the content analysis methods. The study findings were expressed in terms of number (frequency) and percentage, and the results were evaluated in the context of the literature and current preschool education programs, along with recommendations.

Keywords: Art, early childhood, preschool, Türkiye, visual art.

KÜRESEL SUKUK PİYASASINDA YEŞİL SUKUK'UN YÜKSELİŞİ: GELENEKSEL SUKUK İLE KARŞILAŞTIRMALI BİR ANALİZ

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ÖZET

Son yıllarda İslami finans piyasalarında sürdürülebilir finans anlayışının güçlendiği görülmektedir. Buna bağlı olarak çevresel ve sosyal hedefleri önceleyen finansal araçlara olan ilgi de artmaktadır. Bu bağlamda yeşil sukuk, İslami finans ilkeleri ile sürdürülebilirlik hedeflerini bir araya getiren önemli bir enstrüman olarak öne çıkmaktadır. Ancak yeşil sukuk piyasasının gelişimi ve geleneksel sukuk ile olan yapısal farklılıkları üzerine yapılan ampirik çalışmalar sınırlı düzeydedir.

Bu çalışma, küresel sukuk piyasasında yeşil sukukun konumunu incelemeyi ve yeşil sukuk ile geleneksel sukuk arasındaki temel farklılıkları karşılaştırmalı olarak analiz etmeyi amaçlamaktadır. Analizde, farklı ülkelerde gerçekleştirilen sukuk ihraçlarına ait veriler kullanılarak yeşil ve geleneksel sukuk; ihraç hacmi, ihraç sayısı, ülke dağılımı ve zaman içindeki gelişim eğilimleri açısından değerlendirilmiştir. Çalışmada tanımlayıcı istatistikler ve grafiksel analizlerden yararlanılmıştır.

Elde edilen bulgular, yeşil sukuk ihraçlarının toplam sukuk piyasası içindeki payının halen sınırlı olduğunu göstermektedir. Bununla birlikte, son yıllarda belirgin bir artış eğilimi gösterdiğini ortaya koymaktadır. Ayrıca yeşil sukuk ihraçlarının belirli ülkelerde yoğunlaştığı ve ihraç tutarları bakımından geleneksel sukuktan farklılaştığı tespit edilmiştir. Çalışma, yeşil sukukun sürdürülebilir finans hedefleri doğrultusunda İslami sermaye piyasalarındaki potansiyel rolüne ilişkin önemli çıkarımlar sunmaktadır.

Anahtar Kelimeler: İslami Finans, İslami Sermaye Piyasaları, Sukuk Piyasası, Yeşil Sukuk,

THE RISE OF GREEN SUKUK IN THE GLOBAL SUKUK MARKET: A COMPARATIVE ANALYSIS WITH TRADITIONAL SUKUK

ABSTRACT

In recent years, the concept of sustainable finance has gained strength in Islamic finance markets. Consequently, interest in financial instruments that prioritize environmental and social objectives has also increased. In this context, green sukuk stands out as an important instrument that combines Islamic finance principles with sustainability objectives. However, empirical studies on the development of the green sukuk market and its structural differences from traditional sukuk are limited.

This study aims to examine the position of green sukuk in the global sukuk market and to analyze the fundamental differences between green sukuk and traditional sukuk in a comparative manner. In the analysis, data from sukuk issuances in different countries were used to evaluate green and traditional sukuk in terms of issuance volume, number of issuances, country distribution, and development trends over time. Descriptive statistics and graphical analyses were used in the study.

The findings show that green sukuk issuances still account for a limited share of the total sukuk market. However, they reveal a marked upward trend in recent years. It was also found that green sukuk issuances are concentrated in certain countries and differ from traditional sukuk in terms of issuance amounts. The study offers important insights into the potential role of green sukuk in Islamic capital markets in line with sustainable finance objectives.

Keywords: Islamic Finance, Islamic Capital Markets, Sukuk Market, Green Sukuk,

1. GİRİŞ

Son yıllarda İslami finans, dini ve etik ilkelerle uyumlu alternatif finansal araçlar arayan yatırımcılar için küresel piyasalarda giderek artan bir önem kazanmıştır. İslami finans içerisinde en büyük pay, İslami bankalar tarafından oluşturulmaktadır. İslami bankalar, risk paylaşımını ve etik finansal uygulamaları teşvik ederken faize dayalı işlemleri yasaklayarak İslam hukukuna uygun faaliyet göstermektedir. Bu ilkeler, İslami bankaları geleneksel bankalardan net bir şekilde ayırmaktadır (Beck vd., 2013; Ayub vd., 2023; Hassan vd., 2023; Kazak vd., 2024). İslami bankacılığın ardından, İslami sermaye piyasaları büyüklük ve etki açısından ikinci sırada yer almaktadır (Hussain vd., 2015; Khamlichi vd., 2014; Posumah, 2024). Bu piyasaların temel özellikleri, şeffaflık ve inanca dayalı yatırım ilkeleri doğrultusunda, İslam hukuku ile uyumlu enstrümanlar geliştirmektir. Bu enstrümanlar arasında yer alan sukuk piyasası ise, büyüme potansiyeline rağmen hala görece dar bir yatırımcı tabanına sahiptir.

İslami Finansal Hizmetler Kurulu (Islamic Financial Services Board- IFSB) verilerine göre, İslami finans sektörünün 2024 yılı itibariyle 3,88 trilyon ABD doları varlığa ulaştığı görülmüştür. İslami bankacılık ise %71,62 ile en büyük paya sahip olmuştur. İslami sermaye piyasaları, özellikle sukuk piyasasının sürekli genişlemesi sayesinde güçlü bir büyüme kaydetmiştir. 2024 yılında yeni sukuk ihraçları yaklaşık 250 milyar ABD dolarına ulaşırken, toplam sukuk bakiyesi 900 milyar ABD dolarını aşmıştır. Düşük faiz oranı beklentileri, yüksek küresel likidite ve daralan kredi hacimleri ile birleşerek elverişli finansman koşulları yaratmıştır. Bu durum ihraççıları refinansman ihtiyaçlarını karşılamak ve yeni projeleri finanse etmek için sukuk piyasasına yönelmeye teşvik etmiştir. Kamu ve özel sektör aktörleri, büyük

ölçekli altyapı ve ekonomik çeşitlendirme girişimlerini finanse etmek için sukuk ihraçlarına ağırlık vermiştir. Sukuk, 1990'ların başındaki ilk çıkışından bu yana en hızlı büyüyen finansal araçlardan biri haline gelmiştir (IFSB, 2025).

Sukuk, İslami finans ekosisteminde önemli bir rol oynamaktadır. İslami Finansal Kurumlar için Muhasebe ve Denetim Kuruluşu (Accounting and Auditing Organization for Islamic Financial Institutions- AAOIFI, 2015) tarafından sukuk: "maddi varlıkların, menfaatlerin, hizmetlerin veya belirli projelerin ya da özel yatırım faaliyetlerinin varlıklarının mülkiyetindeki bölünemez payları temsil eden eşit değerli sertifikalardır." şeklinde tanımlanmaktadır. Sukuk, dayanak bir varlığın mülkiyetini temsil ettiğinden ne pür borç ne de pür özsermayedir. AAOIFI Standardı, sukuku hisse senetlerinden, tahvillerden ve geleneksel menkul kıymetleştirme yöntemlerinden ayırmaktadır. Sukuk, çeşitli faaliyetleri finanse etmek için ihraç edilen borçlanma araçları olan ve değeri ihraççının kredi değerliliğine bağlı olan tahvillerin aksine, fiyatları ihraççının kredi durumuna ve dayanak varlığın piyasa değerine bağlı olarak dalgalanmaktadır (Godlewski vd., 2013).

Iqbal ve Mirakhor (2011) sukuku: "dayanak varlıklara katılım hakkı olarak" tanımlarken; Addi vd.(2025) bu araçların, aşırı belirsizlik ve her türlü spekülasyonun yasaklandığı, kar ve zarar paylaşımına dayalı İslami finans ilkelerine uygun olduğunu vurgulamaktadır. Sukukun temelinde yatan kavram, sahibinin belirli bir varlığın tam hissesine sahip olması ve bu varlıktan elde edilen gelir üzerinde hak iddia edebilmesi yatmaktadır (Delle Foglie & Keshminder, 2022). Sukuk varlıkları, İslam hukukuna uygun şartlara sahip olup sabit getirili borçlanma araçları gibi getiri sağlamayı amaçlamaktadır. Ancak bunu faizsiz bir şekilde gerçekleştirmektedir (Billah, Amar, vd., 2023; Billah, Elsayed, vd., 2023). Temel ayırt edici unsurlar ise varlığa dayalı yapısı, düşük risk profili ve faizsiz yatırım yapısıdır (Mimouni vd., 2019).

Son yıllarda yoğun bir şekilde ihraç edilen yeşil sukuk, güneş enerjisi parkları, biyogaz tesisleri ve rüzgar santralleri gibi çevre dostu girişimleri destekleyen yatırım aracıdır. Bu enstrümanın geliştirilmesindeki temel amaç, İslam'ın çevrenin korunmasına yönelik ilkelerini somut finansal uygulamalarla desteklemesidir. Müslüman nüfusun yoğun olduğu bölgelerde, çevresel fayda sağlaması ve kurumsal sosyal sorumluluğu teşvik etmesi sayesinde yeşil sukuk, İslam hukukuna uygunluk ve sürdürülebilirlik kriterleri bir arada sunan stratejik bir yatırım aracı olarak öne çıkmaktadır (N. Alam vd., 2016).

Ancak yeşil sukukun kullanımı, küresel ve ulusal düzeyde mevcut potansiyeline kıyasla oldukça sınırlıdır. Bu durum, çevresel sürdürülebilirlik hedefleri ile İslami finans ilkelerin bütünleşmesini zorlaştırmaktadır. Araştırmanın temel amacı, yeşil sukukun geleneksel sukuk

ile karşılaştırmalı analizini yapmaktır. Bunun için küresel sukuk piyasasına ilişkin ikincil veriler kullanılarak tanımlayıcı ve karşılaştırmalı bir analiz gerçekleştirilmiştir. Bulgular, yeşil sukuk ihraçlarının toplam sukuk piyasası içindeki payının henüz çok düşük seviyede olduğuna işaret etmektedir. Ancak yeşil sukuk ihraçlarının son yıllarda artış eğilimi gösterdiğini ortaya koymaktadır. Ayrıca yeşil sukuk ihraçlarının belirli ülkelerde yoğunlaştığı gözlemlenmiştir.

Çalışma dört bölümden oluşmaktadır. Giriş bölümünden sonra literatür taraması anlatılmıştır. Üçüncü bölümde ise karşılaştırmalı analiz kısımlarına yer verilerek son bölümde sonuç kısmı ele alınmıştır.

2. LİTERATÜR TARAMASI

Son yıllarda sukuk piyasasında kayda değer bir büyüme gözlemlenmesine rağmen, literatürde yeşil sukuk uygulamalarına ilişkin çalışmalar görece nadir olup genellikle belirli ülke örnekleriyle kısıtlı kalmaktadır. Mevcut çalışmaların büyük bir bölümü, sukuku yalnızca geleneksel tahvil enstrümanlarıyla karşılaştırmakta ya da piyasa gelişim dinamiklerine odaklanmaktadır. Bu bağlamda çalışma; yeşil sukuk ihraçlarını geleneksel sukuk ile karşılaştırarak literatüre katkı sağlamayı amaçlamaktadır.

Sukuk literatürü, oldukça geniş ve farklı temalara odaklanmaktadır. Sukuk ile ilgili bibliyometrik analizlere örnek olarak Paltrinieri vd. (2023), Rezkyarta ve Irfany (2023), Uluyol (2023), Maulayati & Iswati (2023), Abdul Kader Malim vd. (2024) ve Yazicioğlu (2024) gösterilebilir. Yeşil sukuk ile ilgili çalışmalarda son yıllarda artış göstermiştir (Husain vd., 2024; Pirgaip ve Arslan-Ayaydin, 2024). Örneğin Billah vd. (2023), sukukun, yeşil tahviller ve küresel faktörlerin risklerini dengelemede etkili olduğunu ortaya koyarken; Richardson (2019), sürdürülebilir ve sosyal sukuk ihraçlarındaki gelişmelerin büyük ölçüde hükümet tarafından yönlendirildiğini vurgulamıştır. Öner (2023), Türkiye'deki sukuk ihraçlarının katılım bankalarının finansal performansı üzerindeki etkisini incelemiş; Baykut (2024) ise enflasyon, mevduat faiz oranı, dolar kuru ve sukuk ihracının büyüklüğünün sukuk getirileri üzerindeki etkilerini analiz etmiştir.

Sukukun piyasa işlevi ve risk profili üzerine yapılan çalışmalarda, ürünün varlığa dayalı yapısı nedeniyle görece düşük risk taşıdığı öne çıkmaktadır (Al-Raeai vd., 2019; Balli vd., 2021; Wilson, 2004, 2008). Kalimullina ve Hassan (2022), sukukun temerrüt riski açısından tahvillere benzer şekilde davrandığını ve bazı yapılandırmaların ise orijinal yatırım konseptinden uzaklaştığını savunmaktadır. Tarık ve Dar (2007), sukuk ihraçlarını finansal istikrarın güçlendirilmesi ve piyasa derinliğinin artırılması açısından önemli bir araç olarak değerlendirirken; Boukhatem (2021) sukuk piyasasının enflasyon ve faiz oranı risklerinden

korunmada önemli bir rol oynadığı belgelenmiştir. Ayrıca, sukuk ihracının bankaların iç kontrol kalitesini artırdığı ve hisse senedi fiyat istikrarına katkı sunduğu da literatürde yer almaktadır (Liu vd., 2023).

Sürdürülebilir sukuk literatürü ise daha çok ESG kriterleri ile ilişkiler, çevresel etki ve temiz enerji finansmanı üzerinde yoğunlaşmaktadır. Asl vd. (2023), temiz enerji ve temiz teknoloji endeksleri ile yeşil tahvil ve sukuk endeksleri arasındaki dinamik bağımlılık ve nedensellik ilişkisini incelemiştir. Sukuk endeksleri ile Green Bond Select (GBS) endekslerinin temiz enerji ve temiz teknoloji üzerinde daha belirgin nedensellik etkileri olduğu ve bu tahvillerin riskten korunma veya çeşitlendirme aracı olarak kullanılabileceği ortaya koymuştur. Bunun yanısıra sukuku farklı şekilde ele alan çalışmalar bulunmaktadır. Alhammadi vd. (2024) tarafından yapılan araştırma, sukuk ihraçlarının sukuk yapılarının doğasında bulunan risklerle -özellikle de İslam hukukuna uyumsuzluk riski ve temerrüt riskiyle- başa çıkmada önemli zorluklarla karşı karşıya olduğunu belirtmektedir. Ayrıca Aloui vd. (2024), Körfez İşbirliği Konseyi (KİK) ülkelerinin 2013-2019 dönemine ait günlük verilerini kullanarak jeopolitik risklerin İslami ve konvansiyonel finansal araçlar üzerindeki etkisini incelemiş ve çalışmanın bulguları sukuk getirilerinin tahvil piyasalarına göre jeopolitik dalgalanmalara karşı daha dirençli olduğunu göstermiştir. Bu sonuç, sukukun portföy çeşitlendirmesi ve finansal istikrar açısından avantajlarını net bir şekilde ortaya koymaktadır.

Billah vd. (2024), emtialar ve sukuk getirileri arasındaki ilişkiyi araştırmıştır. Kashif vd. (2025), Pakistan'ın petrol sektöründeki zorlukların ele alınmasında İcara-Murabaha sukukun rolünü incelemiştir. Jatmiko vd. (2023), sukuk gelişimi ile gelir eşitsizliği arasındaki ilişkiyi değerlendirmiştir. Billah vd. (2025), DeFi (Decentralized Finance– Merkezi Olmayan Finans) varlıkları ile sukuk piyasaları arasında farklı seviyelerde bağlantılar olduğunu ortaya koymaktadır. Mohamed vd. (2015), Hassan vd. (2018), Samitas vd. (2021) ve Mustafa (2025), çalışmalarında sukuk ve tahvil arasındaki ilişkileri ele alırken; Aytürk vd. (2017), sukuk ihracı fiyatlandırmasının belirleyicilerini araştırmıştır. Nagano (2022) ise sukuk ihraç piyasalarındaki bilgi asimetrisinin derecesini tahmin etmeye çalışmıştır. Elsayed vd. (2023) ve AlKhazali vd. (2024), İslami ve konvansiyonel finansal piyasalar arasındaki oynaklık yayılımı ve risk iletimi gibi ek boyutları ele alan güncel çalışmalar sunmuştur. Sukuk ihraçların İslami bankaların bilanço yapısı ve finansal istikrarı üzerinde olumlu etkisinin olduğuna dair çalışmalarda yoğun olarak görülmektedir.

Ledhem (2022), sukuk piyasasındaki gelişmenin İslami bankaların finansal istikrarına etkisini analiz etmiştir. Dinamik panel sisteminde uygulanan genelleştirilmiş moment yöntemi

bulguları, sukuk piyasasının gelişiminin İslami bankaların finansal istikrarı üzerinde pozitif bir etki yarattığını ortaya koymaktadır. Ayrıca, Smaoui ve Ghouma (2020) araştırmalarında, sukuk piyasalarının İslami bankaların sermaye yeterlilik üzerinde olumsuz bir etkiye sahip olduğun olduğunu bulmuşlardır. Bhuiyan vd. (2020), sukuk piyasasının geleneksel tahvil piyasalarından farklı olup olmadığını, riske maruz değer (VAR) temel tekniklerini kullanarak araştırmıştır. Bulgular, yatırım portföyüne sukuk yatırımlarının dahil edilmesiyle risklerin önemli ölçüde azaldığını göstermektedir. Mseddi (2023), sukuk menkul kıymetleştirmesinin 2004 ve 2020 yılları arasında şirketler için 68 sukuk ihracı sistematik riskini artırdığına dair uluslararası ampirik kanıtlar sunmaktadır. Ziky vd. (2023), Fas'taki İslami bankaların şube müdürleri ile görüşmeler yaparak nitel bir metodoloji kullanmıştır. Bulgular, sukuk al-muḍarabah yönteminin İslami bankaların likidite ve finansmanı yönetmesi açısından önemli bir araç olduğuna işaret etmektedir. Oseni ve Hassan (2015), sukuk ihraçlarında kullanılan hukuki düzenlemeleri, özellikle de "uygulanacak hukuk" ve "uyuşmazlık çözümü" maddelerinin tarafların menfaatlerini koruma ve adaleti sağlama düzeyini incelemiştir.

Literatürde yeşil sukuk üzerine çeşitli ampirik, teorik ve bibliyometrik çalışmalar mevcuttur. Örneğin, Ulfah vd. (2023), Uluyol (2023), Rezkyarta ve Irfany (2023), Ratnasari vd. (2023), Tahir ve Naz (2024) ve Alam vd. (2023) yeşil sukuku bibliyometrik açıdan ele almıştır. Ampirik çalışmalara bakıldığında, Dewi ve Prihantari (2024), Hindistan'da çevresel farkındalık ve kar paylaşımının yeşil sukuk yatırımı üzerinde önemli bir etkiye sahip olduğunu anket yöntemi ile araştırmıştır. N. Alam vd. (2016), İslami finans piyasalarında yeşil sukukun potansiyelini incelemiştir. Karabulut (2024), yeşil sukukun Türkiye'nin sürdürülebilir gelişimdeki rolünü vurgulayarak çeşitli politika önerileri sunmuştur. Finansal varlık ilişkileri bağlamında, Khamis ve Aassouli (2022), yeşil sukukun kripto para ve emtia piyasalarıyla düşük korelasyonlar gösterdiğini, ancak COVID-19 döneminde Ethereum ve paladyum ile orta düzeyde ilişkiler kurduğunu ortaya koymuştur.

Bölgesel çalışmalar arasında Abdullah ve Keshminder (2022), Malezya'daki yeşil sukuk ihraçlarının ardındaki temel itici güçlerin rekabetçilik, meşruiyet ve ekolojik sorumluluk olduğunu ortaya koymuştur. A. Alam vd. (2023), Malezya'daki yeşil sukuk ve yeşil tahvilleri araştırmıştır. Çalışma, yeşil sukukun yeşil tahvillerden daha yüksek getiri sunduğunu ortaya koymaktadır. Ayrıca, iki finansal araç arasında nedensellik ilişkisinin bulunmadığını belirterek, yeşil sukukun portföy çeşitlendirmesin için değerli bir araç olduğu vurgulanmaktadır. Kadiri (2022) ise Malezya ve Endonezya'daki yeşil sukuk çerçevelerini ve piyasa gelişimini analiz

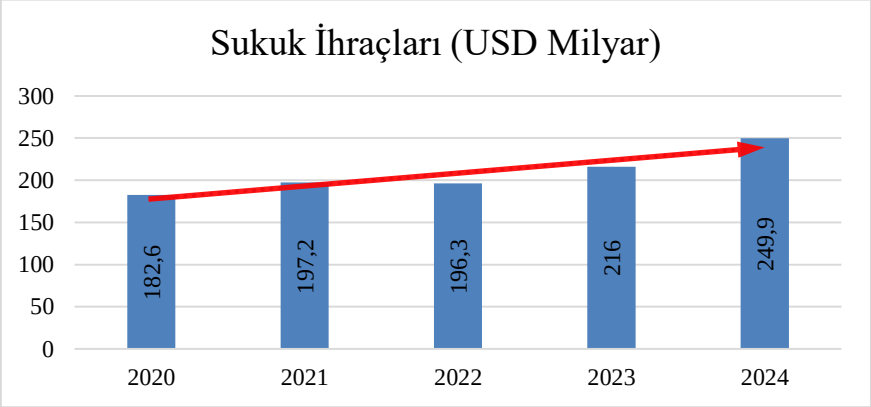
ederek Kanada'da yeşil sukukun kullanımına yönelik bir yol haritası oluşturmuştur. Yeşil sukuku Kanada'da enerji dönüşümü için bir finansman seçeneği olarak önermiştir.

Bu çalışma, sukuk piyasalarına ilişkin mevcut literatüre özgün bir katkı sunmayı amaçlamaktadır. Literatürde, sukuk ihracının farklı ülkelerdeki önemi sıklıkla vurgulanmış ve çoğunlukla konvansiyonel tahvil piyasalarıyla karşılaştırmalar yapılmıştır. Ancak, yeşil sukuk ihraçlarının geleneksel sukuk ile kıyaslamasına dair doğrudan ele alan çalışmalar son derece sınırlıdır. Bu bağlamda çalışma, yeşil sukuk ile geleneksel sukuk arasındaki farkları tanımlayıcı bir çerçevede ele alarak literatüre tamamlayıcı bir katkı sunmayı amaçlamaktadır.

3. ARAŞTIRMA BULGULARI

2020–2024 döneminde sukuk ihraçlarında büyümenin süreklilik kazandığı görülmektedir. Grafik 1'de görüldüğü üzere, toplam sukuk ihraç hacmi 2024 yılında yaklaşık 250 milyar ABD dolarına ulaşmıştır. Bu durum, önceki yıla göre %18 oranında artış göstermiştir. Bu artış, küresel piyasalarda yüksek faiz oranlarının hâkim olduğu bir ortamda gerçekleşmesi bakımından önemlidir.

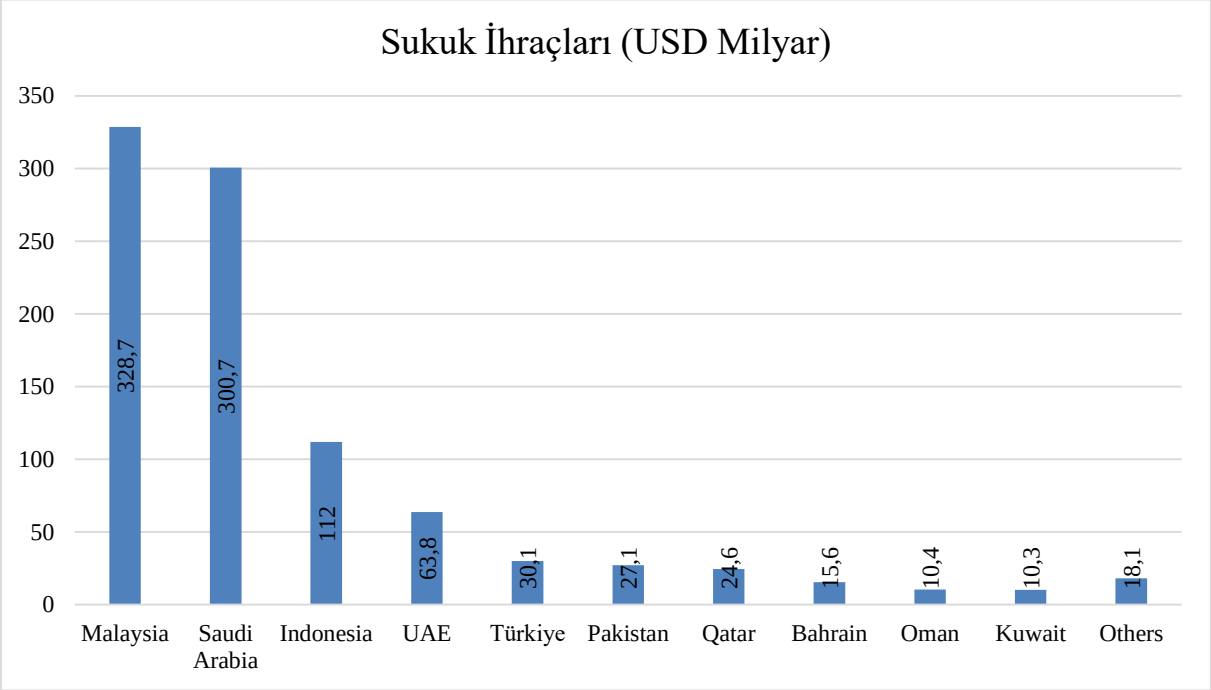
Grafik 1. Sukuk ihraç hacimleri



Kaynak: LSEG Global Sukuk Update 2024

Ülke düzeyinde sukuk ihraçlarına bakılacak olursa Grafik 2'de görüleceği üzere en yüksek ihraç hacmine sahip ülkeler Malezya, Suudi Arabistan, Endonezya, Birleşik Arap Emirlikleri ve Türkiye gelmektedir. Malezya 328 milyar USD, Suudi Arabistan 300 milyar USD ile en yüksek sukuk ihraç hacmine sahip ülkelerdir. Bu iki ülke toplam sukuk ihraç hacimlerinin yarıdan fazlasını oluşturmaktadır. Ülkelere ait sukuk ihraç hacimleri Grafik 2'de yer almaktadır.

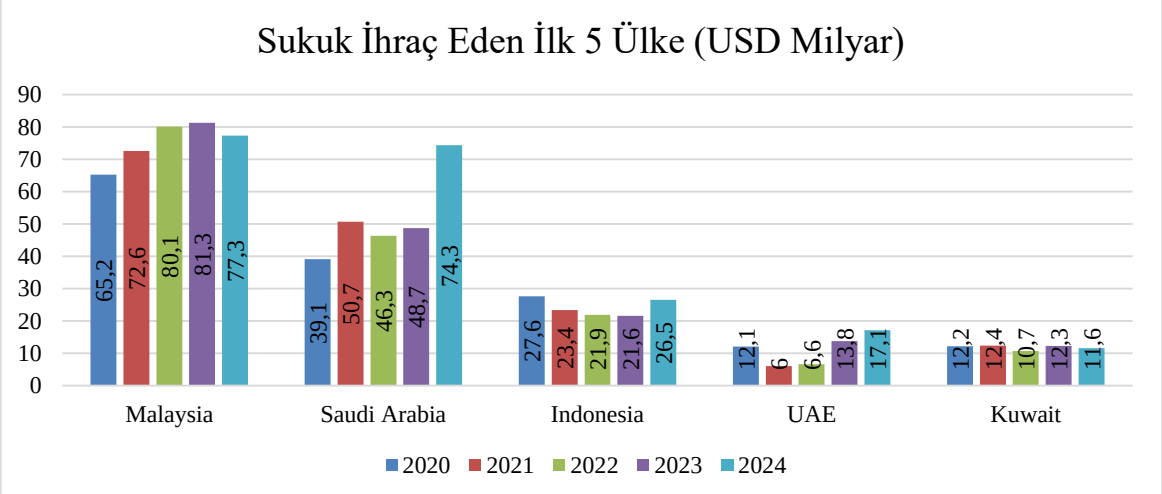
Grafik 2. Ülkelerin sukuk ihraçları



Kaynak: LSEG Global Sukuk Update 2024

Grafik 3'te sukuk ihraç eden ilk 5 ülkenin yıllar içerisindeki sukuk ihraç hacimleri yer almaktadır. En fazla sukuk ihraç hacmine sahip Malezya 2020'de 65 milyar USD ihraç hacmini 2024 yılında 77 milyar USD seviyesine çıkararak istikrarlı bir sukuk piyasa hacmine sahip olduğunu göstermektedir. Suudi Arabistan'ın ise 2024 yılında büyük bir büyüme ivmesi yakaladığı görülmektedir. 2024 yılında 74 milyar USD sukuk ihraç etmiştir. Endonezya ise bu dönemde daha istikrarlı bir sukuk ihraç hacmine sahiptir. Grafik 3'te ilk 5 ülkenin sukuk ihraç hacimleri yer almaktadır.

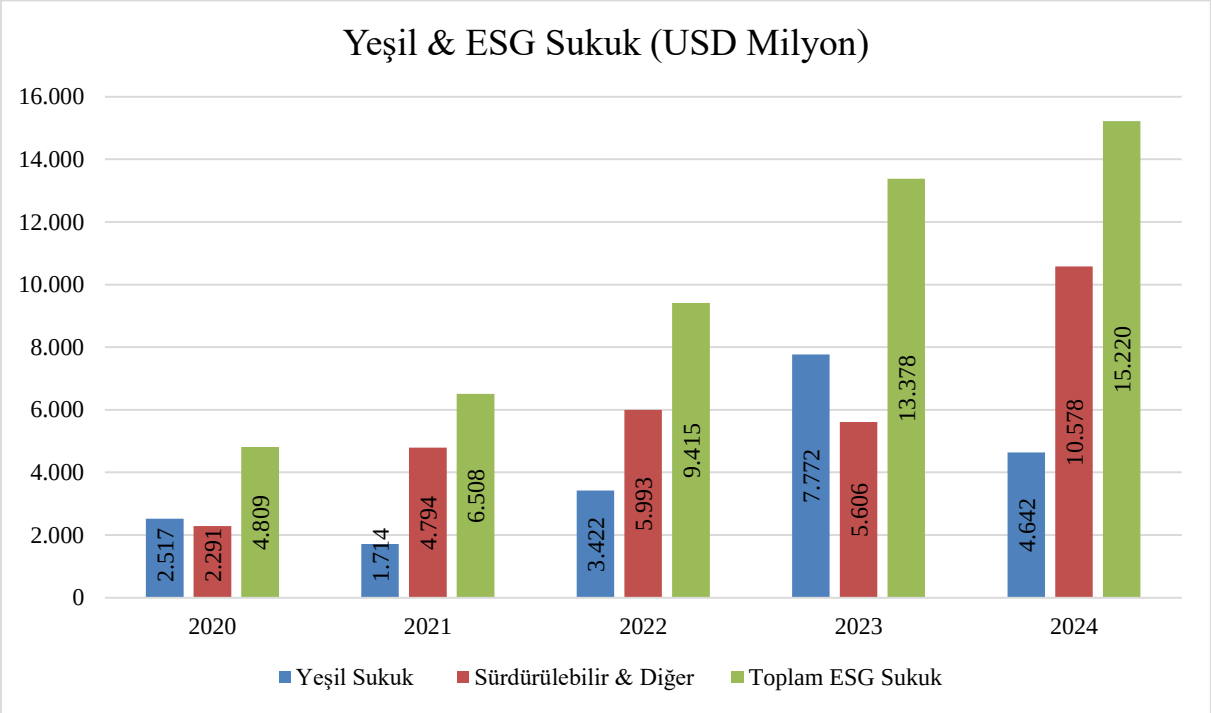
Grafik 3. Sukuk ihracına göre önde gelen ülkeler



Kaynak: LSEG Global Sukuk Update 2024

Çevresel, sosyal ve yönetişim (ESG) sukuk ihracı 2024 yılında rekor seviyeye ulaşarak 15,2 milyar USD'ye ulaşmıştır. Ancak bu genel büyümeye rağmen, yeşil sukukun toplam ESG sukuk ihracı içindeki payı düşük seviyelerdedir. Grafik 4'te yeşil, sürdürülebilir ve ESG sukuk ihraçlarının 2020-2024 yılları arasındaki büyüme ivmesi yer almaktadır.

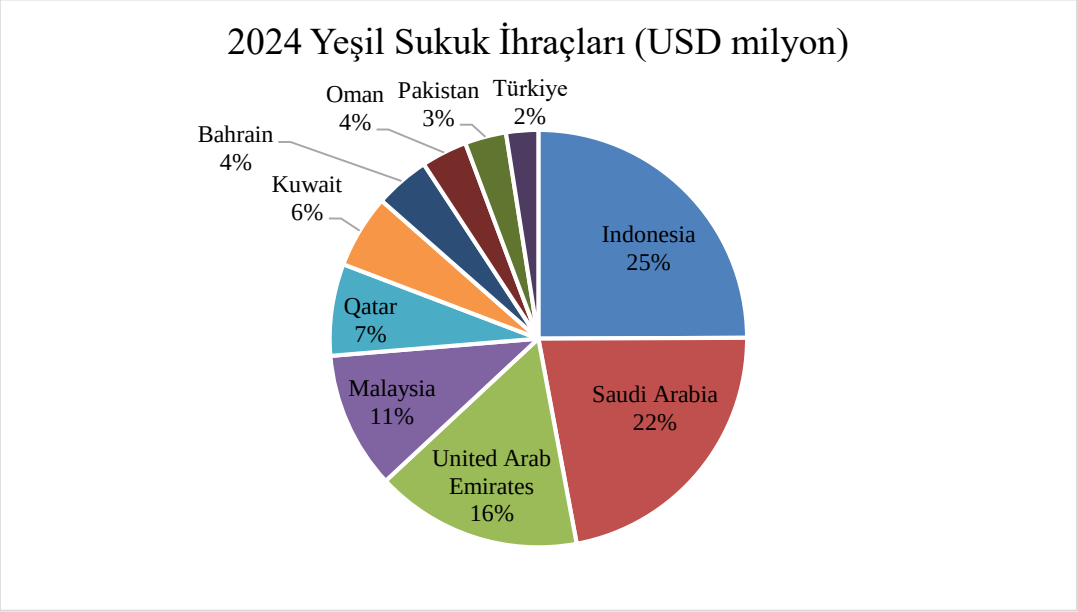
Grafik 4. Yeşil ve ESG sukuk ihraçları



Kaynak: LSEG Global Sukuk Update 2024

2024 yılında yeşil sukuk ihracının belirli ülkelerde yoğunluk kazandığı görülmektedir. Özellikle Endonezya ve Suudi Arabistan toplam küresel yeşil sukuk ihracının önemli bir payını oluşturmaktadır. Bu ülkeleri, Birleşik Arap Emirlikleri ve Malezya takip etmektedir. Grafik 5'te diğer ülkelerin payları yer almaktadır.

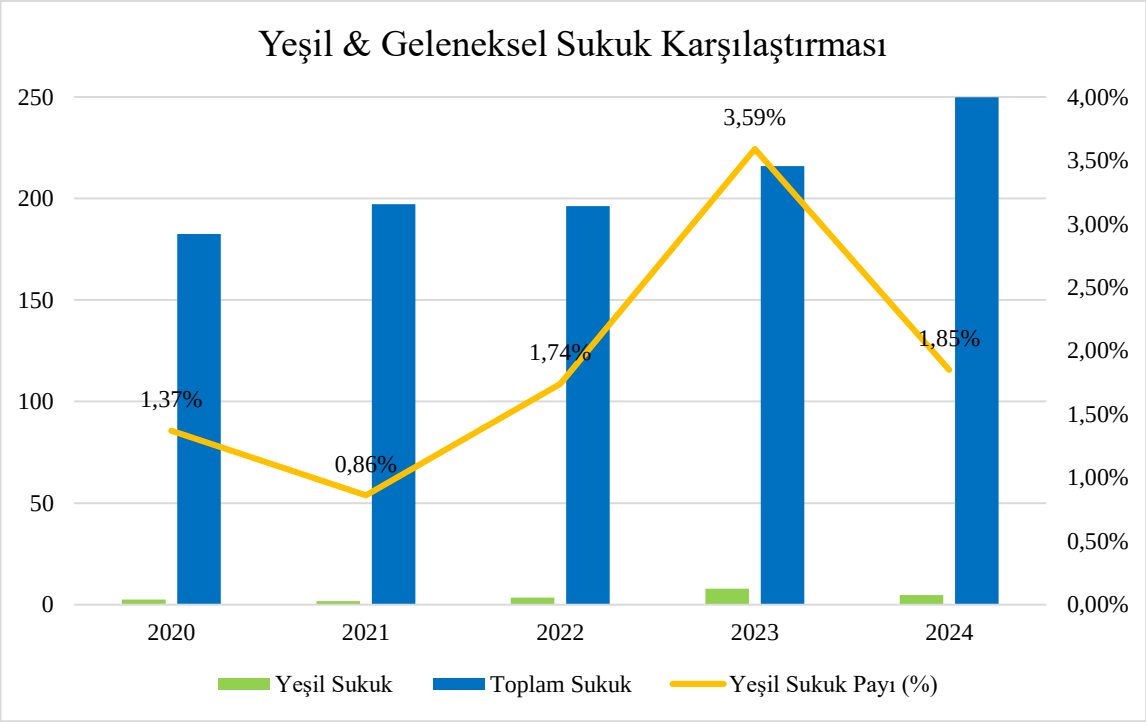
Grafik 5. 2024 yeşil sukuk ihraç hacimleri



Kaynak: Yazar tarafından LSEG Global Sukuk Update raporlarından derlenmiştir.

Yıllar itibariyle geleneksel sukuk ihraçları önemli düzeyde artarken yeşil sukuk ihraçlarının artışına rağmen pazar payının sınırlı olduğu görülmektedir. Yeşil sukuk ihracı 2023'te en yüksek hacme ulaşmış olmakla birlikte 2024'te kısmen bir düşüş yaşanmıştır. Grafik 6, örneklem dönemi boyunca yeşil sukuk ihracında artış olmasına rağmen, toplam sukuk ihracındaki payının sınırlı kaldığını göstermektedir. Bu durum, sürdürülebilir İslami finans alanındaki son dönemdeki büyümenin, yalnızca yeşil etiketli araçlardan ziyade, sürdürülebilirlik bağlantılı sukuk ihraçlarından kaynaklandığını düşündürmektedir.

Grafik 6. Yeşil ve geleneksel sukuk karşılaştırması



Kaynak: Yazar tarafından LSEG Global Sukuk Update raporlarından derlenmiştir

SONUÇ

Bu çalışma, küresel sukuk piyasasında yeşil sukuk ihraçlarının gelişimini ve toplam sukuk ihraçları içerisindeki konumunu incelemektedir. Çalışmada, 2020–2024 dönemine ait küresel sukuk verileri kullanılarak toplam geleneksel sukuk ihraçları ile yeşil sukuk ihraçları karşılaştırılarak oran analizi yoluyla değerlendirilmiştir. Çalışma, sürdürülebilir finans ve İslami finans literatüründe giderek önem kazanan yeşil sukuk ihraçlarının nicel büyümesinin, piyasa payı açısından nasıl bir görünüm sergilediğini ortaya koymayı hedeflemektedir.

Elde edilen bulgular, küresel sukuk ihraç hacminin incelenen dönemde istikrarlı bir artış eğilimi gösterdiğini ortaya koymaktadır. Yeşil sukuk ihraçlarının ise artış göstermesine rağmen toplam sukuk ihraçları içindeki payının oldukça sınırlı kaldığını göstermektedir. Yeşil sukuk oranı 2023 yılında yaklaşık %3,6 ile zirveye ulaşmıştır. Ancak 2024 yılında belirgin bir düşüş sergileyerek %2'nin altına gerilemiştir. Bu durum, sürdürülebilir İslami finans alanındaki büyümenin büyük ölçüde yeşil sukuk ihraçlarından ziyade sürdürülebilirlik bağlantılı sukuk ihraçları tarafından yönlendirildiğine işaret etmektedir.

Sonuç olarak, yeşil sukuk piyasasının sürdürülebilir biçimde büyüyebilmesi için yalnızca ihraç hacimlerinin artırılması yeterli değildir. Yeşil sukuk tanımının netleştirilmesi, ESG sukuk açık biçimde ayrıştırılması, standartlaştırılmış raporlama ve bağımsız doğrulama mekanizmalarının güçlendirilmesi büyük önem taşımaktadır. Bu çerçevede, İslami finans ilkeleri ile küresel

sürdürülebilir finans standartları arasında daha güçlü bir uyum sağlanması, yeşil sukuk küresel finansal sistemde daha etkin bir rol üstlenmesine katkı sağlayacaktır.

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İSLAMİ BANKALARDA LİKİDİTE VE KÂRLILIK İLİŞKİSİ: PANEL VERİ BULGULARI

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ÖZET

Bu çalışma, farklı coğrafi bölgelerde faaliyet gösteren 16 ülkedeki İslami bankalarda likidite ile kârlılık arasındaki ilişkiyi panel veri analizi yöntemiyle incelemeyi amaçlamaktadır. Analizde, 2013 yılının dördüncü çeyreği ile 2024 yılının üçüncü çeyreği arasını kapsayan çeyreklik veriler kullanılmıştır. Banka kârlılığını temsilen aktif kârlılık oranı (ROA) bağımlı değişken olarak ele alınırken, likidite oranı temel açıklayıcı değişken olarak modele dâhil edilmiştir. Ayrıca, banka büyüklüğü, takipteki krediler ve enflasyon oranı gibi bankalara özgü ve makroekonomik faktörler kontrol değişkenleri olarak kullanılmıştır.

Ampirik analiz sürecinde öncelikle sabit etkiler ve rassal etkiler modelleri tahmin edilmiştir. Bunun için uygun modelin belirlenmesi amacıyla Hausman testi uygulanmıştır. Hausman testi sonuçları, sabit etkiler modelinin tercih edilmesi gerektiğini göstermiştir. Elde edilen bulgular, likidite oranının banka kârlılığı üzerinde pozitif yönlü bir etkiye sahip olduğu, ancak bu etkinin istatistiksel olarak anlamlı olmadığını ortaya koymaktadır. Buna karşılık, banka büyüklüğü ve enflasyon oranının kârlılık üzerinde pozitif ve anlamlı bir etkiye sahip olduğu tespit edilmiştir. Takipteki krediler değişkeninin kârlılık üzerindeki etkisi ise negatif yönde olmakla birlikte istatistiksel açıdan anlamlı bulunmamıştır. Genel olarak bulgular, İslami bankalarda kârlılığın likidite düzeyinden ziyade bankalara özgü yapısal faktörler ve makroekonomik koşullar tarafından belirlendiğine işaret etmektedir.

Anahtar Kelimeler: İslami bankalar, likidite, kârlılık, panel veri analizi, sabit etkiler modeli

THE RELATIONSHIP BETWEEN LIQUIDITY AND PROFITABILITY IN ISLAMIC BANKS: PANEL DATA FINDINGS

ABSTRACT

This study aims to examine the relationship between liquidity and profitability in Islamic banks across 16 countries operating in different geographical regions using panel data analysis. The analysis utilizes quarterly data covering the period from the fourth quarter of 2013 to the third quarter of 2024. Return on assets (ROA), representing bank profitability, was considered as the dependent variable, while the liquidity ratio was included in the model as the main explanatory variable. In addition, bank-specific and macroeconomic factors such as bank size, credit risk, and inflation rate were used as control variables.

In the empirical analysis process, fixed effects and random effects models were first estimated. The Hausman test was applied to determine the appropriate model. The results of the Hausman test indicated that the fixed effects model should be preferred. The findings reveal that the liquidity ratio has a positive effect on bank profitability, but this effect is not statistically significant. In contrast, bank size and inflation rate were found to have a positive and significant effect on profitability. The effect of the credit risk variable on profitability was negative but not statistically significant. Overall, the findings indicate that profitability in Islamic banks is determined by bank-specific structural factors and macroeconomic conditions rather than the level of liquidity.

Keywords: Islamic banks, liquidity, profitability, panel data analysis, fixed effects model

1. GİRİŞ

Likidite, finansal bir kurumunun kısa vadeli yükümlülüklerini yerine getirmesidir. Finansal kurumlar genellikle kısa vadeli fon toplayarak uzun vadeli kredi verme durumunda oldukları için varlık-yükümlülük gibi vade uyumsuzluğu ile karşı karşıya kalabilmektedir. Bu vade uyumsuzluğuna rağmen kurumlar borç verme eğiliminde olsalar bile mevduat çıkışlarındaki beklenmedik durumlar, finansal kurumlarda ciddi likidite problemlerine neden olmaktadır (Ben Jedida & Hamza, 2014). Bu nedenle, likidite riskine yönelik finansal piyasa aktörleri ve kamu otoriteleri bu riski yakından izlemiş ve yasal düzenlemeleri sürekli güncel tutmuştur.

Finansal sistemin istikrarı açısından bankacılık sektörü kritik bir rol üstlenmektedir. Bunun için sektörün sağlıklı işleyişi büyük ölçüde bankaların likidite ve kârlılık yapılarına bağlıdır (D'Avino vd., 2022, s. 550). Geleneksel ve İslami bankalar ise, likidite riskini yönetme konusunda çeşitli risklerle karşı karşıyadır. Ancak İslami bankalar, faizsiz finans ilkeleri doğrultusunda faaliyet göstermeleri nedeniyle konvansiyonel bankalardan farklı bir bankacılık sistemine sahiptir. Kâr-zarar paylaşımına dayalı finansman yapıları, varlık temelli işlemler ve riskin taraflar arasında paylaşılması gibi özellikler, İslami bankaların likidite yönetimini daha karmaşık bir hâle getirmektedir. Bu durum, likidite ile kârlılık arasındaki ilişkinin İslami bankalar açısından ayrıca ele alınmasını gerekli kılmaktadır. Özellikle yüksek likidite tutma eğiliminin, ihtiyatlı bir risk yönetimi yaklaşımını yansıtmakla birlikte kârlılık üzerinde sınırlayıcı bir etki yaratıp yaratmadığı literatürde tartışılan temel konular arasında yer almaktadır.

Mevcut literatürde bankacılık sektöründe likidite ve kârlılık ilişkisini inceleyen çok sayıda çalışma bulunmaktadır. Ancak İslami bankacılık sistemine odaklanan çalışmaların daha sınırlı olduğu görülmektedir. Bu çalışma, farklı ülkelerde faaliyet gösteren İslami bankalara ait

2013Q4–2024Q3 dönemi çeyreklik panel veri seti kullanarak incelemeyi amaçlamaktadır. Çalışmada, Banka kârlılığı ROA ile ölçülmüş, likidite göstergeleri temel açıklayıcı değişken olarak modele dâhil edilmiştir. Model tahminlerinde sabit ve rassal etkiler modelleri kullanılmış, Hausman testi sonuçlarına göre uygun model tercih edilmiştir. Standart hatalar heteroskedastisiteye karşı robust olarak hesaplanmıştır.

Çalışmanın literatüre temel katkısı, banka-özel heterojenliği dikkate alan sabit etkiler modeli aracılığıyla likidite-kârlılık ilişkisinin daha tutarlı bir şekilde analiz edilmesidir. Ayrıca banka büyüklüğü, takipteki krediler ve enflasyon gibi kontrol değişkenleri modele dâhil edilerek kârlılığın mikro ve makro belirleyicileri birlikte ele alınmaktadır. Elde edilen bulguların, İslami bankaların likidite yönetimi stratejileri ve düzenleyici politikalar açısından önemli çıkarımlar sunması beklenmektedir.

Çalışma dört bölümden oluşmaktadır. Girişin devamında literatür taraması bölümünde mevcut ulusal ve uluslararası çalışmalar ele alınmıştır. Yöntem bölümünde veriler, örneklem ve model ele alınmıştır. Son kısım ise sonuç ve tartışma bölümüdür.

2. LİTERATÜR TARAMASI

İslami bankacılık literatüründe likidite ve kârlılık arasındaki ilişki uzun süredir tartışılan bir konu olmuştur. Bu ilişkinin yönü konusunda ise araştırmacıların net bir görüş birliğine vardığı söylenemez. Konu ile ilgili yapılmış çalışmalar aşağıda yer almaktadır.

Işıl ve Özkan (2015), katılım bankalarının likidite riski üzerindeki etkileri 2006-2014 yıllarına ait veriler ışığında ele almışlardır. Panel veri analizi bulgularına göre, kredi genişlemesinin likidite riskini etkilediğini tespit etmişlerdir.

Megeid (2017), Mısır'da faaliyet gösteren İslami ve geleneksel bankacılıkta likidite risk yönetimini incelemiştir. 2004-2011 dönemine ait verileri kullanarak yapılan regresyon analizi sonuçları, geleneksel bankaların likidite yönetimi, fonlama ve varlık kalitesi konularında İslami bankalara göre daha başarılı bir performans sergilediğini ortaya koymuştur.

Kucukcolak (2019), Türkiye'deki katılım bankalarının likidite risk yönetimini 2005-2017 yılları arasındaki verileri kullanarak incelemiştir. Görünüşte İlişkisiz Regresyon (SUR) yöntemi ile elde ettiği sonuçlara göre toplam krediler ve fonların likidite üzerinde doğrudan etkiye sahip olduğunu bulmuştur.

Amin vd. (2021), 2000-2017 yılları arasında İslam İşbirliği Teşkilatı'na (İİT) üye 14 ülkedeki geleneksel ve İslami bankaların likidite riski üzerindeki bankacılık düzenlemelerinin rolünü, GMM yöntemi ile incelemişlerdir. Bulgulara göre, düzenlemenin banka likiditetesini sınırlı düzeyde etkilediğini bulmuşlardır.

Addou ve Bensghir (2021), Birleşik Arap Emirlikleri'nde faaliyet gösteren İslami bankaların karşılaştığı likidite riskini etkileyen temel parametreleri incelemişlerdir. Yıllık verileri regresyon modeli ile inceledikleri araştırma bulgularında, özkaynak getirisi ve takipteki kredilerin İslami bankaların likidite riskini olumsuz etkilediğini, diğer belirleyicilerin ise (banka büyüklüğü, özkaynak getirisi, likidite açıkları ve sermaye yeterlilik oranı) bankalarının likiditesinin olumlu etkilediğini tespit etmişlerdir.

Malhou ve Maimoun (2021), İslami bankalarda likidite riski ile varlık-yükümlülük yönetimi arasındaki ilişkiyi incelemek için yapılan tüm çalışmaları incelemiş ve likidite riskine yönelik sorunları ele almışlardır.

Akbaş (2022), Türkiye'deki İslami bankaların likidite riskini etkileyen faktörleri 2016-2019 yılları arasındaki verileri kullanarak panel veri yöntemi ile analiz etmiştir. Bulgulara göre, likidite riski ile sermaye yeterlilik oranı arasında olumlu bir ilişkinin olduğunu tespit etmiştir.

Hashim vd. (2022), İslami bankaların verimlilik ve likidite riski arasındaki ilişkiyi 1986-2015 dönemine ait verileri kullanarak GMM yöntemi ile araştırmışlardır. Analiz sonuçlarına göre, yüksek çıktı verimliliğine sahip bankaların likidite riski ile ters, net istikrarlı fonlama oranı ile pozitif bir ilişkiye sahip olduğunu tespit etmişlerdir.

Cakmak ve Sunal (2023), COVID-19 dönemide İslami ve geleneksel bankaların likidite risk belirleyicilerini araştırmışlardır. 2011Q1-2022Q2 dönemini kapsayan verileri kullanarak yapmış oldukları panel veri analizine göre, geleneksel ve İslami bankalar için likidite riskinin belirleyicilerinin büyük ölçüde benzer olduğu sonucuna varmışlardır.

Safdar vd. (2024), 2011-2020 dönemine ait verileri kullanarak, Pakistan'daki İslami ve geleneksel bankaların likidite risklerini incelemişlerdir. Regresyon analizi bulguları, İslami bankaların operasyonel olarak daha az verimli olduğunu ve geleneksel bankalara göre daha yüksek likidite riski yaşadığını göstermiştir.

Maulana vd. (2025), Endonezya ve Malezya'daki İslami bankaların finansal istikrarına yönelik likidite ve kredi riski ile sermaye yeterlilik oranının etkisini incelemişlerdir. 2018-2024 dönemi kapsayan verileri kullanarak yapmış oldukları panel veri analizi bulgularına göre, daha düşük likidite riski ve kredi riski olan bankaların istikrar açısından daha iyi performans gösterme eğiliminde olduğunu bulmuşlardır.

Aljbour vd. (2025), Körfez İşbirliği Konseyi (GCC) bölgesindeki 29 İslami bankada kurumsal sosyal sorumluluk (KSS) açıklamaları ile finansal istikrar arasındaki ilişkiyi incelemişlerdir. Bulgularda, KSS açıklamaları ile bankaların iflas riski arasında anlamlı negatif bir ilişki ve KSS açıklamaları ile bankaların likidite riski arasında anlamlı pozitif bir ilişki bulmuşlardır.

Yukarıda ele alınan literatür çalışmalarına bakıldığında, birçok çalışma İslami bankaların likidite ve kârlılık ilişkisini farklı şekillerde ele almışlardır. Literatürde likidite ile kârlılık arasındaki ilişki uzun süredir tartışılmakta olup, bu ilişkinin yönü konusunda net bir görüş birliği bulunmamaktadır. Bildiğimiz kadarıyla, farklı ülkelerde faaliyet gösteren İslami bankaların likidite karşılaşmasını bu denli uzun veriler ile karşılaştıran sınırlı sayıda çalışma bulunmaktadır. Bu anlamda çalışma mevcut literatüre katkıda bulunmayı hedeflemektedir.

3. ARAŞTIRMA VERİ SETİ, METODOLOJİ VE BULGULAR

3.1. Veri Seti ve Değişkenler

Bu çalışmada, farklı ülkelerde faaliyet gösteren İslami bankalara ait 2013Q4–2024Q3 dönemini kapsayan veri seti kullanılmıştır. Banka kârlılığı bağımlı değişken olarak (ROA) kullanılmıştır. Likidite oranı, banka büyüklüğü, takipteki krediler ve enflasyon oranı ise bağımsız değişkenler olarak kullanılmıştır. Değişkenlere ait bilgiler Tablo 1'de yer almaktadır.

Tablo 1: Değişkenlere Ait Bilgiler

Değişken	Tanım	Kod	Kaynak
Bağımlı Değişken			
Kârlılık	Aktif Kârlılık Oranı	ROA	Refinitiv Eikon
Bağımsız Değişkenler			
Likidite	Likidite Oranı	LIQ	Refinitiv Eikon
Aktif Büyüklük	Bankaların Akif Büyüklüğü (Doğal Logaritması Alınmıştır)	SIZE	Refinitiv Eikon
Takipteki Krediler	Bankaların Takipteki Kredi Oranı	NPL	Refinitiv Eikon
Enflasyon	Ülkelerin Enflasyon Oranları	INF	Imf

Tablo 2'de değişkenler için tanımlayıcı istatistikler bulunmaktadır. İslami bankalarının kârlılık ortalaması %1'dir. Bu durum İslami bankaların ortalama kâr oranları ile uyumludur. İslami bankaların likide oranlarının ise ortalama %20 seviyesinde olduğu görülmektedir. Tablo 2'de tüm değişkenlere ait özet istatistikler yer almaktadır:

Tablo 2. Özet İstatistikler

Değişken	Gözlem	Ort.	Standart Hata	Min	Mak
roa	472	0.0147013	0.009316	-0.058	0.05
liq	468	0.263645	0.1508869	-0.00015	0.724
size	467	10.70057	1.375573	5.309881	12.87988
npl	473	0.0380894	0.0277605	0	0.149
inf	455	0.0135285	0.0270315	-0.0303527	0.2828672

Değişkenlere ait korelasyon sonuçları Tablo 3'te yer almaktadır. İslami bankalarda kârlılık ile likidite arasında pozitif ve istatistiksel olarak anlamlı bir ilişki bulunduğunu göstermektedir. Ayrıca banka büyüklüğü ve enflasyonun kârlılıkla pozitif, takipteki kredilerin ise negatif ilişkili olduğu görülmektedir.

Tablo 3. Korelasyon Katsayıları

	roa	liq	size	npl	inf
roa	1.000				
liq	0.3012*	1.000			
size	0.1441*	-0.1878*	1.000		
npl	-0.0783*	-0.0743*	-0.1344*	1.000	
inf	0.4493*	0.4558*	-0.1609*	-0.0785*	1.000

%1 seviyesinde anlamlı korelasyon katsayıları * ile gösterilmiştir (* p<0.1).

3.2. Metodoloji

Ekonometrik analizlerde kullanılan veriler genellikle üç ana kategoriye ayrılmaktadır: zaman serileri, yatay kesit verileri ve panel verileri. Zaman serileri, belirli bir zaman dilimi boyunca değişkenlerin sayısal değerlerindeki değişimi göstermektedir. Yatay kesit verileri, belirli bir zaman noktasında farklı örnek birimlerine ait bilgileri sunar. Panel verileri ise, farklı birimlere ait yatay kesit verilerinin, zaman içinde birleştirilmesi ile elde edilen veri setleridir (Brooks, 2014, s. 526; Tatoğlu, 2020, ss. 1-2) . Çalışmanın analiz kısmında, panel veri analizi yöntemi kullanılarak ekonometrik tahminler gerçekleştirilmiştir.

Panel veri analizi, çoklu doğrusal bağlantı sorununu en aza indirdiği için diğer yöntemlere göre daha güvenilir ve başarılı analizler sunmaktadır (Baltagi, 2005, ss. 3-5). Bu çalışmada, İslami bankaların likidite ve kârlılık ilişkisini analiz etmek için panel veri analizi yöntemi kullanılmıştır. Naudé ve Saayman (2005)'ın çalışması referans alınarak, aşağıdaki ekonometrik model oluşturulmuş ve çeşitli varyasyonları tahmin edilmiştir (Yüksel vd., 2018):

$$Y_{it} = \alpha + \sum_{k=1}^{K} \beta_k X_{kit} + \varepsilon_{it} \quad \textbf{(1)}$$

Denklem (1)'deki bağımlı değişkene Y_{it} ve $\sum_{k=1}^{K} \beta_k X_{kit}$ analiz yapılacak modellerde kullanılacak değişkenler eklendiğinde aşağıdaki model ortaya çıkmaktadır:

$$ROA_{it} = \beta_0 + \beta_1 LIQ_{it} + \beta_2 SIZE_{it} + \beta_3 NPL_{it} + \beta_4 INF_{it}$$

(2)

Denklemlerde her t yılı ve i bankası için, ROA İslami bankalarının aktif kârlılığını, LIQ İslami bankalarının likidite oranını, $SIZE$ İslami bankalarının toplam aktiflerini, NPL İslami bankalarının takipteki kredi oranlarını, INF ülkelerin yıllık enflasyon oranını göstermektedir.

3.3. Ampirik Bulgular

Model tahminlerinde öncelikle rassal ve sabit etkiler modelleri uygulanmıştır. Hausman testi sonuçlarına göre sabit etkiler modelinin uygun olduğu belirlenmiştir. Sabit Etkiler Modeli kapsamında yapılan varsayım testleri, grup bazlı heteroskedastisite varlığını ortaya koyduğundan nihai model banka düzeyinde kümelenmiş sağlam standart hatalar kullanılarak tahmin edilmiştir. Bu yaklaşım, heteroskedastisite ve banka-içi bağımlılık problemlerine karşı tutarlı tahminler sağlamaktadır. Panel veri yapısının dengesiz olması nedeniyle Baltagi–Wu ve Pesaran CD testleri güvenilir şekilde uygulanamamıştır. Panel veri setinin dengesiz olmasının temel sebebi ise bazı bankalara ait verilerin temin edilememesinden kaynaklanmaktadır. Tablo 4'te spesifikasyon test sonuçları yer almaktadır.

Tablo 4. Spesifikasyon Testlerinin Sonuçları

Model	Hausman Testi		Levene, Brown ve Forsythe Testi		VIF
	(SEM vs TEM)		(Değişen Varyans-Heterokedastisite)		(Çoklu Doğrusal Bağlantı)
ROA	**İst.**	**Olasılık**	**İst.**	**Olasılık**	**Vif**
1	35.05	0.0000	18060.99	0.0000	1.22

Sabit etkiler modeli ile kârlılık ve likidite arasındaki ilişkiye dair analiz sonuçları Tablo 6 5'te yer almaktadır:

Tablo 5. Analiz Sonuçları

Değişkenler	Model
liq	0.016
	(0.013)
size	0.009**
	(0.003)
npl	-0.029
	(0.056)
inf	0.126***
	(0.017)
Sabit	-0.084**
	(0.033)
Gözlem	443
R^2	0.339

Not: Standart hatalar parantez içinde verilmiştir. *** p<0.01, ** p<0.05, * p<0.1

Bulgulara göre, kârlılık üzerinde likidite oranının katsayısı pozitif bulunmuştur. Ancak bu sonuç istatistiksel olarak anlamlı değildir. Bu durum, İslami bankalarda likiditenin doğrudan kârlılığı artıran bir unsur olmadığına işaret etmektedir. İslami bankaların yüksek likidite seviyelerine sahip olmaları riskten kaçınma davranışını yansıtmaktadır. Ancak bu hususun kısa vadede kârlılık üzerinde güçlü bir etki yaratmadığını ortaya koymaktadır.

Banka büyüklüğünün kârlılık üzerindeki etkisi ise pozitiftir. Bu sonuç, ölçek ekonomileri teorisine dayanmaktadır. Yani daha büyük aktiflere sahip İslami bankaların operasyonel verimlilik, maliyet avantajı ve piyasa gücünün daha yüksek kârlılık elde edebileceklerini ortaya koymaktadır. Takipteki kredilerin katsayısı negatif olup istatistiksel olarak anlamlı değildir.

Makroekonomik değişkenlerden enflasyon oranının kârlılık üzerindeki etkisi pozitiftir. Bu durum, özellikle enflasyonist ortamlarda nominal gelirlerin artması ve finansal ürünlerin fiyatlanmasındaki esneklik sayesinde İslami bankaların kârlılıklarını artırabildiklerini göstermektedir.

Analiz bulguları, İslami bankalarda likidite-kârlılık ilişkisinde, likiditenin tek başına kârlılığı belirleyen bir unsur olmadığını ortaya koymaktadır. Bunun yanında bankaya özgü değişkenler ve makroekonomik verilerin de kârlılık üzerinde belirleyici etkiye sahip olduğunu doğrulamaktadır. Bu bulgular, İslami bankaların likidite yönetiminde ihtiyatlı yaklaşımı sürdürürken, ölçek ve operasyonel verimliliklerini artırmaya yönelik stratejilere odaklanmalarının önemine işaret etmektedir.

SONUÇ

Bu çalışmada, İslami bankalarda likidite ile kârlılık arasındaki ilişki incelenmiştir. 2013Q4–2024Q3 dönemine ait veriler ile yapılan analiz sonuçları, likidite oranının kârlılık üzerinde pozitif bir etkiye sahip olduğunu göstermekle birlikte istatistiksel olarak anlamlı bir etkiye sahip olmamıştır. İslami bankalarda yüksek likidite seviyelerinin doğrudan kârlılığı artıran bir unsur olmadığı söylenebilir. Bu bulgu İslami bankaların kârlılık–likidite dengesini temkinli biçimde yönettiklerine işaret etmektedir.

Banka büyüklüğünün kârlılık üzerindeki etkisinin pozitif ve istatistiksel olarak anlamlı olması ise ölçek ekonomileri teorisini desteklemektedir. Daha büyük İslami bankaların operasyonel verimlilik, maliyet avantajı ve ürün çeşitliliği sayesinde daha yüksek kârlılık elde edebildikleri görülmektedir. Takipteki alacaklar oranının ise kârlılık üzerindeki etkisi istatistiksel olarak anlamlı bulunmamıştır. Enflasyonun ise kârlılık üzerindeki etkisinin pozitif olduğu tespit edilmiştir. Bu bulgu, enflasyonist ortamlarda nominal gelirlerin artması ve fiyatlama mekanizmalarındaki esneklik sayesinde İslami bankaların kârlılıklarını artırabildiklerini ortaya koymaktadır.

Bu çalışma, İslami bankaların likidite yönetiminde aşırı temkinli yaklaşımların kârlılık üzerinde sınırlayıcı etki yaratabileceğini göstermektedir. Buna karşılık ölçek büyümesini ve operasyonel verimliliği artırmaya yönelik stratejilerin kârlılığı destekleyebileceği söylenebilir. Düzenleyici otoritelerin İslam hukukuna uygun likidite enstrümanlarının geliştirilmesi ve ikincil piyasaların

derinleştirilmesine yönelik adımlar atması önemlidir. Bu durum İslami bankaların likidite yönetimini kolaylaştıracak ve kârlılık–istikrar dengesini güçlendirecektir. Gelecek çalışmalarda farklı likidite göstergelerinin kullanılması, bölgesel karşılaştırmalar yapılması ve doğrusal olmayan ilişkilerin incelenmesi literatüre önemli katkılar sağlayabilir.

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FROM COMPLIANCE TO COMPETENCE: A LONGITUDINAL CONTENT ANALYSIS OF AVIATION ENGLISH RESEARCH IN THE TURKISH EFL CONTEXT (2008–2025)

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ABSTRACT

The mandatory implementation of the International Civil Aviation Organization (ICAO) Language Proficiency Requirements in 2008 necessitated a fundamental restructuring of aviation education in expanding EFL (English as a Foreign Language) contexts like Türkiye. Despite a subsequent proliferation of local academic inquiries, the research landscape remains fragmented across disparate repositories and sub-disciplines, often treating pilot training and cabin crew education in isolation. This study presents a comprehensive descriptive content analysis of 82 academic studies—comprising master's theses, doctoral dissertations, and peer-reviewed articles—produced within the Turkish context between 2008 and 2025. Data were systematically harvested from the YÖK National Thesis Center, TÜBİTAK ULAKBİM (DergiPark), and international indices to map the methodological and thematic evolution of the field. The longitudinal analysis identifies a tripartite evolutionary trajectory in Turkish Aviation English research. The initial "Regulatory Phase" (2008–2012) was characterized by reactive studies focusing primarily on test validity and assessment literacy in response to the immediate ICAO mandate. This evolved into a "Curricular Phase" (2013–2019), dominated by Target Situation Analyses (TSA) and syllabus design for rapidly expanding tertiary pilotage programs. Most significantly, validated data from the "Psycholinguistic Phase" (2020–2025) reveals a paradigm shift away from structural linguistics toward human factors. Recent findings confirm a divergence in research focus: while flight deck research remains anchored in regulatory compliance and phraseology, research on cabin crew has emerged as a distinct vocational discipline focused on Intercultural Communication Apprehension (ICA) and stress management. The study concludes that Aviation English in Türkiye has matured from a monolithic, compliance-based obligation into a sophisticated, interdisciplinary field. These findings suggest that future curricula must integrate psychological resilience training alongside linguistic instruction to meet the complex demands of modern operational safety.

Keywords: Aviation English, Descriptive Content Analysis, Needs Analysis, English for Cabin Crew, ICAO, ESP.

UYUMDAN YETKİNLİĞE: TÜRKİYE'DE EFL BAĞLAMINDAKİ HAVACILIK İNGİLİZCESİ ARAŞTIRMALARININ BOYLAMSAL İÇERİK ANALİZİ (2008–2025)

ÖZET

Uluslararası Sivil Havacılık Örgütü (ICAO) Dil Yeterlilik Kriterlerinin 2008 yılında zorunlu hale getirilmesi, Türkiye gibi gelişmekte olan EFL (Yabancı Dil Olarak İngilizce) bağlamlarında havacılık eğitiminin temelden yeniden yapılandırılmasını zorunlu kılmıştır. Takip eden süreçte yerel akademik çalışmalarda büyük bir artış görülmesine rağmen, araştırma manzarası farklı veri tabanlarına ve alt disiplinlere dağılmış durumdadır; nitekim bu çalışmalar genellikle pilot eğitimi ile kabin memuru eğitimini birbirinden yalıtılmış şekilde ele almaktadır. Bu çalışma, 2008 ile 2025 yılları arasında Türkiye bağlamında üretilmiş yüksek lisans tezleri, doktora tezleri ve hakemli makalelerden oluşan **82 akademik çalışmanın** kapsamlı bir betimsel içerik analizini sunmaktadır. Veriler, alanın metodolojik ve tematik evrimini haritalandırmak amacıyla YÖK Ulusal Tez Merkezi, TÜBİTAK ULAKBİM (DergiPark) ve uluslararası indekslerden sistematik olarak toplanmıştır. Boylamsal analiz, Türk Havacılık İngilizcesi araştırmalarında üç aşamalı bir evrimsel süreç tespit etmektedir. Başlangıçtaki **"Mevzuat Evresi" (2008–2012)**, acil ICAO zorunluluğuna yanıt olarak öncelikli olarak test geçerliliği ve ölçme-değerlendirme okuryazarlığına odaklanan tepkisel çalışmalarla karakterize edilmiştir. Bu süreç, hızla genişleyen yükseköğretim pilotaj programlarına yönelik Hedef Durum Analizleri (TSA) ve müfredat tasarımının baskın olduğu bir **"Müfredat Evresi"ne (2013–2019)** evrilmiştir. En önemlisi, **"Psikodilbilimsel Evre"den (2020–2025)** elde edilen doğrulanmış veriler, yapısal dilbilimden insan faktörlerine doğru bir paradigma değişimi olduğunu ortaya koymaktadır. Güncel bulgular, araştırma odaklarında bir ayrışmayı doğrulamaktadır: Kokpit (uçuş güvertesi) araştırmaları mevzuat uyumu ve frasyolojiye (Standart Konuşma Kalıpları) bağlı kalmaya devam ederken, kabin memuru araştırmaları **Kültürlerarası İletişim Kaygısı (ICA)** ve stres yönetimine odaklanan ayrı bir mesleki disiplin olarak ortaya çıkmıştır. Çalışma, Türkiye'de Havacılık İngilizcesinin tek tip, uyum temelli bir zorunluluktan; sofistike ve disiplinler arası bir alana dönüştüğü sonucuna varmaktadır. Bu bulgular ışığında, modern operasyonel güvenliğin karmaşık taleplerini karşılamak için gelecekteki müfredatların, dil öğretiminin yanı sıra psikolojik dayanıklılık eğitimini de entegre etmesi gerektiğini öne sürülmektedir.

Anahtar Kelimeler: Havacılık İngilizcesi, Betimsel İçerik Analizi, İhtiyaç Analizi, Kabin Ekibi İçin İngilizce, ICAO, ESP.

EXAMINING HOW E24 STEEL PREVENTS CORROSION IN ACIDIC ENVIRONMENTS USING 1,4-TRANS PLYMYRCENE AND MYRCENE-LACTIDE BLOCK COPOLYMERS: AN IN-DEPTH ANALYSIS COMBINING CHEMICAL, ELECTROCHEMICAL, AND THEORETICAL MODELING APPROACHES

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ABSTRACT

The present research undertakes a rigorous examination of the corrosion-mitigating potential exhibited by 1,4-trans-polymyrcene (PM) and its myrcene-lactide block copolymer derivatives (PM-PL) when applied to E24 carbon steel immersed in strongly acidic media. A synergistic methodological framework was deployed, wherein state-of-the-art electrochemical interrogation techniques specifically potentiodynamic polarization and electrochemical impedance spectroscopy (EIS) were methodically integrated with Computational analyses using Density Functional Theory (DFT) were performed to investigate the system's properties. dual experimental theoretical paradigm enabled a nuanced elucidation of the adsorption dynamics, perturbations in interfacial electron-transfer processes, and the physicochemical mechanisms underpinning the development of protective surface layers at the steel–electrolyte boundary.the research shows that both PM and PM-PL successfully reduce corrosion in a 1 M HCl solution. Notably, PM-PL was found to outperform PM, achieving an inhibition efficiency of 92.85% compared to 81.02% for PM, particularly at certain concentrations. The results reveal the mechanisms behind their protective effects, primarily by adhering to the steel's surface and slowing down the electrochemical processes that cause corrosion. In addition, the study looks at how factors like temperature, immersion time, and inhibitor concentration affect their efficiency. The DFT analysis sheds light on how PM-PL not only has a stronger interaction with the steel surface but also shows superior chemical reactivity, making it a more potent corrosion inhibitor than PM. This study highlights the potential of bio-based myrcene-lactide block copolymers as eco-friendly and effective corrosion inhibitors, offering promising prospects for industrial use.

Keywords: Plymyrcene, E24 steel, Corrosion inhibitors, Electrochemistry techniques, DFT

EFFECT OF ADDİNG OKRA CALYX POWDER ON THE SENSORY PROPERTİES AND NUTRİTİONALVALUE OF WHEAT BİSCUİTS

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Abstract

This study aimed to evaluate the chemical and nutritional properties of Iraqi okra pods (summer season) and to explore their potential use as a functional ingredient to enhance the nutritional and health value of biscuits. Analysis revealed that okra pod powder contains a high percentage of carbohydrates (58.23%) and dietary fiber (22.66%), along with a good protein content (8.25%) and a significantly low fat content (1.22%). Active compounds (HPLC): Important flavonoid compounds were identified at high concentrations, most notably rutin (101.5 ppm), quercetin (95.0 ppm), kaempferol, and apigenin. Antioxidant activity: The pod extract demonstrated high free radical inhibition activity (DPPH test), outperforming vitamin C at all concentrations used, with an inhibition rate of 78.74% at a concentration of 500 ppm. The biscuits were fortified with okra pod powder at different addition percentages (20%, 40%, and 60%) and compared to a control sample (0%). The results were as follows: Sensory Acceptance: Low and medium addition percentages were sensorily acceptable. Effect on Characteristics: High percentages (60%) led to a significant decrease in taste, color, and appearance scores, while freshness remained the most stable characteristic. Okra pods are a rich source of fiber and antioxidant bioactive compounds. The study concludes that they can be successfully used in the production of functional foods (fortified biscuits) with high nutritional value, with the recommendation to control the addition percentages to maintain the product's sensory characteristics .

Key word : Okra Calyx , Wheat Biscuits, the Sensory Properties and Nutritiona

KÜRESEL EKONOMİDE VE TÜRKİYE'DE LOJİSTİK SEKTÖRÜ: AKILLI SÖZLEŞMELERİN ROLÜ

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ÖZET

Uluslararası ticaretin temel bileşenlerinden biri olan lojistik sektörünün küresel ölçekteki önemi giderek artmakta; dünya ekonomisindeki dijital dönüşümden lojistik süreçler de etkilenmektedir. Lojistik endüstrisindeki dijitalleşme küresel çapta ticari girişimcilik faaliyetlerini kolaylaştırmaktadır. Dünya ticaretinde artan rekabet ortamı firmaların bir rekabet avantajı olarak verimli ve şeffaf lojistik çözümlere yönelmesini zorunlu hale getirmiştir. Bu bağlamda, blockchain teknolojisinin sunduğu olanaklarla taraflar arasında güvenli ve otomatik işlem yapma yeteneği sağlayan akıllı sözleşmeler, lojistik süreçleri optimize eden güncel gelişmeler arasında ilgi odağı haline gelmiştir. Akıllı sözleşmelerin lojistik süreçlerde sağladığı şeffaflık ve verimlilik artışları, işlem akışını hızlandırması, işletmelerin maliyetlerini düşürmesi ve güvenli veri paylaşımına olanak tanıması gibi etkileri sayesinde lojistik yönetiminde ekonomik sürdürülebilirliğe katkı sağlaması beklenmektedir. Bu çalışmada; dünya ekonomisinde ve Türkiye'de lojistik pazarının güncel ekonomik görünümü incelenmekte; uluslararası ticari işlemlere dijital teknolojik yeniliklerin entegrasyonun etkileri akıllı sözleşmeler ekseninde ele alınmakta ve akıllı sözleşmelerin lojistik ekonomisinin dijital dönüşümünde sunduğu olanaklar tartışılmaktadır.

Anahtar Kelimeler: Küresel ekonomi, lojistik ekonomisi, akıllı sözleşmeler

THE LOGISTICS SECTOR IN THE GLOBAL ECONOMY AND IN TÜRKİYE: THE ROLE OF SMART CONTRACTS

ABSTRACT

One of the fundamental components of international trade, the logistics sector, is gaining increasing importance on a global scale; logistics processes are also being affected by the digital transformation of the world economy. The digitalization of the logistics industry facilitates entrepreneurial activities in global trade. The intensifying competitive environment in world trade has made it imperative for companies to adopt efficient and transparent logistics solutions as a competitive advantage. In this context, smart contracts—enabled by blockchain technology, which provide secure and automated transaction capabilities between parties—have become a focal point among recent developments optimizing logistics processes. The transparency and efficiency improvements brought by smart contracts in logistics processes, their ability to accelerate transaction flows, reduce business costs, and enable secure data

sharing, are expected to contribute to economic sustainability in logistics management. In this study, the current economic outlook of the logistics market in the world economy and in Türkiye is examined; the effects of integrating digital technological innovations into international trade transactions are discussed through the lens of smart contracts, and the opportunities offered by smart contracts in the digital transformation of the logistics economy are explored.

Keywords: Global economy, logistics economy, smart contracts

ENGELLİ KARDEŞE SAHİP OLAN BİREYLERİN DENEYİMLEDİKLERİ GÜÇLÜKLER: DİYARBAKIR ÖRNEĞİ

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ÖZET

Engelli doğuştan veya sonradan herhangi bir nedenle bedensel, zihinsel, ruhsal, duyusal ve sosyal yeteneklerini çeşitli derecelerde kaybetmesi nedeniyle toplumsal yaşama uyum sağlama ve günlük gereksinimlerini karşılama güçlükleri olan ve koruma, bakım, rehabilitasyon, danışmanlık ve destek hizmetlerine ihtiyaç duyan kişidir. Bu tanım kapsamında engelli bireyleri; bedensel, zihinsel ve ruhsal olarak üç ana gruba ayırabiliriz. Bu gruplar kendi içinde de alt gruplara ayrılmaktadır. Örneğin; bedensel engelli; görme engelli, işitme engelli, konuşma engelli, ortopedik engelli gibi sınıflandırılabilir. Engelli bireyler günlük yaşamlarında çeşitli güçlüklerle karşılaşmaktadır. Engel durumlarından ve topluma katılım noktasında toplumsal koşulların iyi olmamasından dolayı topluma katılımda güçlük yaşadıkları gibi engel durumuna göre kendi kişisel ihtiyaçlarını karşılamada dahi çeşitli zorluklar yaşamakta ve bir başkasının yardımına ihtiyaç duyabilmektedir. Bu araştırma, engelli kardeşe sahip olan bireylerin deneyimledikleri güçlükleri ve güçlükleri anlamlandırmalarını belirlemek ve sosyal rol kuramıyla deneyimledikleri güçlükleri açıklamak ve çözüm önerileri geliştirmek amacıyla gerçekleştirilmiştir. Araştırmanın sahası olarak Diyarbakır ili seçilmiş ve Diyarbakır' da yaşayan engelli kardeşe (zihinsel, bedensel veya ruhsal) sahip olan katılımcılarla derinlemesine görüşmeler gerçekleştirilmiştir. Nitel araştırma olarak tasarlanan bu araştırma da fenomolojik yaklaşım tercih edilmiştir. Bu kapsamda engelli kardeşe sahip olan bireylerin deneyimledikleri güçlükler ve güçlükleri anlamlandırma süreçleri katılımcıların kendi ifade ve duyguları bağlamında anlaşılmaya çalışılmıştır. Ayrıca engelli kardeşin engel durumunun (fiziksel, zihinsel veya ruhsal) deneyimlenen güçlüklerde farklılık yaratıp yaratmadığı araştırma sürecinde anlaşılmaya çalışılmıştır. Araştırmada elde edilen veriler araştırmacının kendisi tarafından çözümlenmiştir. Araştırma sonucunda engelli kardeşe sahip bireylerin deneyimledikleri güçlükler engelli bireyin içinde bulunduğu koşullara (engel türü, bakım ihtiyacı, sağlık ihtiyacı, yaşadığı fiziksel ve sosyal çevre gibi) göre farklılık gösterdiği bulundu. Ayrıca engelli bireyin cinsiyeti ve bakım sağlayan kişinin cinsiyetinin de deneyimlenen güçlüklerde farklılık oluşturduğu bulundu. Araştırma bulgularının sonuçlarına göre engelli birey ve engelli kardeşe sahip bireylerin deneyimledikleri güçlüklerinin ortadan kaldırılması için insan hakları perspektifinde önerilerde bulunulmuştur.

Anahtar Kelimeler: Engelli, Engellilik, Sosyal Rol, İnsan hakları

CHALLENGES EXPERIENCED BY INDIVIDUALS WITH DISABLED SIBLINGS: THE DIYARBAKIR EXAMPLE

ABSTRACT

A disabled person is someone who, due to congenital or acquired causes, has lost their physical, mental, emotional, sensory, and social abilities to varying degrees, resulting in difficulties in adapting to social life and meeting daily needs, and requiring protection, care, rehabilitation, counseling, and support services. Within this definition, we can divide disabled individuals into three main groups: physical, mental, and emotional. These groups are further subdivided into subgroups. For example, physical disabilities can be classified as visual impairment, hearing impairment, speech impairment, or orthopedic disability. Disabled individuals face various difficulties in their daily lives. Due to their disability and poor social conditions, they experience difficulties in participating in society, and depending on their disability, they may even face difficulties in meeting their own personal needs and may require assistance from others. This research was conducted to identify the difficulties experienced by individuals with disabled siblings, to understand these difficulties, and to explain these difficulties using social role theory and develop solutions. The study's field was selected as Diyarbakır province, and in-depth interviews were conducted with participants living in Diyarbakır who have a disabled sibling (mental, physical, or psychological). Designed as a qualitative study, a phenomenological approach was preferred. Within this scope, the difficulties experienced by individuals with disabled siblings and their processes of understanding these difficulties were examined through the participants' own expressions and emotions. Furthermore, the study aimed to understand whether the sibling's disability (physical, mental, or psychological) created differences in the difficulties experienced. The data obtained in the research were analyzed by the researcher. The results showed that the difficulties experienced by individuals with disabled siblings differed according to the individual's circumstances (type of disability, care needs, health needs, physical and social environment, etc.). It was also found that the gender of the disabled individual and the gender of the caregiver also created differences in the difficulties experienced. Based on the research findings, recommendations were made from a human rights perspective to eliminate the difficulties experienced by disabled individuals and those with disabled siblings.

Keywords: Disability, Social Role, Human Rights

TARİHİ YAPILARDA ÇAĞDAŞ EK KULLANIMININ AGO MODENA'NIN KİNETİK ÇATI UYGULAMASI BAĞLAMINDA İNCELENMESİ

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ÖZET

Tarihi yapıların korunması, kültürel kimliğin sürekliliğinin sağlanması ve toplumsal belleğin gelecek kuşaklara aktarılması açısından büyük önem taşımaktadır. Bu yapıların çağdaş ihtiyaçlara uyum sağlayacak biçimde yaşatılması, koruma disiplininin temel ilkeleri arasında yer alan süreklilik, özgünlük ve bütünlük kavramlarıyla doğrudan ilişkilidir. Günümüzde yeniden işlevlendirme yaklaşımları, tarihi yapıların fiziksel, işlevsel ve kültürel sürdürülebilirliğini destekleyen önemli bir yöntem olarak öne çıkmakta; çağdaş eklerin kontrollü ve dengeli biçimde kullanımı ise bu sürecin ayrılmaz bir parçası haline gelmektedir. Uluslararası koruma çerçevesi içerisinde ICOMOS ve ICCROM gibi kurumlar, çağdaş müdahalelerin geri dönüşlü, okunabilir ve tarihi dokuya zarar vermeyecek nitelikte olması gerektiğini vurgulamaktadır.

Bu çalışma, tarihi yapılarda çağdaş ek kullanımının koruma kuramı ile nasıl uyumlu hale getirilebileceğini tartışmayı ve bu yaklaşımın mekânsal, işlevsel ve estetik boyutlarını analiz etmeyi amaçlamaktadır. Ayrıca çalışma, kinetik mimarlığın çağdaş ek uygulamalarına nasıl yeni bir esneklik, geri dönüşlülük ve uyarlanabilirlik potansiyeli kazandırdığını ortaya koymayı hedeflemektedir. Bu bağlamda Modena kentinde yer alan Ex Ospedale Sant'Agostino yapısının kültür merkezi niteliğindeki AGO Modena Fabbriche Culturali'ye dönüştürülmesi süreci, çağdaş ek kullanımının koruma kuramıyla uyumlu biçimde uygulanmasına yönelik dikkate değer bir örnek oluşturmaktadır.

Yeniden işlevlendirme kapsamında tasarlanan kinetik çatı, hareketli yüzeyleri sayesinde mekânsal esneklik ve iklimsel kontrol sağlayarak yapının yeni işlevlerine katkıda bulunmakta; hafif ve geri dönüşlü strüktürel kurgusu ile tarihi kütleye minimum müdahale ilkesiyle uyum göstermektedir. Bu çağdaş ek, tarihi dokuyla rekabet etmek yerine onu tamamlayan bir mimari katman olarak işlev görmekte ve çağdaş müdahalelerin kültürel miras yapılarında nasıl dengeli bir şekilde uygulanabileceğine dair örnek niteliği taşımaktadır.

Sonuç olarak, AGO Modena örneği, kinetik mimarlığın tarihi yapılarda yeniden işlevlendirme süreçlerine sağlayabileceği katkıları görünür kılmakta ve sürdürülebilir koruma pratikleri içerisinde çağdaş eklerin yenilikçi kullanımına dair fonksiyonel bir model ortaya koymaktadır.

Anahtar Kelimeler: Tarihi yapılar, çağdaş ek, yeniden işlevlendirme, kinetik mimarlık, AGO Modena.

EXAMINATION OF THE USE OF CONTEMPORARY ADDITIONS IN HISTORIC BUILDINGS WITHIN THE CONTEXT OF AGO MODENA'S KINETIC ROOF APPLICATION

ABSTRACT

The conservation of historic buildings plays a crucial role in ensuring the continuity of cultural identity and transmitting collective memory to future generations. Their adaptation to contemporary needs is grounded in the core conservation principles of continuity, authenticity, and integrity. Today, adaptive reuse approaches stand out as an important method that supports the physical, functional, and cultural sustainability of historic buildings, while the controlled and balanced incorporation of contemporary additions has become an integral part of this process. Within the international conservation framework, institutions such as ICOMOS and ICCROM emphasize that contemporary interventions must be reversible, legible, and non-destructive to the historic fabric.

This study aims to examine how contemporary additions to historic buildings can be aligned with conservation theory and to analyze the spatial, functional, and aesthetic dimensions of this relationship. Additionally, the study seeks to demonstrate how kinetic architecture introduces new potentials for flexibility, reversibility, and adaptability within contemporary addition practices. In this context, the transformation of Ex Ospedale Sant'Agostino into AGO Modena Fabbriche Culturali stands as a notable example of contemporary additions aligned with conservation principles.

The kinetic roof designed within the scope of adaptive reuse contributes to the building's new functions by offering spatial flexibility and climatic control through its movable surfaces, while its lightweight and reversible structural configuration aligns with the principle of minimal intervention on the historic mass. Rather than competing with the historic fabric, this contemporary addition functions as a complementary architectural layer and provides a representative case of how contemporary interventions can be integrated into cultural heritage structures in a balanced manner.

In conclusion, the AGO Modena case reveals the potential contributions of kinetic architecture to adaptive reuse processes in historic buildings and offers a functional model for the innovative application of contemporary additions within sustainable conservation practices.

Keywords: Historic buildings, contemporary addition, adaptive reuse, kinetic architecture, AGO Modena.

1. INTRODUCTION

Historic buildings represent tangible evidence of architectural, cultural, and social values accumulated over time. Their conservation is not limited to preserving physical fabric but also involves sustaining collective memory, cultural identity, and continuity within the urban environment (Feilden, 2003). However, rapid socio-economic changes, evolving user expectations, and technological advancements often render the original functions of historic buildings obsolete. In this context, adaptive reuse has emerged as a critical conservation strategy that enables historic structures to remain active components of contemporary life (Cantell, 2005). Adaptive reuse processes inevitably raise questions regarding the nature and extent of contemporary interventions. Among these, contemporary additions constitute one of the most debated issues in architectural conservation discourse. While such additions are often necessary to accommodate new functions, technical requirements, and spatial demands, they must be designed in a manner that does not compromise the authenticity and integrity of the historic fabric (Jokilehto, 1999). International conservation principles emphasize that contemporary interventions should be distinguishable from the original structure, reversible when possible, and respectful of the historic context. Institutions such as ICOMOS and ICCROM emphasize the importance of legibility, minimal intervention, and compatibility in conservation practices (ICOMOS, 1964; ICCROM, 2015). In recent years, kinetic architecture has gained attention as an innovative approach that offers flexibility, adaptability, and reversibility—qualities that align closely with conservation principles. Through movable components such as retractable roofs and transformable envelopes, kinetic systems provide dynamic solutions that respond to changing functional and environmental conditions (Fox & Kemp, 2009). This study examines the use of contemporary additions in historic buildings within the framework of conservation theory, focusing specifically on the kinetic roof application implemented in the transformation of the former Ex Ospedale Sant'Agostino into AGO Modena Fabbriche Culturali. The research aims to evaluate how kinetic architecture can contribute to adaptive reuse processes while maintaining respect for historic values.

This study adopts a qualitative case study methodology based on literature review, analysis of conservation principles, and architectural evaluation of the AGO Modena kinetic roof intervention. By examining this case within the framework of contemporary addition theory and kinetic architecture, the research aims to contribute to the discourse on adaptive reuse strategies for historic buildings. Within this framework, the study is guided by the following research questions:

- How can contemporary additions be integrated into historic buildings in accordance with conservation principles?
- In what ways does the kinetic roof application at AGO Modena respond to the criteria of reversibility, minimal intervention, and legibility in adaptive reuse projects?

2. THEORETICAL FRAMEWORK AND CASE-BASED EVALUATION

The evaluation of the AGO Modena kinetic roof intervention is conducted through a case-based analytical framework derived from international conservation principles. The analysis focuses on four main criteria:

- Spatial and functional flexibility
- Structural independence and reversibility
- Environmental performance
- Architectural legibility and visual compatibility

These criteria are examined through architectural drawings, visual documentation, and comparative evaluation with established contemporary additions in historic contexts.

2.1. Contemporary Additions in Historic Buildings: A Theoretical Framework

The integration of contemporary additions into historic buildings requires a careful balance between preservation and transformation. According to conservation theory, new interventions should neither imitate historic forms nor dominate the existing structure; instead, they should establish a clear yet harmonious relationship with the original fabric (Ahunbay, 1996).

The Venice Charter explicitly states that additions must bear a contemporary character while respecting the existing monument's composition and scale (ICOMOS, 1964). This approach prevents falsification of history and ensures that different architectural layers remain legible over time. Key principles guiding contemporary additions can be summarized as follows:

- Minimal physical and visual intervention
- Reversibility and removability
- Clear distinction between old and new
- Compatibility in scale, material, and proportion

These principles aim to preserve the authenticity and integrity of historic structures while allowing them to function effectively in contemporary contexts (Jokilehto, 1999).

Contemporary additions in historic buildings are expected to remain clearly distinguishable while maintaining harmony with the existing fabric. Widely discussed examples such as the Louvre Pyramid (Fig. 1), the Great Court roof of the British Museum (Fig. 2), and Carlo Scarpa's intervention at Castelvecchio Museum (Fig. 3) illustrate how contemporary

architectural layers can coexist with historic structures without compromising authenticity (ICOMOS, 1964; Jokilehto, 1999; Plevoets & Van Cleempoel, 2019).



Fig. 1. Louvre Pyramid (Fakharany, 2025)



Fig. 2. Great Court Roof of the British Museum (Taylor-Foster, 2014)



Fig. 3. Castelvecchio Museum (Duque, 2014)

2.2. Adaptive Reuse and the Historical Background of AGO Modena

Adaptive reuse projects often require flexible spatial configurations capable of accommodating diverse and evolving activities. In historic buildings, traditional static architectural solutions may prove insufficient in addressing fluctuating programmatic needs, environmental conditions, and contemporary standards of comfort. Within this context, kinetic architecture offers a responsive design strategy that enables architectural elements to transform according to user demands and climatic conditions, thereby enhancing spatial adaptability without extensive structural intervention (Schumacher et al., 2010).

Kinetic architectural components—such as movable roofs, sliding façades, and operable shading systems—introduce temporality, flexibility, and adaptability into the built environment. In heritage contexts, these systems are particularly valuable because they can be conceived as lightweight, detachable, and reversible structures, aligning with conservation principles that emphasize minimal intervention and reversibility (Fox & Kemp, 2009; Feilden, 2003). By enabling seasonal use and multifunctional programming, kinetic systems support functional sustainability while preserving the integrity of historic fabric.

These theoretical considerations are especially relevant to the architectural complex known today as AGO Modena Fabbriche Culturali, originally constructed in the late eighteenth century as Ex Ospedale Sant'Agostino. Designed according to Enlightenment principles of rationality, hygiene, and spatial clarity, the hospital complex was organized around a system of internal courtyards that ensured natural light and ventilation (Bianchini, 2014; Carbonara, 2012).

Throughout the nineteenth and twentieth centuries, the complex underwent several expansions and internal modifications to accommodate evolving medical practices. Despite these changes,

the fundamental courtyard-based spatial structure remained largely intact. However, by the early twenty-first century, advancements in medical technology and changing healthcare standards rendered the historic hospital inadequate for contemporary use, leading to the gradual relocation of its functions and partial abandonment of the site (Plevoets & Van Cleempoel, 2019).

In response, local authorities initiated an adaptive reuse strategy aimed at transforming the former hospital into a multidisciplinary cultural hub. This transformation, officially realized as AGO Modena Fabbriche Culturali, introduced exhibition spaces, archives, educational facilities, and public areas while preserving the historic spatial logic of the complex (ModenaToday, 2021). Within this adaptive reuse framework, the historic courtyards emerged as critical spaces requiring architectural solutions capable of accommodating diverse cultural activities under varying climatic conditions. The contemporary functional organization of AGO Modena Fabbriche Culturali is articulated through a layered spatial structure, which is clearly represented in the post-intervention functional layouts (Fig. 4 and Fig. 5).

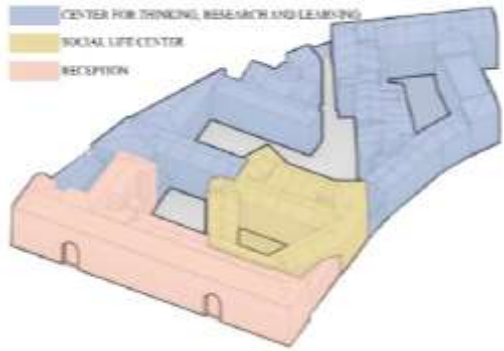


Fig. 4. Post-intervention layout showing the main functional zone (adapted and modified by the author from Fondazione AGO Modena Fabbriche Culturali, n.d.)

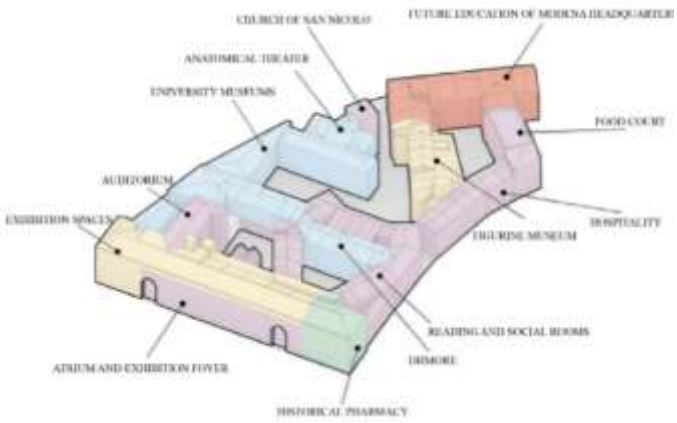


Fig. 5. Post-intervention layout illustrating the detailed functional distribution within the complex (adapted and modified by the author from Fondazione AGO Modena Fabbriche Culturali, n.d.)

Consequently, the integration of kinetic architectural systems—particularly a kinetic roof structure—became a rational and context-sensitive response. By offering spatial flexibility, environmental control, and reversibility, kinetic architecture provides a contemporary layer that mediates between the historic fabric and new functional demands, establishing a conceptual and practical foundation for the architectural intervention examined in the following section.

2.3. Evaluation of the Kinetic Roof Application at AGO Modena

The transformation of the former Ex Ospedale Sant'Agostino into AGO Modena Fabbriche Culturali constitutes a significant example of adaptive reuse supported by a contemporary architectural intervention that is both functionally and conceptually aligned with conservation principles. At the core of this transformation lies the kinetic roof system designed to cover the historic courtyard, which functions as the primary public space of the complex and is located within the central courtyard of the historic complex (Fig. 6). The kinetic roof system consists of a lightweight steel structure supporting operable translucent panels that can open and close in response to climatic conditions and functional requirements. The system is designed as a modular and mechanically independent layer, avoiding direct structural integration with the historic load-bearing walls. Its operation allows controlled daylight penetration, natural ventilation, and seasonal adaptability, reinforcing both environmental performance and spatial flexibility. Importantly, the system is conceived as fully reversible, ensuring that its removal would not result in permanent alterations to the historic fabric.

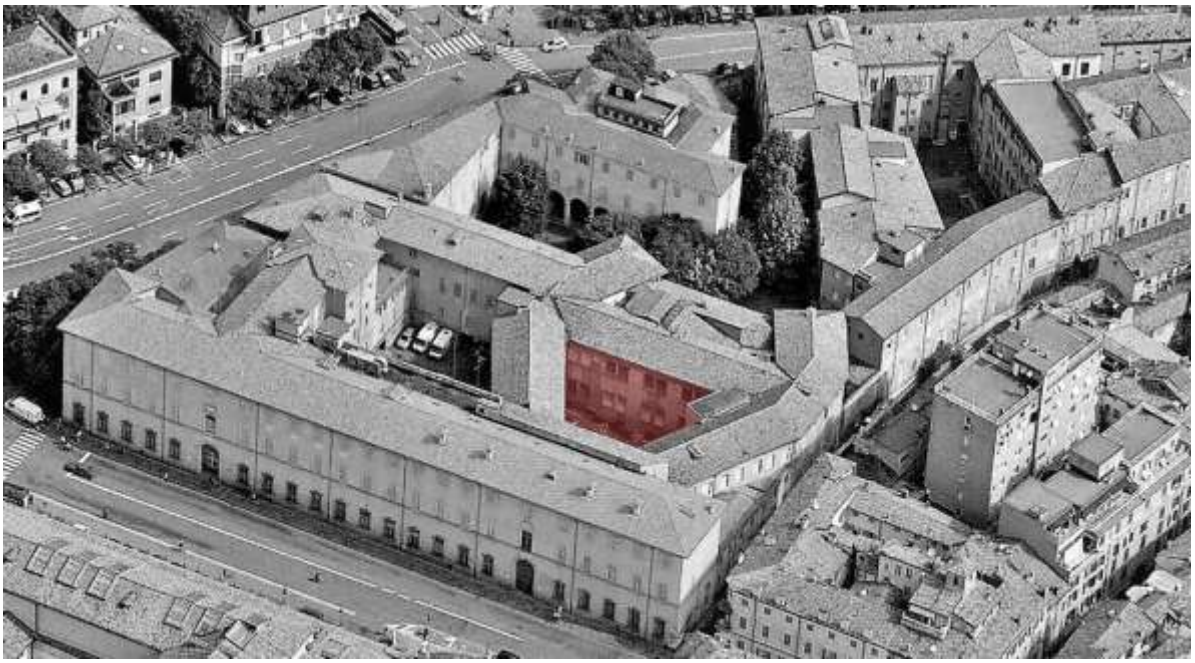


Fig. 6. Aerial view of the courtyard where the kinetic roof is planned to be constructed at Ex Ospedale Sant'Agostino (adapted and modified by the author from ModenaToday, 2021)

From a spatial perspective, the kinetic roof enhances the usability of the courtyard by enabling year-round occupation without permanently enclosing the historic open space. The spatial transformation of the courtyard before and after the proposed kinetic roof intervention is illustrated through a comparative visual analysis (Fig. 7 and Fig. 8). The movable canopy allows the courtyard to operate as an outdoor space during favorable climatic conditions while

providing protection against rain, excessive solar exposure, and cold weather when closed. This flexibility supports a wide range of cultural activities—including exhibitions, performances, and public gatherings—thereby reinforcing the courtyard's role as a central social and spatial node within the complex (Plevoets & Van Cleempoel, 2019).

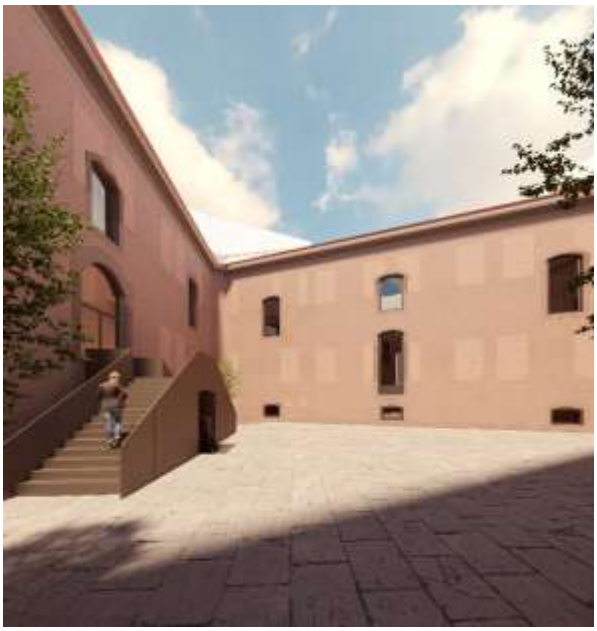


Fig. 7. Historic courtyard without the kinetic roof (Carlo Ratti Associati 2022)



Fig. 8. Historic courtyard with the kinetic roof (Carlo Ratti Associati 2022)

In terms of environmental performance, the kinetic roof system contributes to climatic control by regulating daylight, ventilation, and thermal comfort. Unlike static glass roofs that often result in overheating and visual dominance, particularly in historic courtyards, the operable structure responds dynamically to environmental conditions, reducing the need for mechanical climate control (Schumacher et al., 2010; Fox & Kemp, 2009). This responsiveness aligns with contemporary sustainability goals while respecting the passive environmental logic of historic courtyard architecture.

Structurally, the kinetic roof is conceived as a lightweight and modular system that operates independently of the historic load-bearing fabric. This design strategy minimizes physical intervention and avoids irreversible alterations to the original structure. The system's reversibility ensures that the roof can be removed in the future without causing permanent damage to the historic building, thus complying with fundamental conservation principles such as minimal intervention and reversibility (Feilden, 2003; ICOMOS, 1964).

From an architectural and visual standpoint, the kinetic roof is clearly distinguishable from the historic fabric through its materiality, detailing, and contemporary expression. At the same time, its transparency, scale, and structural rhythm prevent visual competition with the surrounding

historic façades. Rather than mimicking historical forms, the roof establishes a legible architectural layer that complements the existing structure and reinforces the principle of stratification in architectural conservation (Jokilehto, 1999).

When evaluated in comparison with static contemporary additions—such as permanent glass enclosures commonly applied to historic courtyards—the kinetic roof at AGO Modena demonstrates a more adaptable and conservation-sensitive solution. Its capacity to transform according to functional and environmental demands allows the historic space to retain its original openness while accommodating contemporary uses. In this regard, the intervention exemplifies how kinetic architecture can mediate between preservation and transformation in adaptive reuse projects.

Overall, the kinetic roof application at AGO Modena represents a balanced contemporary addition that successfully integrates spatial flexibility, environmental responsiveness, and conservation ethics. By functioning as an independent, reversible, and legible architectural layer, the kinetic roof enhances the functional sustainability of the historic complex while preserving its architectural integrity.

3. CONCLUSION

The incorporation of contemporary additions into historic buildings demands a nuanced and theoretically grounded approach. As demonstrated by the AGO Modena case, kinetic architecture offers a viable strategy for achieving compatibility between new interventions and historic fabric.

The kinetic roof application provides spatial flexibility, environmental control, and functional adaptability while maintaining minimal intervention and reversibility. These qualities align closely with international conservation principles and support the sustainable reuse of heritage structures.

In conclusion, the AGO Modena example illustrates how kinetic architectural systems can serve as effective contemporary additions in adaptive reuse projects. By enhancing usability without undermining historical values, kinetic architecture presents a forward-looking model for sustainable conservation practices and offers valuable insights for future interventions in historic environments.

The study is limited to a single case analysis and does not include post-occupancy performance data of the kinetic system. Future research may focus on comparative studies of kinetic roof applications in different climatic and cultural contexts, as well as long-term environmental performance assessments.

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EVRENSEL TASARIM İLKELERİ DOĞRULTUSUNDA BEŞİKTAŞ / DOLMABAHÇE STADI YOLU İNCELENMESİ

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ÖZET

Bu çalışma, Beşiktaş-Dolmabahçe Stadı arasındaki bölgeyi evrensel tasarım ilkeleri doğrultusunda değerlendirmek ve bu doğrultuda erişebilirlik durumunun incelenmesi amacıyla gerçekleştirilmiştir. Bu çalışmada incelemeler yapılırken evrensel tasarımın eşit kullanım, esneklik, basit ve sezgisel kullanım, algılanabilir bilgi, hata toleransı, düşük fiziksel çaba ile boyut ve alan ilkeleri temel alınmıştır. Bu bağlamda ise Beşiktaş Dolmabahçe stadı arası yolunun engelli bireylerin, çocukların ve farklı kullanıcı gruplarının ihtiyaçlarının nasıl karşılandığı incelenmiştir.

Çalışmada, özellikle dar yaya yolları, standartlara uygun olmayan rampalar, dinlenme alanlarının azlığı ve trafik-yaya ayrımı eksikliği gibi sorunların yol hattını olumsuz etkilediği fark edilmektedir. Ayrıca bu eksikliklerin özellikle maç günlerinde artan kalabalık ve trafik yoğunluğunun eklenmesiyle daha ciddi boyutlara ulaştığı görülmektedir. Tabelalarda bulunan yönlendirme ve bilgilendirme eksiklikleri, görme ve işitme engelli bireylerin alanda rahatça hareket edememesine yol açarken, oturma noktalarının olmaması yaşlı bireyler için olumsuz etki yaratmaktadır. Çalışmada sonuç kısmında önerilen düzenlemelerde, yaya yollarının genişletilmesi, güvenli geçiş alanlarının oluşturulması, dokunsal yüzeylerin eklenmesi ve çocuklar için güvenli oyun alanlarının öneri olarak sunulmasını ele almaktadır.

Sonuç olarak, bu çalışmada, Beşiktaş-Dolmabahçe Stadı arasındaki yolun evrensel tasarım ilkelerine uygun bir halde düzenlenmesinin erişilebilirliği artırmasının yanı sıra, toplumsal eşitlik ve sürdürülebilir bir kentsel yaşam açısından da kritik öneme sahip olabileceği öngörülmektedir. Bu bağlamda, çalışma, evrensel tasarım ilkelerinin önemini vurgulamakta ve her kullanıcı grubu için alanın kullanıcı dostu olabileceğine dair somut öneriler sunarak katkıda bulunmaktadır.

Anahtar Kelimeler: Kentsel Tasarım, Kapsayıcılık, Erişebilirlik, Beşiktaş Dolmabahçe Hattı, Eşit Kullanım

AN EVALUATION OF THE BEŞİKTAŞ / DOLMABAHÇE STADIUM ROAD WITHIN THE FRAMEWORK OF UNIVERSAL DESIGN PRINCIPLES

ABSTRACT

This study was conducted to evaluate the area between Beşiktaş and Dolmabahçe Stadium in accordance with universal design principles and to examine its accessibility. In this study, the

principles of universal design, including equitable use, flexibility, simple and intuitive use, perceptible information, tolerance for error, low physical effort, and appropriate size and space, were used as the foundation for the evaluations. In this context, the study examined how the road between Beşiktaş and Dolmabahçe Stadium meets the needs of disabled individuals, children, and other user groups.

The study identified significant issues such as narrow pedestrian paths, non-standard ramps, a lack of rest areas, and insufficient segregation of pedestrian and vehicle traffic, which negatively affect the road. Additionally, these deficiencies are exacerbated on match days with increased crowds and traffic density. The lack of adequate signage and informational systems creates difficulties for visually and hearing-impaired individuals, while the absence of seating areas negatively impacts elderly users. In the results section of the study, proposals were made to widen pedestrian paths, create safe crossing areas, add tactile surfaces, and establish secure play areas for children.

In conclusion, this study suggests that reorganizing the road between Beşiktaş and Dolmabahçe Stadium in line with universal design principles would not only improve accessibility but also contribute significantly to social equity and sustainable urban living. In this regard, the study emphasizes the importance of universal design principles and provides concrete suggestions for making the area user-friendly for all groups, thus contributing to the broader discourse on inclusive urban design.

Key Words: Urban Design, Inclusivity, Accessibility, Beşiktaş Dolmabahçe Line, Equitable Use

MEKÂNIN PSİKOLOJİK YANSIMALARI: GEÇMİŞTEN GÜNÜMÜZE OTURMA ALANI TEFRİŞ DÜZENLERİNİN KARŞILAŞTIRMALI DÖNEM ANALİZİ

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ÖZET

Mimari mekân, biçimsel ve estetik tasarım kararları ile sınırlı bir alan olmanın ötesinde, kültürel özellikler, toplumsal yaşam biçimleri ve psikolojik etkileşimler arasında güçlü bir ilişki kuran çok yönlü bir üretim alanıdır. Konut yapısını oluşturan mekanlar ise, planimetrik kurgu içerisinde belirlenen tefriş yerleşim düzeni ile bütünlük sağlayan işlevsel alanları kapsamaktadır. Bu doğrultuda konut mekânının fiziksel durumu, yaşam biçimlerine, kültürel sürekliliğe ve duygusal bağlara göre yeniden biçimlenmektedir. Bu çalışma, konutlarda yer alan oturma mekânı tefriş düzeninin birey üzerindeki psikolojik etkilerini, geleneksel ve modern konut tipolojileri üzerinden karşılaştırmalı bir analiz çerçevesinde ele almaktadır.

Geleneksel Türk evi oturma mekânı, sedir, ocak, dolap, halı gibi tefriş elemanlarının yer aldığı çok işlevli ve esnek yapısı ile öne çıkmaktadır. Bu mekânsal düzen, mahremiyet, kimlik bilinci ve sosyalleşme gibi psikolojik etkileri olumlu yönde etkileyen kapsayıcı bir mekân kurgusu meydana getirmektedir. Fenomenoloji kuramı bağlamında, geleneksel Türk evi plan şemasına sahip özgün yapılardan biri olan Birgi Çakırağa Konağı'nın oturma alanı elde edilen veriler doğrultusunda detaylı bir şekilde analiz edilmiş; sedir, ocak, halı ve yüklük gibi tefriş elemanlarının yerleşim düzeninin bireyler üzerinde tarihsel süreklilik, mahremiyet ve aile içi etkileşim gibi davranışsal özellikleri olumlu yönde etkilediği belirtilmiştir. Aynı şekilde, modern konut tipolojisi bağlamında Şevket Saatçioğlu Villası oturma alanı tefriş düzeni incelenmiştir. Bu tipolojideki yerleşimler ise, işlevsel sınırlamalar, estetik tasarım kararları ve bireyselleşme-özel alan kavramları doğrultusunda yeniden şekillenmiştir. Bu dönüşüm hareketi, standartlaşmış ve tek tip tasarımların ortaya çıkmasına neden olmuş; tefriş elemanlarının bu şekilde tasarlanmasının ise aile içi bağları ve sosyalleşme kültürünü zayıflattığı gözlemlenmiştir. Özetle, bu araştırma, geleneksel ve modern konut dönemlerinde farklılaşan oturma mekânı tefriş yerleşimlerinin, bireyler arası etkileşimleri ve toplumsal yaşam biçimlerini anlamlı bir biçimde etkilediğini ortaya koymaktadır. Elde edilen veriler, oturma mekânı tefriş düzenlerinde kültürel süreklilik ve tarihsel kimlik gibi kavramların dikkate

alınarak psikolojik etkileri destekleyen kapsayıcı tasarımların geliştirilmesi gerektiğine dikkat çekmektedir.

Anahtar Kelimeler: Tefriş Düzeni, Ruhsal Etkiler, Geleneksel Konut, Modern Konut, Fenomenoloji.

THE PSYCHOLOGICAL REFLECTIONS OF SPACE: A COMPARATIVE PERIOD ANALYSIS OF SEATING AREA FURNISHING ARRANGEMENTS FROM PAST TO PRESENT

ABSTRACT

Architectural space is not merely a confined area defined by formal and aesthetic design decisions; rather, it constitutes a multifaceted domain of production that establishes strong connections among cultural characteristics, social lifestyles, and psychological interactions. The spaces that form a residential structure encompass functional areas that achieve integrity through the furnishing layout determined within the planimetric configuration. Accordingly, the physical condition of the residential space is reshaped in relation to lifestyles, cultural continuity, and emotional bonds. This study addresses the psychological effects of furnishing arrangements in living rooms on individuals through a comparative analysis of traditional and modern housing typologies.

The living space of the traditional Turkish house stands out with its multifunctional and flexible structure, incorporating furnishing elements such as the sedir (built-in seating), fireplace, cupboards, and carpets. This spatial organization creates an inclusive setting that positively influences psychological aspects such as privacy, identity awareness, and socialization. Within the framework of phenomenology theory, the seating area of Birgi Çakırağa Mansion—an authentic structure with a traditional Turkish house plan scheme—was analyzed in detail based on collected data. It was observed that the arrangement of furnishing elements such as the sedir, fireplace, carpet, and storage units positively affects behavioral characteristics including historical continuity, privacy, and intra-family interaction. Similarly, within the context of modern housing typology, the furnishing layout of the living area in the Şevket Saatçioğlu Villa has been examined. In this typology, spatial arrangements have been reshaped in accordance with functional constraints, aesthetic design decisions, and concepts of individualization and private space. This transformation has led to the emergence of standardized and uniform designs; moreover, it has been observed that such furnishing configurations weaken family bonds and the culture of socialization. In summary, this research demonstrates that the differing furnishing layouts of living spaces in traditional and modern housing periods significantly influences interpersonal interactions and social lifestyles. The findings highlight the necessity

of developing inclusive designs for living room furnishing arrangements that take into account concepts such as cultural continuity and historical identity, thereby supporting positive psychological effects.

Keywords: Furnishing Arrangement, Psychological Effects, Traditional Housing, Modern Housing, Phenomenology

1. GİRİŞ

Mimari mekân, biçimsel ve estetik tasarım kararları ile oluşturulan bir alan olmasının yanı sıra, kültürel değerler, sosyal ilişkiler ve psikolojik etkileşimleri de yansıtmaktadır. Konut tasarımları ise hem fiziksel faktörlerden hem de tarihsel değerlerden etkilenerek meydana getirilen fonksiyonel bir mimari mekân olarak karşımıza çıkmaktadır. Bu doğrultuda konut, bireylerin kendini dış çevreden soyutladığı, iç dünyası ile bağ kurduğu ve kendi kişiliğini yansıttığı fenomenolojik bir mekân olarak tanımlanabilir (Heidegger, 1971).

Oturma mekânları ise, konutların planimetrik kurgusu içerisinde oluşturulan tefriş yerleşim düzeni ile şekillenen işlevsel alan ve ailenin sosyalleşme merkezi olarak öne çıkmaktadır. Söz konusu işlevsellik; yaşam koşullarına, kültürel sürekliliğe ve duygusal etkileşimlere göre yeni bir boyut kazanmaktadır (Rapoport, 1969).

Geleneksel Türk evinde oturma mekânı kurgusu sedir, ocak, raf-sergen, dolap ve halı gibi tefriş elemanları ile oluşturularak, toplumun kültürel değerlerini ve aile bireyleri arasındaki güçlü ilişkiyi vurgulamaktadır. Geleneksel ev tipolojisindeki bu tefriş düzeni, bireyler üzerinde mekânsal algı ve aidiyet duygularını güçlendirmektedir (Göğebakan, 2015).

Sanayileşme ile köklü bir dönüşüme uğrayan konut yapısında ise, modernizm ilkeleri öne çıkarılmış, bu nedenle konut iç mekanlarında standart bir düzen kurgusu ortaya çıkmıştır. Bu standartlaşmış düzen, bireylerin mekâna yabancılaşmasına ve tarihsel sürekliliğin yitirilmesine neden olmuştur (Kınalı, 1999).

Bu araştırma, geleneksel Türk evi ile modern konut örnekleri üzerinden, oturma mekânı kurgusundaki tefriş düzenlerinin kullanıcı üzerindeki psikolojik yansımalarını karşılaştırmalı bir analiz çerçevesinde ele almaktadır. Fenomenoloji kuramı bağlamında, geleneksel Türk evi plan şemasına sahip özgün yapılardan biri olan Birgi Çakırağa Konağı'nın oturma alanı ve modern konut tipolojisi örneği Şevket Saatçioğlu Villası oturma alanı tefriş düzeni incelenmiştir. Dönemsel analiz olarak iki ayrı örnek yapının seçilmesi, konut oturma mekânı kurgusunun tarihsel dönemler içerisinde geleneksel Türk evinde bütüncül ve hiyerarşik bir yaşam biçimine sahip olduğunu, ancak bu düzenin modern konutta birey odaklı ve parçalanmış

bir yapıya dönüştüğünü ortaya koymaktadır. Bu karşılaştırmalı analiz verileri, araştırmanın ortaya koyduğu modernizm ilkelerinin bireyleri bulundukları mekâna yabancılaştırdığı ve bireyler arasındaki ilişkileri ayrıştırdığı düşüncesini güçlendirmektedir.

Sonuç olarak, araştırmanın amacı, geleneksel Türk evi yapısından modern konut tipolojisine dönüşen iç mekân kurgusunun biçimsel bir tasarım olarak karşımıza çıkmasının yanı sıra, toplumun sahip olduğu kültürel ve sosyal özelliklerin bir yansıması olduğunu da ortaya koymaktır.

2. MATERYAL VE METOT

Bu çalışmanın amacı, geleneksel ve modern konut tipolojilerinde dönüşüme uğrayan oturma mekânı tefriş düzeninin, bireyler arası etkileşimleri ve toplumsal yaşam biçimlerini nasıl etkilediğini ortaya koymaktır. Geleneksel Türk evi mekân kurgusunu ve modern konut plan tasarımını yansıtan iki örnek yapı belirlenmiş olup; bu yapılara ait tefriş yerleşimleri fenomenoloji ve mekânsal algı bağlamında ele alınmıştır. Bu yaklaşım, oturma mekânında kurgulanan tefriş düzenlerinin, birey psikolojisi üzerinde güçlü bir etki oluşturduğunu ortaya koymaktadır.

Araştırma, nitel analiz yöntemi ile ele alınarak, literatür taramaları ve arşiv belge analizleri ile desteklenmiştir. Ayrıca bu çalışmada, iki farklı tarihsel dönem üzerinden iki ayrı konut yapısı belirlenerek, karşılaştırmalı bir analiz çerçevesi meydana getirilmiştir.

Bu bağlamda, geleneksel Türk evi mimarisini yansıtan özgün örneklerden biri olan Birgi Çakırağa Konağı ve modern konut tasarımını nitelikli bir şekilde yansıtan Şevket Saatçioğlu Villası seçilmiştir. Birgi Çakırağa Konağı işlevsel plan şeması ve tasarımsal özellikleri bakımından sağlam bir örnek oluşturmaktadır. Aynı şekilde, Şevket Saatçioğlu villası da hem plan özellikleri hem de mobilya ve cephe detayları ile araştırmayı çok yönlü bir kaynak haline getirmektedir.

Bu araştırma kapsamında, akademik tarama (tez, makale, bilimsel yazılar, rapor vb.) ve görsel analiz yöntemleri kullanılmıştır. Geleneksel Türk evi oturma mekânına ait tefriş kurgusu, sedir, raf, halı, dolap ve ocak gibi tefriş elemanları üzerinden; modern konuttaki tefriş yerleşimleri ise koltuk, masa, televizyon ünitesi gibi mobilyaların tasarım özellikleri açısından detaylı bir şekilde analiz edilerek değerlendirilmiştir.

Elde edilen bulgular, fenomenoloji ve mekânsal algı bağlamında incelenerek, geleneksel ve modern konut oturma mekanlarındaki tefriş düzenleri, aidiyet, kimlik bilinci ve kültürel süreklilik gibi olguların birey üzerindeki psikolojik karşılıkları kapsamında değerlendirilmiştir.

Özetle, bu çalışma; karşılaştırmalı analiz ve belge tarama yöntemleri kullanarak, geleneksel Türk evi oturma mekânı tefriş yerleşiminin olumlu etkilerini, modern konuttaki tefriş düzeninin ise bireyi mekândan uzaklaştıran bir yapıya dönüştüğünü örneklem analizi sonucunda tartışmayı amaçlamaktadır. Böylece, konut tasarımlarında görülen biçimsel dönüşümlere ek olarak, birey üzerindeki ruhsal değişimler ve aile içi etkileşim durumlarında meydana getirdiği değişikliklerin kuramsal çerçeve ve somut verilerle desteklenmesi hedeflenmektedir.

3. OTURMA MEKÂNININ TEFRİŞ DÜZENLERİ VE PSİKOLOJİK ETKİLERİ

3.1 Geleneksel Türk Evi Plan Kurgusu ve Tefriş Düzeni

Geleneksel Türk evi, tarihsel özelliklere ve kültürel sürekliliğe bağlı kalınarak meydana getirilen, eski Türklerin yaşam biçimlerini ve karakteristik değerlerini mekânsal kurguya yansıtan çok yönlü mimari bir üretim alanıdır (Özcan & Güngör, 2019). Bu mimari mekanlar, bulundukları coğrafyanın iklimsel özellikleri ve biçimsel unsurları dikkate alınarak şekillenmiştir.

Geleneksel Türk evi plan şeması, konar göçer yaşam biçimine sahip Orta Asya Türklerinin çadır düzeninin konut yapısına dönüştürülmesiyle meydana getirilmiştir. Fonksiyonel ve esnek tasarımıyla öne çıkan Türk evi yapısı, aile bireylerindeki artışa veya azalmaya bağlı olarak değişebilecek nitelikte mekânsal bir kurguya sahiptir (Küçükerman, 1978).

Sedad Hakkı Eldem, Türk evi hakkında yaptığı çalışmalar neticesinde, Türk evi plan şemasını üç ana bölüm üzerinde sınıflandırmıştır (Eldem, Türk Evi Plan Tipleri , 1954).

- Odalar
- Sofalar ve Müştemilat
- Geçit ve Merdivenler

Eldem'in oluşturduğu bu özel tasnif ile Türk evi plan şemasını şekillendiren ana unsurların mekânsal kurgu ve tefriş düzeni olduğu söylenebilir. Bu plan kurgusu doğrultusunda, odalar birbirine "sofa" adı verilen mekanlar ile bağlanmaktadır (bkz. Şekil 1). Sofa, oda birimleri arasındaki ilişkiyi kuvvetlendirmesinin yanı sıra, aile içi etkileşimin sağlandığı sosyal bir oturma alanı olarak görülmektedir. Konut yapısının inşa edildiği coğrafyanın iklimsel özelliklerine ve tasarımsal etkilere göre şekillenen sofa, açık, yarı açık, kapalı mekân şeklinde düzenlenerek Türk evinin plan tipolojisini meydana getirmektedir (Eldem, Türk Evi Plan Tipleri , 1954).



Şekil 1. Geleneksel Türk Evi'ne Ait İç Mekân Görselleri (Küçükerman, 1978)

Bu bağlamda, geleneksel Türk Evi'nin planimetrik kurgusu, oda yerleşimleri ve biçimsel özelliklerinin yanı sıra; kültürel özellikler, iklimsel koşullar ve sosyal yaşam biçimleri doğrultusunda biçimlenmektedir.

Bir ocak ekseni etrafında kurgulanan oturma mekânı, sedir, dolap, halı, pencere gibi elemanların yerleşim düzeniyle farklılaşmaktadır. Duvar boyunca görülen sedir elemanları, pencerelerin alt kısımlarında olacak şekilde düzenlenmekte ve mekânsal algıyı bozmayarak bir bütünlük meydana getirmektedir. Ayrıca, odanın mekânsal kurgusunun ocak elemanının merkeze alınarak oluşturulması hem ısıtma konforunu hem de insanları bir arada tutan yerleşim düzenini göstermektedir (bkz. Şekil 2).

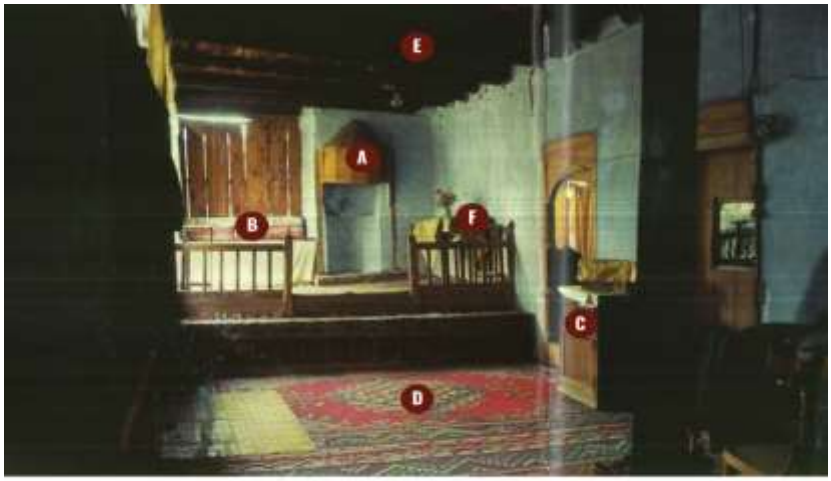


Şekil 2. Geleneksel Türk Evi Sedir ve Ocak Elemanı İlişkisi (Kuban, 1975), (Küçükerman, 1978)

Dolap, raf ve halı gibi elemanlar da mekân algısını şekillendiren ve mekânsal kurguyu yönlendiren unsurlar olarak karşımıza çıkmaktadır. Bu tefriş elemanlarının tasarımında sıcak

malzemelerin ve bitkisel motiflerin kullanılması, mekânı yaşayan bir üretim alanına dönüştürmektedir (Harmanbaşı, 2024).

Geleneksel Türk evi plan şemasında yer alan elemanların hareket ettirilebilir ve esnek bir yapıda olması, mekânın bir süreklilik döngüsü içerisinde yer aldığını ve farklı ihtiyaçlara cevap veren işlevsel bir nitelikte olduğunu göstermektedir. Bu bağlamda, geleneksel Türk evindeki tefriş elemanlarının sadeliği ve esnekliği, birey üzerinde aidiyet duygusunu güçlendirmesinin yanı sıra, aynı zamanda aile bireyleri arasındaki etkileşimi güçlendiren bir yapı ortaya koymaktadır (Aslanapa, 1984).



Şekil 3. Geleneksel Türk Evi Oturma Mekânı Tefriş Düzeni (Küçükerman, 1978)

Özetle, geleneksel Türk evi oturma mekânı tefriş düzeni, biçimsel ve fiziksel özelliklerin ötesinde, mekânsal aidiyet ve kültürel süreklilik sağlayan bir kurgu olarak dikkat çekmektedir. Bu mekânsal düzen, bireyin mekân içerisindeki dolaşımını canlandırarak aile içi etkileşimi güçlendirmekte; mekânı sosyal bir merkeze dönüştürerek esnek bir alan kurgusu sunmaktadır.

3.2 Birgi Çakırağa Konağı Örneği

Birgi Çakırağa Konağı'nın yapım tarihi kesin olmamakla beraber, taşıdığı mimari ve yapısal özellikler doğrultusunda 18.yüzyılın sonlarına doğru inşa edildiği tahmin edilmektedir. Konak yapısı, sahip olduğu plan özellikleri ve süsleme detayları ile özgün Türk evi mimarisini yansıtan en önemli örneklerden biri olarak anılmaktadır (Eldem, 1977).

Geleneksel Türk evinin yapısal özelliklerini taşıyan konakta, ahşap, taş ve toprak malzemeler kullanılmıştır. Ahşap çatı sistemi, iç mekânda ahşap tavan ve duvar elemanları, yığma taş duvarlar (taşıyıcı), cam malzeme, toprak esaslı tuğla gibi malzemeler konağın strüktürel sistemini oluşturmaktadır (bkz. Şekil 4) (Aksu, 2025).

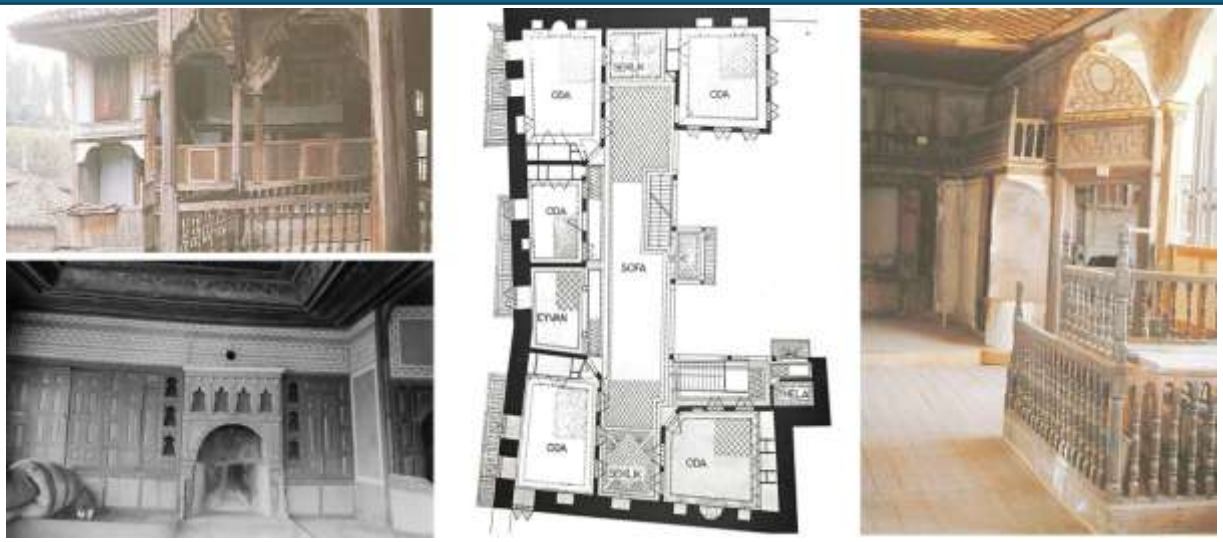
Bu konak yapısı, üç kattan meydana gelmekte ve geniş bir bahçe alanına sahiptir. Yapı toplamda on dört odadan, geniş hacimli sofa ve eyvanlardan, her katta bulunan çıkma detaylarından meydana gelmektedir. Her katta bulunan odalardan ikisinde ocak elemanı yer almakta ve ahşap tefriş elemanlarında dönemin mimarisini yansıtan bitkisel motif ve süsleme detayları yer almaktadır (bkz. Şekil 4) (Aksu, 2025).

Oturma mekânlarında ve odalarda bulunan sedir yerleşimleri ve pencere detayları ise, bu alanların inşa edildiği dönemde yaşayan ve ait hissedilen bir mekân olduğu anlayışını güçlendiren etkenler olarak dikkat çekmektedir (Coşkun, 2019).



Şekil 4. Birgi Çakırağa Konağı Zemin Kat Planı (ortada), İç ve Dış Mekân Görselleri (Aksu, 2025)

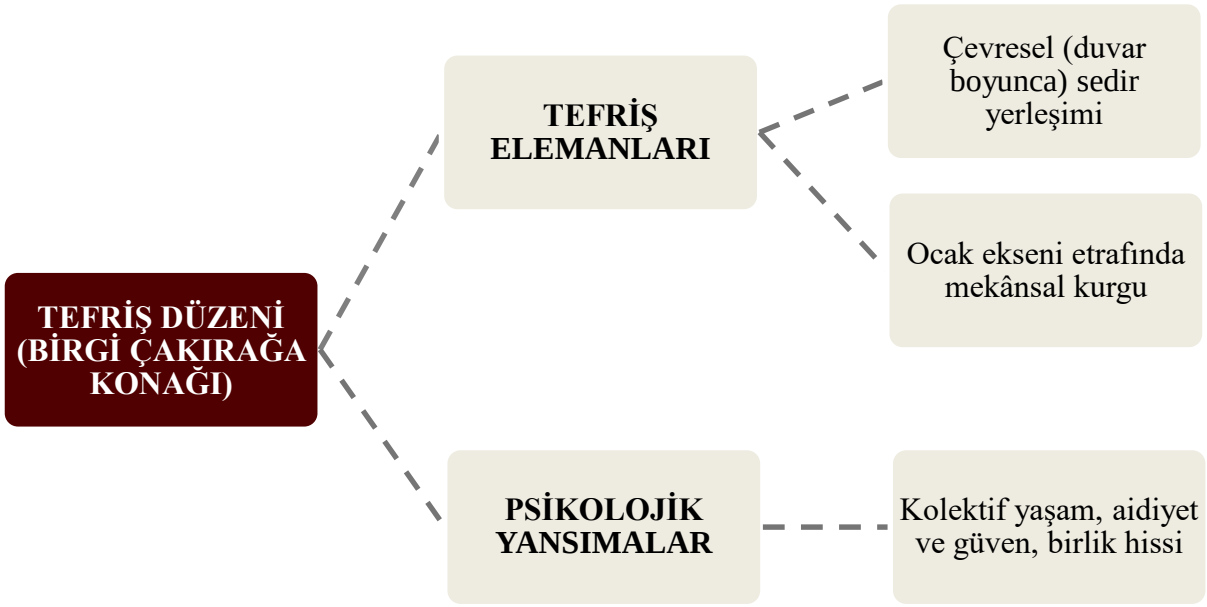
Birgi Çakırağa Konağı'nda bulunan oturma mekânı tefriş düzeni, biçimsel ve estetik tasarım kurgusu ile kültürel özellikler ve birey üzerindeki ruhsal etkiler açısından bütünlük sağlamaktadır. Oturma mekânında yer alan sedir yerleşimi, ocak elemanı ile bir bağ kurarak mekân içerisinde süreklilik ve aidiyet sağlamakta; bu sayede birey üzerinde olumlu etkiler uyandırmaktadır (bkz. Şekil 5). Sedir yüksekliklerinin uygun şekilde ayarlanması ile bu oturma elemanlarının hemen üzerinde yer alan pencere düzenleri ise, bireyin bahçe ile kesintisiz bir ilişki kurmasına ve dış çevreyi kendi özel alanından izlemesine olanak sağlamaktadır (Eldem, 1984).



Şekil 5. Birgi Çakırağa Konağı Birinci Kat Planı (ortada), İç ve Dış Mekân Görselleri (Salt Arşiv, 2025), ((Kuban, 1975), (Aksu, 2025)

Bu şekilde, Birgi Çakırağa Konağı'ndaki tefriş yerleşimleri, bireye bütüncül bir mekân kurgusu sunmakta; psikolojik açıdan ise kullanıcının kendini ait ve huzurlu hissettiği bir alan üretmektedir (bkz. Tablo 1).

Tablo 1. Birgi Çakırağa Konağı Oturma Mekânı Tefriş Düzeni ve Psikolojik Etkileri Şema Gösterimi (Yazarlar tarafından düzenlenmiştir, 2025)



3.3 Modern Konutlarda Plan Tipolojisi ve Tefriş Yerleşimleri

18.yüzyılda sanayide yaşanan gelişmeler ile konut mimarisi, kültürel bir üretim biçimi olmaktan ayrılarak, modernleşme olgusunun mekânsal bir temsili olarak gösterilmiştir. Bu bağlamda, modern mimarlığın beş temel ilkesi (Pilotiler, yatay bant pencereler, serbest cephe,

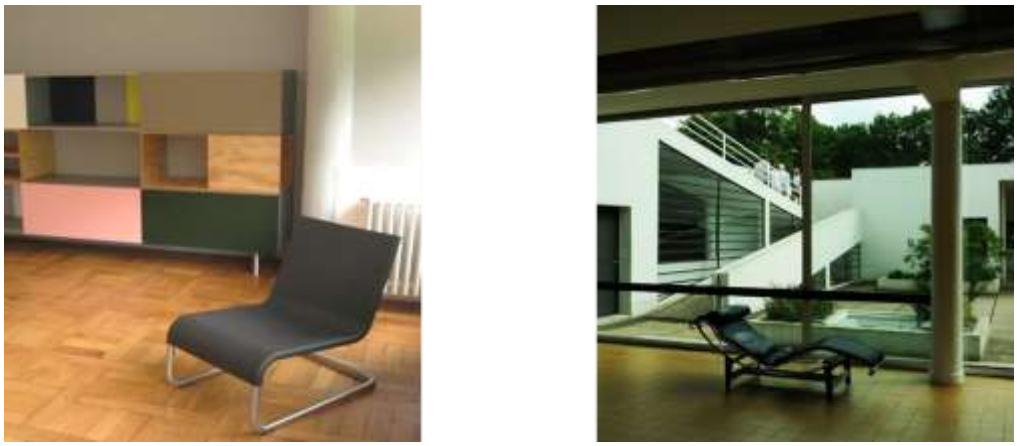
serbest plan ve çatı bahçesi) doğrultusunda meydana getirilen konut tasarımları, standart, tek düze ve kültürel kimlikten kopuk mekânlar olarak karşımıza çıkmaktadır (bkz. Şekil 6) (Tuğcu, 2022).



Şekil 6. Modern Konut İç Mekân Görselleri (Villa Savoye- Le Corbusier) (Kroll, 2025)

Yerel malzeme kullanımı, iklimsel koşullar ve toplumsal kimlik gibi özellikler, modernizmin ilkeleri karşısında arka plana atılmış; konut mekanları, tekdüze ve endüstriyel bir tasarım anlayışının sembolü haline dönüşmüştür (bkz. Şekil 7) (Kınalı, 1999).

Ahşap ve toprak esaslı sıcak malzemelerin modern konut yapısında terk edildiği, betonarme ve çelik gibi soğuk elemanların tercih edildiği, geleneksel Türk evindeki kolektif düzen anlayışının tam tersi olarak parçalanmış ve bireysel bir mekân kurgusu yer almaktadır (bkz. Şekil 7). Modern konutta, işlevler birbirinden ayrılmış ve her işlev için ayrı mekân yerleşimi oluşturulmuştur. Geleneksel Türk evindeki fonksiyonel ve her işleve hizmet eden oturma mekânının yerini, modern konut planında sadece oturma işlevine ayrılmış serbest bir mekân tasarımı almaktadır (Demirarslan, 2007).



Şekil 7. Modern Konut İç Mekân Görselleri (Kroll, 2025), (Archweb, 2025)

Modern konut oturma mekânı tefriş yerleşimleri, mekândan ayrı bir biçimde konumlandırılmış ve hareket edebilen endüstriyel elemanlara dönüşmüştür. Bu konut tasarımında, geleneksel

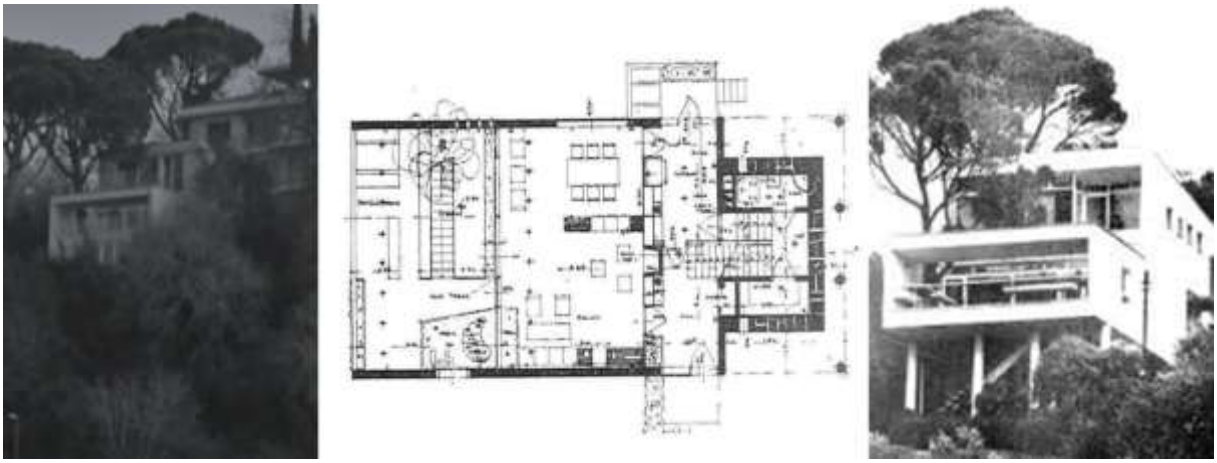
Türk evi oturma mekânında yer alan sedir yerleşimleri terk edilmiş ve onların yerini çelik gibi çağdaş malzemelerden üretilmiş mobilya tasarımları almıştır.

Modern konut oturma mekânı plan düzeninde, belli bir odak noktası yer almamakta; TV, kitaplık, çalışma alanları ve şömine gibi mekânsal elemanlara bağlı olarak tefriş düzeninin yönelimi değişkenlik göstermektedir. Bu yaklaşım, bireyler arası etkin iletişim kültürünü zayıflatarak, kullanıcıların mekândan uzaklaşmasına ve mekânın ruhunu yitirmesine neden olmuştur (Kınalı, 1999).

Sonuç olarak, fenomenolojik açıdan mekânsal deneyimi, sadece fiziksel bir alan olarak sınırlandırmış ve bu durum, bireylerin bulundukları mekâna ait hissetmemesine ve güven duygusunun zayıflamasına neden olmuştur.

3.4 Şevket Saatçioğlu Villası Örneği

1960 yılında inşa edilen Şevket Saatçioğlu Villası, İstanbul'un Anadoluhisarı bölgesinde Körfez Caddesi üzerinde konumlanmaktadır. Yapının iç mekânı beş ayrı kotta çözülmüş olup; binanın ±0.00 kotunda giriş bölümü, oturma mekânı ve yemek odası, mutfak ve kapalı teraslar; +1.95 seviyesinde iki adet yatak odası, ıslak hacim (banyo) ve açık mekanlar; +3.00 seviyesinde iki adet yatak odası, ıslak hacim (banyo ve tuvalet) ve açık mekanlar; -1.08 seviyesinde saklama alanı, ıslak hacim (banyo ve tuvalet); -2.70 seviyesinde ise görevli odası, depo, çamaşırlık ve kazan dairesi yer almaktadır (Arkitekt, 1970).



Şekil 8. Şevket Saatçioğlu Villası Zemin Kat Planı (ortada) ve Dış Mekân Görselleri (Arkitekt, 1970), (Ennaç, 2025)

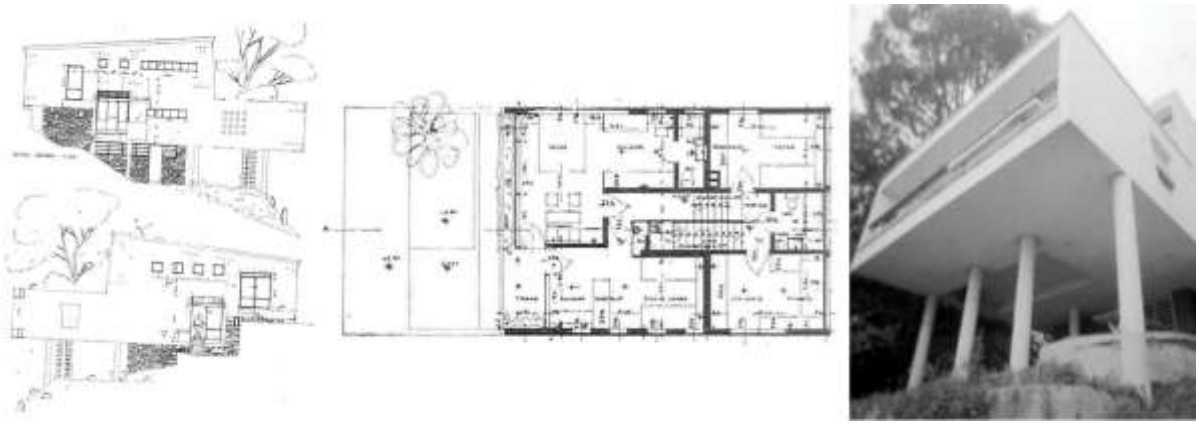
Şevket Saatçioğlu Villası, modern mimarlık ilkelerini yansıtan önemli yapılardan biri olarak, Le Corbusier'in mimari yaklaşımını benzer özellikler taşımaktadır. Kütle, pilotiler üzerinde yükseltilmiş, yalın cephe ve serbest plan şeması tasarımına sahiptir. İç mekânda, teras

bölümüne yerleştirilen bir ağaç ile oluşturulan açıklık tasarımı, mekânı doğa ile bütünleştirmektedir (bkz. Şekil 8) (Canoğlu Kocaman, 2019).

Geleneksel Türk evinde birbiriyle güçlü bir bağ kuran sofa-oda kurgusuna benzer şekilde, Şevket Saatçioğlu villasında oturma mekânı, yemek ve çalışma alanları gibi birçok işlev iç içe kurgulanmıştır (bkz. Şekil 8). Tefriş düzeni duvarlarla değil, mobilya elemanları (oturma grubu, yemek masası, kitaplıklar) ile mekanları ayrıştırmaktadır (Canoğlu Kocaman, 2019).

Villa tasarımında rasyonel ve çizgisel tasarım kararları ile meydana getirilen tefrişler, mekânın sadeliğini ve işlevsel sınırlılığını ortaya koyarak modern konutun kültürel etkilerini iç mekân kurgusu ile bir bütünlük oluşturmaktadır.

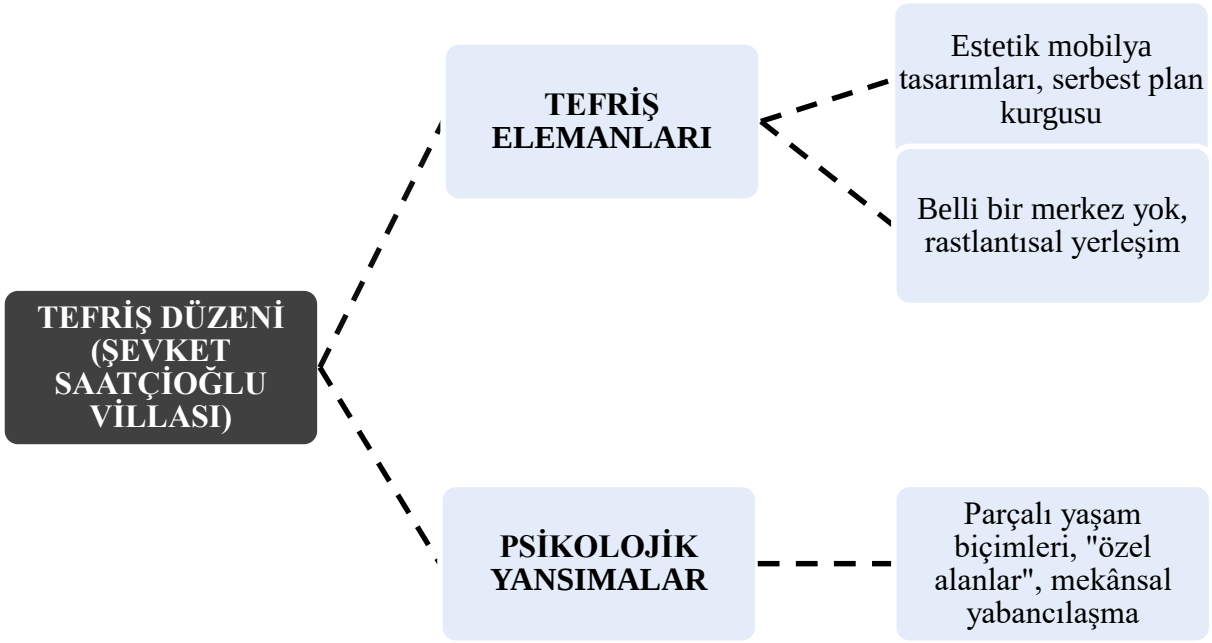
Şevket Saatçioğlu Villasında geniş cam yüzeyler ve bant pencerelerin bulunması, mobilyaların yerleşimini doğrudan bahçe mekanına yönlendirmektedir. Bu villa yapısında tefriş düzeni, mekânı sınırlandırmak için değil bireyi dış çevreye yönlendirmek için meydana getirilmiştir.



Şekil 9. Şevket Saatçioğlu Villası Görünüş Çizimleri (solda), Birinci Kat Planı (ortada) ve Dış Mekân Görseli (Arkitekt, 1970), (Ennaç, 2025)

Ayrıca, iç mekânda kullanılan tefriş elemanlarının iskeletlerinde ve doğramalarda alüminyum veya çelik gibi çağdaş malzemelerin kullanılması, rasyonalist ve çizgisel bir yaklaşım anlayışını ortaya koymaktadır. Geleneksel Türk evindeki sıcak malzemelerin aksine beton, çelik gibi soğuk malzemelerin tercih edilmesi, mekânın anlamsal yönünü zayıflatan unsurlar arasında yer almaktadır (bkz. Şekil 9).

Tablo 2. Şevket Saatçioğlu Villası Oturma Mekânı Tefriş Düzeni ve Psikolojik Etkileri Şema Gösterimi (Yazarlar tarafından düzenlenmiştir, 2025)



Özetle, Şevket Saatçioğlu villasında, geleneksel Türk evindeki bütünlük ve birlik düzenine karşılık olarak, iç mekân bölümleri mobilya gruplarıyla sınırlandırılmış ve bireyselleşmiş alanlar meydana getirilmiştir. Böylece, modern konutta oturma mekanına ait tefriş elemanlarının tekil kullanım bölgeleri oluşturduğu ve bu durumun bireyler üzerinde yalnızlaşma ve mekâna yabancılaşma hislerini uyandırdığı görülmektedir.

4. KARŞILAŞTIRMALI ANALİZ: GELENEKSEL TÜRK EVİ VE MODERN KONUT TEFRİŞ DÜZENİ

Araştırma doğrultusunda, Birgi Çakırağa Konağı ve Şevket Saatçioğlu Villası örnekleri üzerinden yapılan incelemeler, konutlardaki oturma mekânı tefriş düzenlerinin fiziksel, sosyal ve kültürel özellikleri yansıtan ve mekânsal kurguyu şekillendiren önemli unsurlar olduğu görülmektedir. Birgi Çakırağa Konağı oturma mekânı tefriş düzeni, mekânın üç tarafını çevreleyen yerleşim kurgusu ile bireyler arasındaki etkileşimi güçlendiren ve ortak alan kavramını meydana getiren bir yapıya sahiptir. Şevket Saatçioğlu Villasındaki oturma mekânı tefriş yerleşimi ise, kullanıcılarına serbest plan şeması içerisinde mobilya elemanları ile sınırlandırılmış fiziksel alanlar sunmaktadır. Bu bağlamda, geleneksel Türk evinde kolektif bir tasarım anlayışını yansıtırken, modern konut yapısında parçalanmış ve ayrışmış bir yapı kurgusunu meydana getirmektedir (bkz. Tablo 3).

Tablo 3. Karşılaştırmalı Analiz Bulguları (Birgi Çakırağa Konağı ve Şevket Saatçioğlu Villası) (Yazarlar tarafından düzenlenmiştir, 2025)

ANALİZ ÖZELLİKLERİ	BİRGİ ÇAKIRAĞA KONAĞI	ŞEVKET SAATÇİOĞLU VİLLASI
Mekânsal Kurgu	Kolektif düzen	Sınırlı Alanlar
Odak Noktası	Ocak (ısıtma elemanı)	Sabit bir odak noktası yok (mekânın işlevine, tasarımına ve kullanıcı tercihine göre değişken)
Ruhsal Etkiler	Aidiyet, topluluk hissi	Bireyselleşme ve görsel estetik
Tefriş Düzeni	Çevresel (duvar boyunca)	Serbest / rastlantısal / sadelik
Mekânsal Algı	Sıcak ve samimi	Görsel unsurlar ve işlev ağırlıklı

Elde edilen veriler doğrultusunda, Birgi Çakırağa Konağı oturma mekânı tefriş düzeninde yer alan sedir ve ocak ilişkisi, bireyler üzerindeki aidiyet duygusunu güçlendirerek, mekândaki kültürel süreklilik hissini muhafaza etmektedir.

Şevket Saatçioğlu Villası oturma mekanındaki tefriş düzeni ise, serbest mobilya yerleşimleri ve değişen odak noktaları ile değişen toplumsal yaşam biçimlerini yansıtmakta ve mekânı yaşayan bir alandan soyut bir ortama dönüştürmektedir. Fenomenolojik bağlamda ise, geleneksel Türk evindeki yerleşim kurgusu bireylerin mekân içerisinde kendisini huzurlu ve güvende hissetmesini sağlarken, modern konuttaki tefriş kurgusu mekânı sadece işleve yönelik oluşturulmuş ve standartlaşmış bir alan haline getirmektedir (bkz. Tablo 4).

Tablo 4. Psikolojik Etkiler (Birgi Çakırağa Konağı ve Şevket Saatçioğlu Villası) (Yazarlar tarafından düzenlenmiştir, 2025)

PSİKOLOJİK ETKİLER	BİRGİ ÇAKIRAĞA KONAĞI	ŞEVKET SAATÇİOĞLU VİLLASI
Aidiyet	Tarihsel süreklilik ve kültürel özellikler ile yaşayan bir mekân	"Özel alan" kavramı doğrultusunda bireyselleşmiş mekanlar
Güven	Bütünlük hissi ve doğal malzeme kullanımları, birey üzerinde olumlu etkiler	Serbest plan şeması, parçalanmış odalar ve endüstriyel teknik malzeme kullanımları, birey üzerinde güvensizlik hissi
Sıcaklık	Ahşap ve tuğla malzeme kullanımları, bitkisel motifler	Beton, çelik ve alüminyum gibi soğuk malzemeler, yalın cephe ve iç mekân tasarımları
Mahremiyet	Oda mekanına girmeden önce yer alan seki altı bölümü, duvar boyunca görülen sedir yerleşimi	Serbest plan şeması, parçalı birimler

Görsel Estetik	Hareketli cepheler, iç mekânda süsleme detayları, ahşap işçilikleri	Yalın plan şeması, düz yüzeyler ve iç mekânda endüstriyel mobilya tasarımları

5. SONUÇ VE ÖNERİLER

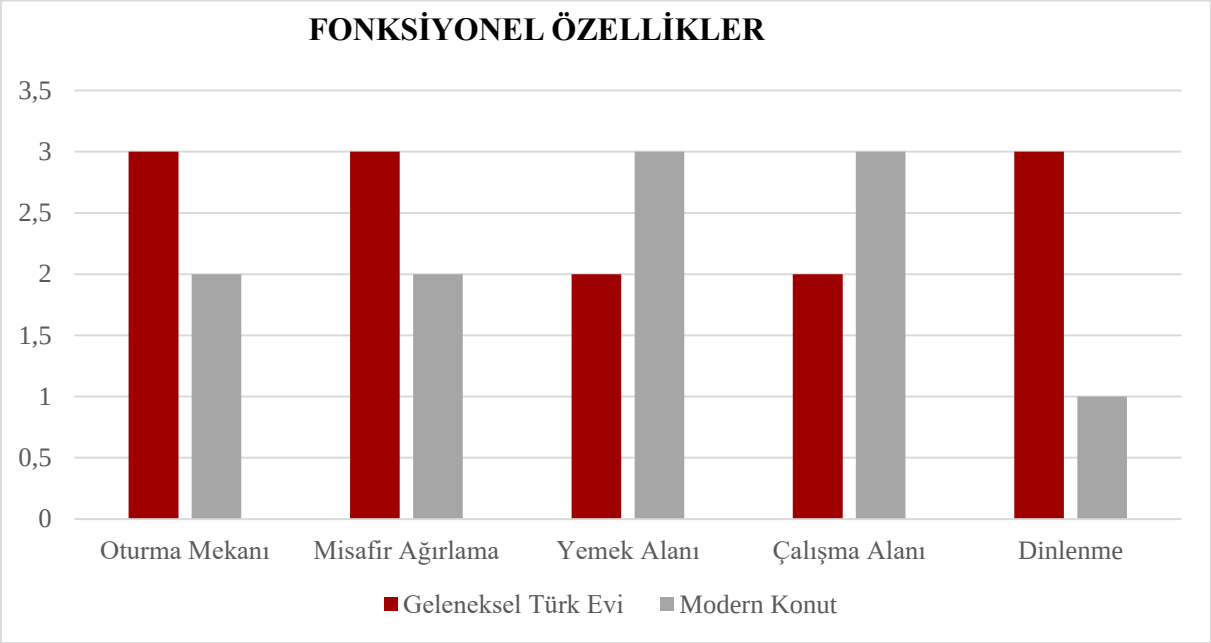
Bu çalışma, konutlardaki oturma mekânı tefriş düzeni bağlamında, bireyler üzerindeki psikolojik etkileri ve toplumsal yaşam biçimlerini nasıl ve hangi yönlerden etkilediğini karşılaştırmalı bir analiz çerçevesinde meydana getirmiştir. Bu veriler sonucunda, geleneksel Türk evi ve modern konut plan yerleşimleri arasındaki asıl değişimin sosyal normlar ve toplumsal yaşam biçimleri arasında yaşandığı görülmektedir.

Birgi Çakırağa Konağı'ndaki tefriş yerleşiminin sedir, ocak, halı ve dolap gibi elemanlar ile bir bütünlük oluşturması, birey üzerinde bulunduğu mekânın kendine ait bir alan olduğu hissini oluşturmaktadır. Çevresel sedir yerleşimleri ve pencere düzenleri ise, mekân kurgusu içerisinde rahat bir hareket alanı sunarak, kullanıcının çevre ile doğrudan etkileşimini sağlar. Bu doğrultuda, aile içi iletişim güçlü bir boyut kazanarak, kullanıcıya sosyal bir merkez imkânı sağlamaktadır.

Şevket Saatçioğlu Villası ise, modern konutun rasyonel tasarım anlayışını yansıtan ve tefriş elemanlarının serbest plan kurgusu ile standartlaşan endüstriyel alanlar ortaya koymaktadır. Bu konut yapısında, birey mekândan uzaklaştırılarak sadece geçici kullanıma hizmet eden somut birimler oluşturulmuştur. Modern konut düzeninde mobilya elemanlarının oturma mekanının sınırlandırılması, geleneksel Türk evindeki birlik hissinin parçalı bir yapıya dönüşmesine neden olmuştur (bkz. Tablo 5).

Fenomenolojik çerçeve açısından ise, modern konut oturma mekânı tefriş düzeninin estetik tasarım kararlarıyla kurgulanması, bireyi içerisinde bulunduğu mekâna yabancılaştırmakta ve yalnız bir hale getirmektedir. Geleneksel Türk evindeki bütüncül ve kapsamlı mekân kurgusunun birey üzerinde oluşturduğu "güven" ve "aidiyet" duygularına karşılık, modern konut yapısında oluşturulan bireysel alanlar ile bu bütünlük ayrılmıştır. Bu yaklaşım, aile bireyleri arasındaki ilişkinin ve kültürel sürekliliğin yitirilmesine sebep olmuştur.

Tablo 5. Birgi Çakırağa Konağı ve Şevket Saatçioğlu Villası Oturma Mekânı Fonksiyonel Özelliklerinin Grafik Gösterimi (Yazarlar tarafından düzenlenmiştir, 2025)



Sonuç olarak, bu çalışma, modern konut tasarımlarında kültürel özelliklerin, sosyal etkileşimlerin ve toplumsal yaşam biçimlerinin geri plana atılmaması gerektiğine dikkat çekmektedir. Elde edilen veriler sonucunda, geleneksel Türk evi plan kurgusunun sahip olduğu esneklik, çok işlevlilik ve mahremiyet gibi özelliklerin modern tasarım ilkeleri ile entegre edilerek bir tasarım oluşturulması; birey psikolojisi üzerinde olumlu etkiler uyandıracağını göstermektedir. Bu doğrultuda, oturma mekânı tefriş düzenlerinin mekânsal kurguyu ve birey psikolojisini etkileyen temel unsurlardan biri olduğu düşüncesi hem akademik literatürde hem de mimari çalışma alanlarında çok yönlü bir bakış açısıyla yeniden değerlendirilmelidir.

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HİZAN İLÇESİNE BAĞLI UZUNTAŞ KÖYÜ GELENEKSEL KONUTLARININ EKOLOJİK İLKELER AÇISINDAN ANALİZİ

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ÖZET

Dünyada coğrafi olarak farklı yerlerde inşa edilen geleneksel konutlar, kendine özgü bir mimari üsluba sahiptir. Farklı coğrafyalarda, üretilen bu geleneksel konutlar, toplumun ortak kültürel mirasının ürünü olması, tarihi belleğini oluşturması ve yaşam felsefesini yansıtması bakımından önemli bir rol üstlenmektedir. Bu çalışma, Bitlis ili Hizan ilçesine bağlı Uzuntaş (Küçköy) köyünde yer alan geleneksel kırsal konut dokusunu ekolojik mimarlık ilkeleri doğrultusunda incelemektedir. Günümüzde geleneksel konutlara ait sürdürülebilir özelliklerin dikkatte alınmaması, bunların günümüz çağdaş konutları tasarımında referans olarak değerlendirilmemesi ve bu değerlerin yok olma tehlikesi ile karşı karşıya kalması çalışma açısından problem olarak görülmüştür. Araştırmanın temel amacı, bulunduğu iklim ve topografya uyumu, pasif iklimlendirme stratejileri, yerel malzeme kullanımı ve yapım tekniği , kültürel sürdürülebilirlik ve mekânsal organizasyon üzerinden köy konutlarının sürdürülebilirlik performansını ortaya koymaktır. Uzuntaş köyü, Doğu Anadolu'nun sert iklim koşullarına ve yüksek rakım değerlerine rağmen, yüzyıllardır canlılığını koruyan özgün bir taş konut geleneğine sahiptir. Bu çalışma; literatür taraması, saha gözlemi, fotoğraflama yöntemine dayanmaktadır. Çalışmada, yapılan literatür taraması sonucunda Uzuntaş kırsal konutları, belirlenen ekolojik ilkeler doğrultusunda analiz edilip elde edilen veriler tablolara aktarılmıştır. Elde edilen veriler özelikle sürdürülebilir yapılaşmanın önemini ortaya koyma açısından büyük önem taşımaktadır. Ayrıca Uzuntaş köyü konutlarının yerel malzemelerle inşa edildiğini, pasif iklimlendirme yöntemlerine dayalı olduğunu, topografyayla uyumlu konumlandığını ve yüksek sürdürülebilirlik değerine sahip olduğunu göstermektedir. Sonuç olarak, Uzuntaş köyü kırsal konutları modern ekolojik tasarım ilkeleri açısından önemli referanslar sunmakta ve günümüz mimarlığı için potansiyel bir model oluşturmaktadır. Bu açıdan bunun önemi bir kez daha Uzuntaş köyü kırsal konutları üzerinden değerlendirilerek ortaya konulmaya çalışılmıştır.

Anahtar Kelimeler: Hizan, Uzuntaş köyü, ekolojik mimarlık, geleneksel konut, sürdürülebilirlik

ANALYSIS OF TRADITIONAL HOUSES IN UZUNTAŞ VILLAGE, HİZAN DISTRICT, FROM AN ECOLOGICAL PERSPECTIVE

ABSTRACT

Traditional dwellings built in different geographical locations around the world have their own unique architectural style. Produced in different geographical areas, these traditional dwellings play an important role in that they are the product of the community's shared cultural heritage, form its historical memory, and reflect its philosophy of life. This study examines the traditional rural housing fabric in the village of Uzuntaş (Küçköy) in the Hizan district of Bitlis province in line with the principles of ecological architecture. The fact that the sustainable features of traditional dwellings are not taken into consideration today, that they are not evaluated as a reference in the design of contemporary dwellings, and that these values are at risk of disappearing is seen as a problem in this study. The main objective of the research is to reveal the sustainability performance of village dwellings through their adaptation to the climate and topography, passive climate control strategies, use of local materials and construction techniques, cultural sustainability, and spatial organization. Despite the harsh climatic conditions and high altitude of Eastern Anatolia, the village of Uzuntaş has a unique stone dwelling tradition that has remained alive for centuries. This study is based on literature review, field observation, and photography methods. As a result of the literature review conducted in the study, Uzuntaş rural dwellings were analyzed in line with the defined ecological principles, and the data obtained were transferred to tables. The data obtained are particularly important in terms of highlighting the importance of sustainable construction. It also shows that the houses in Uzuntaş village are built with local materials, based on passive climate control methods, located in harmony with the topography, and have high sustainability values. As a result, the rural houses in Uzuntaş village provide important references in terms of modern ecological design principles and constitute a potential model for today's architecture. From this perspective, its importance has been re-evaluated and highlighted through the rural dwellings of Uzuntaş village.

Keywords: Hizan, Uzuntaş village, ecological architecture, traditional housing, sustainability

1. GİRİŞ

Mimarlık tarihinin büyük bir kısmı, insanların doğayla uyum içinde yaşama çabalarının ürünüdür. Sanayi devrimi öncesi inşa edilen yapıların önemli bir bölümü, bulunduğu coğrafyanın iklimsel koşullarını, topografyasını, malzeme olanaklarını ve kültürel yaşam biçimlerini doğrudan yansıtan, kendiliğinden gelişen mimari sistemlerdir. Bu nedenle geleneksel konut tipolojileri, yalnızca estetik ya da kültürel miras değeri taşımaz; aynı zamanda

çağdaş ekolojik mimarlığın beslendiği en önemli bilgi kaynaklarından biridir. Özellikle sürdürülebilir mimarlık yaklaşımlarında temel kabul edilen enerji verimliliği, yerel malzeme kullanımı, iklimle uyumlu tasarım, doğal havalandırma stratejileri ve mekânsal optimizasyon gibi kavramların birçoğu, geleneksel yapılarda yüzyıllardır uygulanmaktadır (Fathy, 1986; Oliver, 2003; Rapoport, 2006).

Günümüzde küresel ölçekte yaşanan çevresel krizler, doğal kaynakların azalması, fosil yakıtlara bağımlılık, hızlı kentleşme ve karbon emisyonlarının yükselmesi, yapı sektörünü sürdürülebilirlik açısından en kritik alanlardan biri hâline getirmektedir. Birçok araştırma, dünyadaki toplam enerji tüketiminin yaklaşık %40'ının binalar tarafından kullanıldığını, toplam karbon salımının ise %30'unun yapı üretim–kullanım süreciyle bağlantılı olduğunu ortaya koymaktadır (Kibert, 2016). Bu nedenle çevresel etkisi düşük, yerel kaynakları kullanan, iklimle uyumlu ve doğal süreçleri dikkate alan mimari yaklaşımlar hem akademik literatürde hem de uygulamalı alanlarda giderek önem kazanmaktadır.

Bu çerçevede ekolojik mimarlık kavramı, sürdürülebilir kalkınma hedefleriyle uyumlu, çevreyle barışık, doğal döngülerle ilişkili ve yaşam döngüsü maliyeti düşük yapılar üretmeyi amaçlayan bir yaklaşım olarak tanımlanmaktadır. Ekolojik tasarım; enerji verimliliği, yerel malzeme kullanımı, düşük enerji kullanımı, doğal havalandırma, güneş yönelimi, mikroklima oluşturma ve kültürel süreklilik gibi ilkeler üzerine kuruludur (Edwards, 2005; Yeang, 1999; Szokolay, 2008). Bu ilkeler modern bir kavram gibi görünse de, geleneksel Anadolu konutlarının büyük bölümünde yüzyıllardır uygulanmaktadır.

Türkiye'nin kırsal yerleşimleri, coğrafyanın sunduğu doğal malzemelerin ustalıkla kullanıldığı, topoğrafya ve iklimle uyumlu fonksiyonel çözümlerin geliştirildiği, çevresel uyumu yüksek yapı örnekleriyle doludur. Geleneksel Doğu Anadolu konutlarında taş, kerpiç ve ahşap gibi malzemelerin kullanılması; kalın duvarlarla ısıl kütle sağlanması; toprak dam sisteminin doğal yalıtım sunması; güneye yönelim, rüzgâr kontrolü ve avlu kullanımı gibi özellikler, modern ekolojik tasarım literatürüyle birebir örtüşmektedir (Aksoy & İnceoğlu, 2015; Türkmen, 2017; Kuban, 2010).

Doğu Anadolu Bölgesi'nin kırsal yerleşimleri, iklimsel zorlayıcılığa rağmen yüksek uyum kapasitesi gösteren konut tipolojileriyle dikkat çekmektedir. Sert kış koşulları, düşük sıcaklık değerleri, güçlü rüzgâr etkisi ve mevsimsel sıcaklık farkları, bölgedeki konutların biçimlenişinde belirleyici rol oynamıştır. Bu bağlamda Hizan ilçesine bağlı Küçköy, hem topoğrafik hem de iklimsel açıdan zorlu bir konumda bulunmasına rağmen uzun süredir

varlığını sürdüren bir taş yapı geleneğine sahiptir. Köyün mevcut konut dokusu, iklimsel zorunlulukların şekillendirdiği özgün bir mimari düzen ortaya koymaktadır.

Küçköy konutlarının büyük çoğunluğu, yığma taş duvarlar, toprak damlar, ahşap hatıllar, kompakt plan tipolojisi ve güneye yönlendirilmiş cepheleri ile bölgesel iklimle uyumlu bir düzen oluşturur. Yapıların avlu düzeni, alt kat–üst kat işlev ayrımı, küçük pencere açıklıkları, hayvan barınağının ısı kaynağı olarak kullanımı ve topoğrafyayla bütünleşik yerleşim karakteri, mimari yapının ekolojik davranış biçimini ortaya koymaktadır. Bu özellikler, literatürde sıklıkla vurgulanan pasif iklimlendirme stratejileri ile oldukça yakın ilişkiler göstermektedir (Fathy, 1986; Szokolay, 2008).

Bu çalışmanın temel amacı, Küçköy konutlarının ekolojik mimarlık ilkeleri açısından kapsamlı biçimde analiz edilmesi; özellikle malzeme, iklimsel uyum, pasif iklimlendirme ,yapım tekniği, ısıl kütle ve ya ve sürdürülebilirlik performansı kriterleri üzerinden bilimsel bir değerlendirme yapılmasıdır. Çalışma ayrıca, geleneksel bilgi ile çağdaş sürdürülebilirlik yaklaşımlarının kesişim noktalarına ışık tutmayı hedeflemektedir.

Araştırmanın yöntemi; geniş literatür taraması, saha gözlemi, fotoğraf belgelemesine dayanmaktadır. Öncelikli olarak hazırlanan çalışmada, ekolojik mimarlık ve genel ilkeleri hakkında literatür taraması yapılmıştır. Daha sonra Küçköy konutlarına ait mimari oluşum kriterleri ile ilgili genel bilgiler verilmiştir. Ekolojik mimarlık ilkeleri doğrultusunda belirlenen parametreler kapsamında analiz edilip konutlara ait veriler hazırlanan tablolara aktarılarak hazırlanmıştır. Analizi yapılan parametreler; bulunduğu iklime ve topografyaya uyum, pasif iklimlendirme stratejileri, yapım tekniği ve malzeme kullanımı ve kültürel sürdürülebilirlik analizidir. Bu doğrultuda hazırlanan bulgular bölümü, yapıları ekolojik ölçütlerle açıklayan kapsamlı veri ve değerlendirmeler içermektedir. Sonuç olarak çalışmada; Küçköy konutlarının modern sürdürülebilir mimarlık açısından sunduğu katkılar tartışılmakta, gelecek çalışmalara yönelik öneriler sunulmaktadır. Bu çerçevede çalışma yalnızca mimari bir inceleme sunmamakta; sürdürülebilirlik ve ekolojik uyum açısından Küçköy geleneksel konutların nasıl bir potansiyel taşıdığını da bilimsel bir çerçevede ele almaktadır.

2. MATERYAL VE METOT

Bu çalışma, Bitlis'in Hizan ilçesine bağlı Küçköy yerleşimindeki geleneksel konut dokusunu ekolojik mimarlık ilkeleri doğrultusunda analiz etmeyi amaçlayan nitel bir araştırma olarak tasarlanmıştır. Araştırmanın materyalini saha gözlemleri sırasında elde edilen mimari fotoğraflar, literatür kaynakları ve bölgenin iklim–topoğrafya verileri oluşturmaktadır.

Çalışmada öncelikle ekolojik mimarlık, üzerine kapsamlı literatür taraması yapılmış; bu tarama aracılığıyla değerlendirmede kullanılacak kavramsal çerçeve oluşturulmuştur.

Saha araştırması kapsamında; yapıların konumlanma biçimleri, malzeme özellikleri, pencere ölçüleri, yapım tekniği, dam yapısı, sokak ilişkisi ve topoğrafyaya uyumu sistematik biçimde gözlemlenmiştir. Analizler ağırlıklı olarak dış mimari üzerinden gerçekleştirilmiştir. Araştırma yöntemi; literatür taraması, yerinde gözlem, fotoğraf belgeleme ve ekolojik kriterlere göre mimari analiz olmak üzere dört aşamadan oluşmaktadır. Yapılan analizler belirli ekolojik kriterler doğrultusunda ele alınarak elde edilen veriler tablolara aktarılmıştır.

2.1. Ekolojik mimarlık ve temel ilkeleri

Ekolojik mimarlık, doğa ile uyumlu, enerji verimliliği yüksek, kaynak tüketimi minimuma indirgenmiş ve sürdürülebilir yaşamı destekleyen yapı üretim süreçlerini kapsayan bir mimarlık yaklaşımıdır. Temelde, doğal sistemlere zarar vermeyen; malzeme, enerji ve mekânsal organizasyon açısından çevresel etkiyi azaltmayı hedefleyen tasarım ilkelerine dayanır. Günümüzde küresel iklim krizi, yapılı çevrenin artan enerji tüketimi ve doğal kaynakların hızla tükenmesi, ekolojik mimarlığı akademik literatürde ve mimarlık pratiğinde zorunlu hâle getirmiştir (Edwards, 2005; Yeang, 1999).

Ekolojik mimarlığın temelinde doğal süreçleri taklit etme ve bu süreçlerle uyumlu bir yaşam alanı üretme fikri vardır. Bu açıdan bakıldığında ekolojik tasarım, yalnızca teknik bir tasarım yöntemi değil, aynı zamanda çevreyle kurulan etik bir ilişki biçimidir. Yeang (1999), ekolojik mimarlığın yapıyı "doğal döngülere entegre bir organizma" olarak tasarladığını belirtirken; McDonough ve Braungart (2002) ise sürdürülebilir mimarlığın özünü "döngüsel malzeme ekonomisi" ve "atık üretmeyen sistemler" olarak tanımlar.

Ekolojik mimaride öne çıkan ilkeler genel olarak şu başlıklar altında toplanmaktadır:

Enerji verimliliği**:** yapının pasif iklimlendirme yöntemleri ile kendi kendine ısınma ve serinleme kapasitesini arttırması anlamına gelir. Güneş yönlenmesi, doğal havalandırma, gölgeleme stratejileri, ısıl kütle kullanımı ve kompakt kütle organizasyonu gibi yöntemler, ekolojik mimarlık literatüründe temel kabul edilmektedir (Givoni, 1994; Hyde, 2000). Pasif tasarım, yalnızca enerji tüketimini azaltmaz, aynı zamanda yapının yaşam döngüsü boyunca çevresel etkisini minimize eder.

Yerel malzeme kullanımı**:** Ekolojik mimarlığın en belirgin özelliklerinden biridir. Taş, toprak, ahşap ve doğal harç gibi malzemelerin düşük enerjiye sahip olması, yakın çevreden temin edilmeleri ve geri dönüşebilir olmaları çevresel etkiyi azaltır (Fathy, 1986; Oliver, 2003, Goodhew & Griffiths, 2004). Yerel malzeme kullanımının aynı zamanda kültürel sürekliliği

desteklemesi, ekolojik mimarlığı yalnızca çevresel değil sosyo-kültürel bir yaklaşım hâline getirir. Kenneth Frampton (1992), yerel malzemenin mimari kimlik oluşumundaki önemini "kritik bölgeselcilik" kavramı üzerinden ele alarak, yerel malzeme kullanımını hem ekolojik hem kültürel bir gereklilik olarak tanımlar.

İklim–topografya uyumu**:** yapının bulunduğu coğrafyanın fiziksel özelliklerini kullanarak enerji tasarrufu sağlamasıdır. Yapıların hâkim rüzgâr yönüne göre konumlandırılması, güneş kazancını optimize edecek açıların belirlenmesi, topoğrafyanın rüzgâr kırıcı veya güneş toplayıcı özelliklerinden yararlanılması ekolojik tasarımın ana bileşenleri arasındadır (Szokolay, 2008). Ekolojik mimarlığın başarısı büyük ölçüde yapının çevresi ile kurduğu ilişkide ortaya çıkar. Su yönetimi, döngüsel sistemler ve atık azaltımı: Ekolojik mimarlığın güncel kapsamı, yalnızca enerjiye değil su verimliliğine, yağmur suyu tasarrufuna, gri su kullanımına ve atık döngülerine de odaklanmaktadır (Kibert, 2016).

Kültürel sürdürülebilirlik ve yerel bilgi : Modern araştırmalar, ekolojik mimarlığın yalnızca teknik değil kültürel bir süreç olduğunu ortaya koymaktadır (Rapoport, 2006; Fathy, 1986). Geleneksel konutların biçimlenmesinde yer alan yerel üretim teknikleri, kolektif bilgi, zanaatkârlık ve yaşam biçimi, çevresel uyumun ana bileşenidir.

Bu ilkelerin tümü modern mimarlığın çevre dostu bir yapı üretme çabasıyla ortaya çıkmış olsa da, literatürde geniş biçimde vurgulandığı üzere, geleneksel mimarlık örneklerinin büyük bölümü bu ilkeleri yüzyıllardır içselleştirmiştir (Rapoport, 2006; Watson & Labs, 1984). Geleneksel taş, kerpiç ve ahşap konut tipolojilerinin tamamında doğal havalandırma, kalın duvarlarla ısıl kütle oluşturma, güneş kazancını arttırma, gölgeleme ve avlu-mikroklima üretme stratejileri görülmektedir. Yeang (2006), biyoklimatik mimarinin "en yüksek enerji verimliliğini en düşük teknolojik müdahale ile sağlayan tasarım yaklaşımı" olduğunu vurgular. Bu çalışmada kullanılan ekolojik ilkeler ; iklime ve topografyaya uyum, pasif iklimlendirme stratejileri, yapım tekniği ve malzeme kullanımı ve kültürel sürdürülebilirlik analizidir. Bu ilkeler bulgular bölümünde analiz tablolarına temel oluşturacaktır.

2.2. Bitlis, Hizan Uzuntaş köyü geleneksel mimarisi

Bitlis'in Hizan ilçesinde yer alan Uzuntaş köyü, coğrafi konumu, iklimsel özellikleri ve geleneksel yaşam biçimi nedeniyle oldukça kendine özgü bir mimari dokuya sahiptir. Yerleşim, yüksek rakımlı bir bölgede yer almakta olup sert kış koşulları, düşük sıcaklık değerleri, yoğun kar yağışı ve belirgin sıcaklık farkları ile karakterize edilir. Bu iklimsel zorluklar, yerleşim dokusunun ve konutların biçimlenmesinde belirleyici rol oynamıştır. Köyün geleneksel

konutları, her ne kadar sınırlı kaynaklarla inşa edilmiş olsa da sürdürülebilirlik açısından oldukça güçlü teknik özellikler göstermektedir (Şekil 1).



Şekil 1. Hizan Uzuntaş köyü

Uzuntaş köyü, konutlarının en önemli özelliği, tamamen yerel malzemelerle inşa edilmesidir. Bölgede yoğun olarak bulunan bazalt, tüf ve kalker türleri yapıların taşıyıcı duvarlarında kullanılmaktadır. Duvar kalınlıklarının 70–90 cm arasında değişmesi, hem yapısal dayanımı artırmakta hem de güçlü bir ısıl kütle oluşturarak iç mekân sıcaklığının korunmasına yardımcı olmaktadır. Taş örgü sistemi çoğunlukla moloz taşlardan oluşur ve taşlar yerinde şekillendirilerek duvarlara uygulanır (Şekil 2).



Şekil 2. Hizan Uzuntaş köyü geleneksel konutları

Bir diğer karakteristik unsur toprak dam sistemidir**.** Ahşap hatıllar üzerine yerleştirilen dal-çalı örgüsü, üzerine sıkıştırılan toprak dolgu ile tamamlanır. Bu sistem, yüksek yalıtım kapasitesine sahip olduğu gibi kış aylarında çatı üzerinde biriken kar tabakası ek bir yalıtım görevi görür. Bu geleneksel dam sistemi, düşük maliyetli olmasına rağmen yüksek enerji verimliliği sunar (Şekil 3).



Şekil 3. Hizan Uzuntaş köyü geleneksel konutları

Uzuntaş köyü konutlarının mekansal düzeni iklimsel koşullarla birebir ilişkilidir. Genellikle alt kat depo ve ahır olarak kullanılırken, üst katlar yaşam mekanlarını oluşturur. Hayvanlardan yayılan ısının üst katlara doğru yükselmesi sayesinde pasif bir ısıtma sistemi ortaya çıkar. Bu yöntem, geleneksel Doğu Anadolu konutlarında yaygın olan ama ekolojik açıdan oldukça etkili bir uygulamadır. Evlerin büyük çoğunluğu güneye yönlendirilmiştir. Bu sayede kış aylarında güneş kazancı artırılırken kuzey rüzgarlarının etkisi minimuma indirilir. Pencerelerin küçük tutulması, rüzgar ve ısı kaybını önlemek için alınan bir önlemdir. Bu tasarım, literatürde "pasif güneşlenme stratejisi" olarak tanımlanan bir performans artışı sağlar.

Yerleşimin topoğrafyayla kurduğu ilişki de oldukça işlevseldir. Evler, yamaç eğimine paralel veya kademeli olarak konumlanır. Bu düzen, hem rüzgar yükünü azaltır hem de güneşlenme performansını iyileştirir. Aynı zamanda köy dokusunun kompakt biçimde oluşmasını sağlayarak ısı kayıplarını minimuma indirir. Yoğun ve sıkı bir köy düzeni, kışın ısı kayıplarını azaltırken yazın gölgelenme avantajı yaratır (Kuban, 2010) (Şekil 4).



Şekil 4. Hizan Uzuntaş köyü geleneksel konut dokusu

Uzuntaş köy konutlarında kullanılan tüm malzemeler yerelden temin edildiği için hem maliyet düşüktür hem de karbon ayak izi minimumdur. Ayrıca topluluk içi dayanışma ile gerçekleşen yapım süreçleri, kültürel sürdürülebilirliği destekleyen önemli bir unsurdur. Genel olarak değerlendirildiğinde, Uzuntaş köyü konutları modern ekolojik mimarlığın neredeyse tüm

kriterlerini doğal biçimde karşılamaktadır. Bu yapılar, düşük enerji ihtiyacı, yerel malzemeye dayalı çevreci yapım tekniği ve iklimle tam uyumlu form üretimi açısından önemli bir örnek oluşturmaktadır.

3. BULGULAR

Bu bölümde Uzuntaş köyü, geleneksel konutları ekolojik mimarlığın temel kriterlerine göre analiz edilmiştir. Ekolojik ilkeler; saha gözlemleri ve literatürle karşılaştırılarak 4 ana kategori altında değerlendirilmiştir. Her bir kriter için tablo hazırlanmış; tabloların altında bulgular olarak yorumlanmıştır.

3.1. Yerel malzeme kullanımı ve yapım tekniği

Tablo 1. Uzuntaş köy konutlarında yerel malzeme kullanımı ve yapım tekniği

Özellik	Bulgular
Ana taşıyıcı malzeme	Yerel bazalt taşı; kuru duvar veya çamur harçlı yığma teknik
Dolgu ve ara kat malzemesi	Ahşap hatıl, dal örgüsü, sıkıştırılmış toprak
Çatı/dam sistemi	Toprak dam; 20–40 cm sıkıştırılmış toprak + dal örgüsü
Zemin	Taş döşeme, sıkıştırılmış toprak
Taş duvar	Yığma, kuru duvar / çamur harç
Dam	Dal örgüsü + toprak
Temel	Taş temel
Hatıl	Ahşap hatıl sistemi
Yeniden kullanılabilirlik	Taş ve ahşap tamamen geri kazanılabilir
Bakım–onarım kolaylığı	Yerel ustalık geleneği sayesinde yüksek
Fotoğraf	



Saha gözlemlerinde, köydeki yapıların %95'inden fazlasında yerel taşının kullanıldığı görülmüştür. Bu durum yalnızca malzeme temini açısından değil, malzemenin çevresel uyumu**,** ısıl performansı ve sürdürülebilirliği açısından da anlamlıdır. Dam sisteminin tamamen toprak malzemeden oluşması, geleneksel ekolojik mimarinin en belirgin göstergelerinden biridir. Toprak, hem doğal bir yalıtım sağlar hem de bakım-onarım için bölge halkı tarafından kolayca işlenebilir. Saha gözlemlerinde, yapıların büyük ölçüde usta–çırak geleneği ile inşa edildiği, endüstriyel malzeme kullanımının yok denecek kadar az olduğu tespit edilmiştir. Bu durum

ekolojik mimaride aranan düşük karbonlu yapım kültürünün temelidir. Toprak dam ve ahşap hatıl gibi tamamen doğal sistemler, hem sürdürülebilir hem de bakım açısından ucuz çözümler sunmaktadır.

3.2 İklim ve topografya uyumu

Tablo 2. Uzuntaş köy konutlarının iklim ve topografyaya uyum analizi

Özellik	Bulgular
Arazi kullanımı	Eğimli araziye teraslanmış yapılaşma
Yapı konumlanması	Güney yönelimi baskın
Sokak morfolojisi	Dar, eğimli, rüzgarı kesen sokaklar
Kar birikimi davranışı	Teras yapısı sayesinde kontrollü
Rüzgar kontrolü	Kuzey cepheleri kapalı, açıklıklar minimal
Arazi kullanımı	Eğimli araziye teraslanmış yapılaşma
Mekansal düzeni	Genellikle alt kat depo ve ahır olarak kullanılırken, üst katlar yaşam mekanlarını oluşturur (pasif ısıtma sistemi).
Fotoğraf	
	

Uzuntaş köy yerleşimi, eğimli topoğrafyaya müdahale etmeden**,** yapıların araziye oturduğu bir teras sistemiyle gelişmiştir. Bu yerleşim modeli, araziye uyumlu sürdürülebilir morfoloji tanımıyla örtüşmektedir. Güney yönelimi, pasif güneş kazanımı açısından oldukça etkilidir. Kış aylarında güneş ışığı alımını artıran bu düzenleme, köyün sert iklimine karşı enerji verimliliği sağlar. Sokakların dar yapısı rüzgar hızını keserek mikroklima oluşturur. Bu özellik geleneksel yerleşimlerde görülen pasif rüzgar kontrolünün tipik bir uygulamasıdır.

3.3 Pasif iklimlendirme stratejileri

Tablo 3. Uzuntaş köy konutlarında pasif iklimlendirme stratejileri

Özellik	Bulgular
Güneş yönelimi	Güney–güneydoğu cepheler
Isı kaybı azaltma	Kuzey açıklıklarının sınırlı olması
Gölgeleme	Kütle yoğunluğu ve sokak daralması
Sokak etkisi	Sokak mikrokliması
Kütle kompaktlığı	Komşu binalarla bitişik düzende
Güneş yönelimi	Güney–güneydoğu cepheler
Doğal havalandırma	Hakim rüzgar yönü ve güney cepheye açılan pencere açıklıkları
Duvar kalınlığı	70–100 cm taş
Duvar ısıl davranışı	Gece–gündüz ısı salınımlarını dengeler, Kışın ısı kaybını azaltır, yazın ısınmayı engeller
Dam malzemesi	20–40 cm sıkıştırılmış toprak
İç mekân sıcaklık kararlılığı	Yüksek, mevsim geçişlerinde stabil
Dış cephe açıklıkları	Kapı ve pencereler olabildiğince küçük yapılmış
Yönelim	Evler genel olarak güneye yönlendirilmiştir
Fotoğraf	



Uzuntaş köy konutlarının pasif iklimlendirme açısından en önemli özelliği kompakt yerleşim modeli ve cephe yönelimidir. Güneye dönük cepheler, kışın güneşten maksimum yararlanmayı sağlarken, kuzey cephelerin kapalı olması ısı kaybını ciddi ölçüde azaltmaktadır. Binaların birbirine yakın inşa edilmesi ısı kaybını azaltan komşu kütle ısı kalkanı etkisi yaratır. Kısacası, Uzuntaş köyü, pasif iklimlendirmeyi modern bir teknik olarak değil, tarihsel bir yaşam pratiği olarak doğal biçimde uygulamaktadır. Kalın taş duvarlar, yüksek ısıl kütleli yapı sınıfına girer. Bu yapı formu, sıcaklık değişimlerinin şiddetli olduğu Doğu Anadolu ikliminde son derece avantajlıdır. Toprak damlar, doğal ısı geciktirici özellik gösterir; ısıyı gün içinde yavaşça emer ve gece geri salar. Bu nedenle konutlar yazın serin, kışın ise sıcak kalır. Isıl kütle performansı bakımından Uzuntaş köy evleri, modern ekolojik tasarımla tam uyum içerisindedir.

3.4 Kültürel sürdürülebilirlik ve mekansal organizasyon

Tablo 6. Uzuntaş köy konutlarında kültürel sürdürülebilirlik analizi

Özellik	Bulgular
Alt kat ahır – üst kat yaşam	Enerji verimliliği + üretim modeli uyumu
Kompakt plan	Mahremiyet- Isı kaybını azaltır
Çok amaçlı mekan kullanımı	Minimal enerji ihtiyacı
Mahalle dokusu	Komşuluk ilişkilerini güçlendirir
Dam	Damlarda gıda kurutma geleneği, kültürel sürdürülebilirliğin yerel bir yansımasıdır
Fotoğraf	



Uzuntaş köy konutlarında alt katın ahır olarak kullanılmasına dair geleneksel çözüm, hayvanların vücut ısısı nedeniyle kışın üst katı ısıtarak pasif enerji kazancı sağlar. Bu düzen hem ekonomik hem ekolojik bir pratik olarak ortaya çıkmıştır. Evlerin çok amaçlı tek oda

etrafında şekillenmesi, küçük hacimli ve enerji tasarruflu bir plan şeması sunar. Uzuntaş köyü geleneksel konutlarına ilişkin yapılan ekolojik analiz, yerleşimdeki yapı kültürünün doğal çevreyle güçlü bir uyum içinde geliştiğini göstermiştir. Bulgular, konutların yerel bazalt taşı ve toprak dam sistemi sayesinde düşük enerjiye sahip, dayanıklı ve ısıl kütle performansı yüksek bir yapım geleneği oluşturduğunu ortaya koymuştur. Yapıların güney yönelimli yerleşimi, kuzey cephelerde açıklıkların sınırlı olması, sokakların dar ve rüzgârı kesen formu gibi uygulamalar, pasif iklimlendirme açısından etkili stratejilerdir.

Topografyaya uyumlu teraslanmış yerleşim düzeni ve kompakt kütle yapısı, enerji verimliliğini artırırken, alt kat ahır–üst kat yaşam düzeni hem sosyo-ekonomik hem ekolojik bir çözüm sunmaktadır. Geleneksel yapım tekniklerinin doğal, geri dönüştürülebilir ve bakım maliyeti düşük malzemelere dayanması, bölgenin sürdürülebilir bir yapı kültürüne sahip olduğunu göstermektedir. Genel olarak Uzuntaş köyü geleneksel konutları, modern ekolojik mimarlığın birçok ilkesini kendiliğinden barındıran, iklim–topografya–malzeme uyumuna dayalı güçlü bir geleneksel konut örüntüsü sunmaktadır.

4. TARTIŞMA VE SONUÇ

Bu çalışma, Bitlis'in Hizan ilçesine bağlı Uzuntaş köy yerleşimindeki geleneksel konut dokusunu ekolojik mimarlık ilkeleri çerçevesinde değerlendirerek, köydeki yapı kültürünün hem çevresel hem de kültürel açıdan sürdürülebilir özellikler taşıdığını göstermeyi amaçlamıştır. Elde edilen bulgular, Uzuntaş köy konutları, modern ekolojik mimarlık literatüründe önerilen birçok tasarım ilkesini, herhangi bir teknolojik müdahaleye ihtiyaç duymadan, doğal süreçlerin ve yerel bilgi birikiminin sonucu olarak bünyesinde barındırdığını ortaya koymaktadır. Bu durum, geleneksel mimari pratiklerin günümüz sürdürülebilirlik arayışları açısından önemli dersler içerdiğine işaret etmektedir.

Çalışmada ulaşılan temel sonuçlardan biri, köydeki yapıların malzeme kimliğinin tamamen yerel kaynaklara dayanmasıdır. Yerel bazalt taşının taşıyıcı malzeme olarak kullanılması, düşük enerji ve yüksek dayanıklılık açısından dikkate değer bir ekolojik avantaj sunmaktadır. Toprak dam sistemi ise doğal yalıtım sağlaması ve kolay onarılabilir olması bakımından düşük maliyetli ve çevresel etkisi az bir çözümdür. Bu malzeme seçimi, ekolojik tasarım ilkelerinde vurguladığı doğal ve yerel malzeme kullanımının ideal bir örneğini oluşturmaktadır.

Konutların topoğrafyaya uyumlu biçimde teraslanarak yerleştirilmesi, enerji verimliliği bakımından önemli katkılar sağlamaktadır. Kademeli yerleşim modeli, güneş ışığından yararlanmayı artırırken, rüzgar ve kar birikimi gibi iklimsel etkileri de kontrol altına almaktadır. Bu noktada, yerleşimin doğal topografyaya uyumlu yapısı, araziye saygılı yerleşim

yaklaşımıyla doğrudan paralellik göstermektedir. Sokakların dar, korunaklı ve kıvrımlı biçimi, geleneksel Anadolu yerleşimlerinde sıkça görülen pasif mikroklima üretimini destekler.

Uzuntaş köy konutlarının pasif iklimlendirme açısından en dikkat çekici özelliklerinden biri, cephe yönelimidir. Yapıların güney yönelimli olması, kış aylarında güneş ışığından maksimum oranda yararlanılmasına olanak sağlamakta; kuzey yönünde açıklıkların sınırlı tutulması ise ısı kaybını azaltmaktadır. Bu yönlenme, tamamen deneyimsel bilgiye dayansa da günümüzde biyoklimatik mimarlığın temel tekniklerinden biri olarak kabul edilmektedir. Ayrıca kompakt kütle yapısı ve yapıların birbirine yakın konumlanması, ısı kayıplarını azaltan doğal bir koruma etkisi oluşturmaktadır.

Yapım tekniği açısından değerlendirildiğinde, köy yapılarında kullanılan taş, ahşap ve toprak malzemelerin tamamının geri dönüştürülebilir nitelikte olduğu görülmektedir. Ustaların kuşaktan kuşağa aktardığı yapım bilgisi sayesinde bu tekniklerin devamlılığı sağlanmış; böylece hem çevresel etki düşük tutulmuş hem de kültürel miras korunmuştur. Bu durum, ekolojik mimarlığın yalnızca çevresel değil, aynı zamanda kültürel sürdürülebilirlik boyutunu da desteklemekte; modern tasarımın unuttuğu birçok değerin yerel bilgiyle yaşatıldığını göstermektedir.

Mekansal organizasyon ve kültürel sürdürülebilirlik açısından da önemli bulgular elde edilmiştir. Alt katın ahır, üst katın yaşam alanı olarak kullanımına dayanan geleneksel çözüm, kış aylarında pasif ısı kazancı sağlayarak enerji gereksinimini azaltmakta; aynı zamanda üretim ve yaşam ilişkisini tek yapı kütlesi içinde bütünleştirmektedir. Çok amaçlı oda düzeni, kompakt yaşam alanı ve minimal ısıtma ihtiyacı, modern sürdürülebilir konut arayışlarında giderek önem kazanan mekansal verimlilik ilkesine karşılık gelmektedir.

Genel olarak değerlendirildiğinde, Uzuntaş köy konutlarının iklim, topoğrafya, malzeme ve sosyo-kültürel yapı ile kurduğu ilişki, “kendiliğinden ekolojik mimarlık” örneği olarak nitelendirilebilecek bir bütüncül sürdürülebilirlik performansı sunmaktadır. Bu konutların hiçbir modern teknolojik sistem olmaksızın yüksek ısıl performans sağlaması, enerji verimliliği yaratması ve çevresel etkiyi minimize etmesi, geleneksel yapı bilgisinin günümüz mimarlığına önemli katkılar sunabileceğini göstermektedir.

Sonuç olarak, Uzuntaş köyü geleneksel konutları hem korunması gereken önemli bir kültürel miras hem de günümüz ekolojik tasarım yaklaşımlarıyla uyumlu bir sürdürülebilir konut modeli olarak değerlendirilebilir. Bu yapılar, modern mimarlığın çevresel sorunlara çözüm arayışlarında yararlanabileceği zengin bir yerel bilgi kaynağı oluşturmaktadır. Bunun yanında,

bölgenin geleneksel yapı tekniklerinin belgelenmesi, korunması ve gelecek nesillere aktarılması, hem kültürel hem çevresel sürdürülebilirlik açısından kritik bir önem taşımaktadır.

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MİMARİ TASARIM PARADİGMALARI BAĞLAMINDA İŞGAL MEKÂNLARININ DÖNÜŞÜMÜ: GECEKONDU OLGUSU ÜZERİNDEN BİR İNCELEME

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ÖZET

Sanayi devriminden sonra kırsal kesimlerden kentlere yoğun göçler olmuştur. Kentlere göç eden aileler ekonomik sorunlardan dolayı mülkiyet hakkı gözetmeksizin herhangi bir boş alan bulup üzerine geçici yapılar yapıp buraya yerleşmişlerdir. Bu bölgeler kent içerisinde ayrıştırılmış bölgelerin oluşmasına sebep olmuştur. Literatürde gecekondu gibi işgal mekânları; barınma ihtiyacının karşılanamaması, ekonomik eşitsizlik, sosyal dışlanma, kentsel dönüşüm baskısı ve mekânsal özgürleşme arayışı gibi çok boyutlu dinamiklerle açıklanmaktadır. Dünya genelinde yaygınlaşan bu pratikler, mekânın yalnızca planlayıcı ya da tasarımcı tarafından üretilmediğini; kullanıcıların gündelik deneyimleri ve ihtiyaçları doğrultusunda yeniden oluşturulan canlı bir organizma olduğunu göstermektedir.

Hazırlanan bu çalışmanın amacı; işgal kavramının mimari tasarımlar üzerindeki etkisini araştırmak, işgal mekânı ve mimari mekân kavramları arasındaki ilişkiyi sorgulamaktır. Özellikle gecekondu olgusu üzerinden işgal pratiklerinin mekânı dönüştürme biçimleri incelenmekte; bu dönüşümlerin mimarlıkta esneklik, katılımcılık ve mekânın yeniden üretimi gibi kavramlara nasıl katkı sunduğu değerlendirilmektedir. Çalışmanın temel problemi, işgal mekânlarının çoğu zaman yalnızca bir "kentsel sorun" olarak görülmesi, buna karşın kullanıcı tarafından üretilen özgün mekânsal pratiklerin mimarlık literatüründe yeterince görünür olmamasıdır. Yöntem olarak kavramsal analiz ve literatür taraması birlikte kullanılmış ve üç uluslararası yapı olan; Torre David (Caracas), Kowloon Walled City (Hong Kong) ve Rocinha Favelası (Rio de Janeiro) örnek olay (case study) yaklaşımıyla değerlendirilmiştir. Bu üç örnek, işgal mekânlarının farklı coğrafyalarda nasıl dönüştüğü, hangi toplumsal ilişkilerle şekillendiği ve kullanıcı müdahalesiyle nasıl yeni mekânsal modeller oluşturduğu konusunda karşılaştırmalı bir bakış sunmaktadır.

Anahtar Kelimeler: İşgal mekânı, informel yerleşim, gecekondu, kullanıcı odaklı tasarım, mekânsal dönüşüm.

THE TRANSFORMATION OF SQUATTED SPACES IN THE CONTEXT OF ARCHITECTURAL DESIGN PARADIGMS: AN EXAMINATION THROUGH THE PHENOMENON OF SQUATTER SETTLEMENTS

ABSTRACT

After the industrial revolution, there was a massive migration from rural areas to cities. Families migrating to cities settled in any vacant land they could find, building temporary structures without regard for property rights due to economic hardship. These areas led to the formation of segregated neighborhoods within cities. In the literature, squatter settlements are explained by multidimensional dynamics such as unmet housing needs, economic inequality, social exclusion, pressure for urban transformation, and the search for spatial liberation. These practices, which are widespread throughout the world, show that space is not only produced by planners or designers; it is a living organism that is recreated according to the daily experiences and needs of its users.

The aim of this study is to investigate the effect of the concept of occupation on architectural designs and to question the relationship between the concepts of occupied space and architectural space. Specifically, it examines how occupation practices transform space, particularly through the phenomenon of shantytowns, and evaluates how these transformations contribute to concepts such as flexibility, participation, and the reproduction of space in architecture. The fundamental problem of the study is that occupied spaces are often seen only as an "urban problem," while the unique spatial practices produced by users are not sufficiently visible in architectural literature. Conceptual analysis and literature review were used as methods, and three international structures—Torre David (Caracas), Kowloon Walled City (Hong Kong), and Rocinha Favela (Rio de Janeiro)—were evaluated using a case study approach. These three examples offer a comparative perspective on how squatted spaces transform across different geographies, how they are shaped by social relations, and how user intervention creates new spatial models.

Keywords: Squatted space, informal settlement, shanty town, user-centered design, spatial transformation, flexible space.

Keywords: Occupied space, informal settlement, shantytown, user-centered design, spatial transformation.

1. GİRİŞ

Mekânın yasadışı yollarla işgal edilmesi, tarih boyunca farklı coğrafyalarda gözlemlenen yaygın bir pratik olarak karşımıza çıkmaktadır. Kullanılmayan yapıların içine yerleşmek, boş alanlara hukuki dayanağı olmadan konut inşa etmek ya da terk edilmiş yapıları barınma alanına

dönüştürmek, başta ekonomik yoksunluk olmak üzere çeşitli sosyo-mekânsal nedenlerin bir sonucudur. Batı dillerinde "squat" olarak adlandırılan bu mekânlar, hukuki sahiplikten bağımsız olarak kullanıcıların doğrudan mekânı dönüştürmesiyle ortaya çıkar. Neuwirth'e göre günümüzde dünya üzerinde yaklaşık bir milyar insan işgalci statüsünde yaşam sürmekte olup, bu durum işgal olgusunun küresel ölçekte ne kadar yaygın olduğunu göstermektedir (Neuwirth, 2004). İşgal mekânlarının oluşum motivasyonları yalnızca yoksunlukla sınırlı değildir. Özellikle Avrupa'da kimi işgal pratiklerinin ideolojik, politik ya da kültürel üretimi destekleyen sosyal hareketlere bağlı olarak ortaya çıktığı bilinmektedir (Mayer, 2011). Dolayısıyla işgal, hem zorunluluk hem de bir mekânsal özgürleşme aracı olarak değerlendirilebilmektedir.

Bu çalışma, işgal olgusunu mimarlık disiplini içerisinde ele alarak mekânın üretimi açısından taşıdığı potansiyelleri sorgulamaktadır. Mekân, modern mimarlık kuramı içinde yalnızca fiziksel bir varlık değil, aynı zamanda kullanıcıyla kurduğu etkileşim üzerinden sürekli değişen ve dönüşen bir yapı olarak ele alınmaktadır. Robert Park'ın ifadesiyle kent, insanın kendisini yeniden ürettiği bir "yaşam deneyimi alanıdır" (Park, 1967). Kullanıcı ile mekân arasındaki karşılıklı etkileşim, mekânsal aidiyetin oluşmasına ve bireylerin mekâna anlam yüklemesine zemin hazırlar. Bu bağlamda mekân, hem özneyi şekillendiren hem de özne tarafından şekillendirilen çift yönlü bir varlıktır.

Gecekondu bölgeleri de bu etkileşimsel süreç içinde ortaya çıkan en belirgin işgal mekânlarıdır. Türkiye'de 1950 sonrası hızlı şehirleşme ve kırsal-kentsel göç dalgaları, devletin yeterli konut üretimi sağlayamamasıyla birleşince, kent çeperlerinde gayriresmî yerleşim biçimleri olarak gecekondular ortaya çıkmıştır. Keleş (1998), gecekonduyu "mülkiyet hakkı gözetilmeksizin kamu veya özel mülkiyete ait topraklar üzerinde, ihtiyaçtan doğan, hızlı ve geçici nitelikte yapılan barınaklar" olarak tanımlar. Dolayısıyla gecekondu, yalnızca yapısal bir sorun değil; aidiyet, yersizlik, kente uyum ve mekânsal dönüşüm gibi sosyal-kültürel süreçlerle ilişkili bütüncül bir olgudur.

Ayrıca mekân kavramı üzerine tartışmalar geçmişten günümüze kadar hala devam etmektedir. Mimarlık, mekân oluşturmak, mekânı anlamak ve dönüştürmek etrafında gerçekleşmektedir. Mekân üzerine tartışmalar, özellikle toplumsal hareketlerin canlılık kazandığı 70'lerden bu yana zenginleşmektedir ve sadece mimarlığın değil, sosyal bilimlerin de merkezine oturmuştur. 'Space' (mekân) ve 'place' (yer) anahtar kelimeleri üzerinden farklı mekân ve sosyo- ekonomik yaşam ilişkisi okumaları yapılmıştır. Bu doğrultuda bu çalışma mekânı anlamak ve yorumlamak adına da geleceğe ışık tutabilmektedir.

Çalışma kapsamında gecekondu örnekleri üzerinden işgal mekânlarının oluşum mantığı açıklanmakta, kullanıcıların mekânı dönüştürme biçimleri analiz edilmekte ve bu dönüşümlerin mimari tasarım alanına nasıl etki ettiği incelenmiştir. Bu kapsam doğrultusunda, çalışmanın yöntem ve analiz sürecinde üç uluslararası örnek—Torre David, Kowloon Walled City ve Rocinha Favelası örnek olay olarak ele alınmıştır. Böylece işgal olgusu yalnızca bir "sorun alanı" olarak değil, aynı zamanda yeni tasarım yaklaşımlarının gelişmesine katkı sunabilecek potansiyel bir paradigma olarak ele alınmaktadır. Bu doğrultuda temel problem, işgal mekânlarının mimari tasarım literatüründe yeterince kuramsal karşılık bulmaması ve kullanıcı müdahalesiyle şekillenen bu özgün mekânların tasarım paradigmalarına nasıl bir katkı sunabileceğinin belirsizliğidir. Çalışmanın amacı, özellikle gecekondu örüntüsü üzerinden işgal olgusunun mimari tasarımla olan ilişkisini tartışmak, kullanıcı tarafından dönüştürülen bu yapılı çevrenin tasarım düşüncesine getirdiği alternatifleri görünür kılmaktır. Aynı zamanda işgal mekânlarının mimari tasarım paradigmaları içindeki yerini sorgulamak, bu mekânların üretim dinamiklerini anlamak ve kullanıcı temelli mekân kurgusunun geleceğin mimari tasarımlarına nasıl yön verebileceğini ortaya koymaktadır. Gecekondu oluşum biçiminden yola çıkarak işgal mekânlarının mimarı tasarımların şekillenmesi üzerindeki etkisini sorgulamak, mimarlığa farklı bir bakış açısı kazandırmak, tasarım ufkunu geliştirmek ve bu çalışma verileriyle farklı çalışmalara yol açmak amaçlanmıştır Kapsam, barınma ihtiyacı temelli işgal pratikleriyle sınırlı tutulmuş; ekonomik, kültürel ve sosyal dinamiklerin şekillendirdiği gecekondu mekânları odak alınmıştır. Yöntem olarak kavramsal analiz ve literatür taraması benimsenmiş, işgal–mekân–kullanıcı ilişkisini açıklayan kuramsal çerçeve üzerinden değerlendirmeler yapılmıştır. Bu yönüyle çalışma, işgal mekânlarının mimarlık disiplini açısından yalnızca kontrol edilmesi gereken olgular değil, aynı zamanda esnek, dönüşebilir ve kullanıcı odaklı tasarım paradigmalarının gelişimi için değerli bir referans alanı olduğunu ortaya koymayı hedeflemektedir.

2. MATERYAL VE METOT

Bu çalışma, literatüre dayalı bir araştırma olarak hazırlanmıştır. Materyal olarak mekâna dair aidiyet–yersizlik kavramlarını, işgal mekânlarının tanımı ve dönüştürme pratikleri ile gecekondu oluşum süreçlerini ele alan ulusal ve uluslararası kaynaklar incelenmiştir. Yöntem kapsamında kavramsal analiz ve betimleyici literatür taraması birlikte kullanılmıştır. Ayrıca literatürde kapsamlı şekilde yer alan Torre David (Caracas)**,** Kowloon Walled City (Hong Kong) **ve** Rocinha Favelası (Rio de Janeiro) örneği, işgal mekânlarının mekânsal örgütlenmesi ve kullanıcı odaklı dönüşüm potansiyelini somutlaştırmak amacıyla örnek olay (case study)

niteliğinde değerlendirilmiştir. Böylece çalışma, işgal ve gecekondu pratiklerini kuramsal kaynaklar üzerinden yorumlayarak mimari tasarım paradigmaları bağlamında analitik bir bakış sunmayı amaçlamaktadır.

2.1. Mekana dair duygular; aidiyet ve yersizlik

Kent, insanın yaşadığı dünyayı yeniden kurma çabasının en belirgin mekânsal ürünüdür. Park'ın (1967:3) ifade ettiği gibi insan kenti inşa ederken aslında kendi yaşam biçimini, toplumsal ilişkilerini ve kimliğini de yeniden üretmektedir. Bu nedenle mekân, yalnızca fiziksel bir varlık değil; kullanıcının müdahalesiyle şekillenen ve aynı zamanda kullanıcıyı şekillendiren karşılıklı bir etkileşim alanıdır. Mekân ile kullanıcı arasındaki bu çift yönlü etkileşim zamanla *mekânsal aidiyet* olarak tanımlanan bir duygusal bağa dönüşür. Relph'e (1976) göre aidiyet, bireyin bir mekânı tanıması, anlamlandırması ve o mekâna ilişkin bir kimlik oluşturmasıyla ortaya çıkar; mekân bu yönüyle hem özneyi etkileyen hem de özne tarafından sürekli yeniden üretilen dinamik bir yapıdır.

Mekânın aidiyet üretmedeki rolü, farklı kullanıcıların aynı mekânla kurduğu ilişki üzerinden de okunabilir. Tuan'ın (1977) belirttiği üzere mekân, deneyim yoluyla "yer"e dönüşür; mekân üzerindeki izler, müdahaleler, kullanım biçimleri ve hatıralar mekânı kişisel bir anlam alanına dönüştürür. Bu bağlamda, tıpkı ikinci el bir kitabın içindeki notların yeni kullanıcı için önceki kullanıcıyla görünmez bir bağ kurması gibi, mekânda bırakılan her iz de bireyler arası dolaylı bir iletişim yaratır ve aidiyet hissini güçlendirir.

Göç olgusu, aidiyet ve yersizlik kavramlarının birlikte değerlendirilmesini gerektiren önemli bir toplumsal süreçtir. Kırsal alanlardan kentlere göç eden bireyler, alışkın oldukları yaşam pratiklerini yeni mekânlara taşımaya çalışırken bir yandan yersizleşme deneyimi yaşamakta, diğer yandan kente tutunabilmek için yeni aidiyet alanları yaratmaktadır. Türkiye bağlamında gecekondular bu sürecin en görünür mekânsal örüntüsünü oluşturur. Keleş'in (1998) belirttiği gibi gecekondu yerleşmeleri, kentte tutunmak isteyen göçmenlerin hem ekonomik zorunluluklarının hem de sosyal dayanışma ağlarının bir sonucudur. Ailelerin aynı bölgeye yerleşmesi, hemşerilik ilişkilerinin sürdürülmesi ve komşuluk pratiklerinin yeniden üretilmesi, mekân üzerinde güçlü bir aidiyet duygusu yaratırken, aynı zamanda bu alanları yasal statü bakımından "yersiz" kılar.

Bu açıdan bakıldığında gecekondu ve işgal mekânları, bir yandan bireylerin kent içinde yer edinme ve kente uyum sağlama ihtiyacından, diğer yandan kendi yaşam kültürlerini mekâna aktarma çabasından doğar. Üst ölçekte yersizleşme yaşayan bireyler, alt ölçekte kendi müdahaleleriyle dönüştürdükleri mekânlarda yeni bir aidiyet geliştirirler. Bir mekân

dönüştürülüp kişisel deneyimle bütünleştiğinde, o mekân birey için "ait olunan yer" niteliği kazanır. Bu nedenle işgal ve gecekondu mekânları, yalnızca yasal olmayan yerleşim biçimleri değil; bireyin kendine ait bir yaşam alanı yaratma, görünür olma ve kentsel hayata dahil olma çabasının mekânsal ifadeleridir.

2.2. İşgal mekânları ve sebepleri

İşgal mekânları, bireylerin hukuki mülkiyet hakkına sahip olmadıkları bir alanı ya da yapıyı çeşitli gerekçelerle kullanıma açması ve çoğu zaman kendi ihtiyaçları doğrultusunda dönüştürmesiyle oluşan mekânsal pratiklerdir. Mimari işgal, yalnızca fiziksel bir alanın ele geçirilmesi değil; aynı zamanda mekânın yeniden düzenlenmesi, işlevlendirilmesi ve kullanıcı tarafından bir yaşam alanına dönüştürülmesiyle karakterize edilir (Neuwirth, 2004). Bu nedenle işgal mekânları, hem toplumsal hem mekânsal dinamiklerin kesişiminde oluşan, esnek ve kullanıcı müdahalesine açık bir çevre üretim biçimi olarak değerlendirilebilir.

İşgal olgusunu sistematik olarak inceleyen Hans Pruijt (2013), işgalleri beş ana kategori altında sınıflandırmaktadır. İlk kategori olan *yoksunluk temelli işgal*, barınma ihtiyacının karşılanamadığı durumlarda ortaya çıkar. Türkiye'de Ankara Kalesi çevresi ve Altındağ gibi bölgelerde gecekondu alanlarının oluşumu bu tür işgalin tipik örneğidir. Göç eden bireyler ekonomik yetersizlikler nedeniyle barınma sorununu çözmek için kendi imkânlarıyla geçici yapılar inşa ederek alanı işgal ederler (Keleş, 1998).

İkinci kategori *alternatif barınma stratejileri* olarak tanımlanır. Bu tür işgallerde belediyelerin ya da merkezi yönetimlerin yeni gelen nüfusa yeterli barınma alanı sağlayamaması sonucunda, bireyler boş buldukları yapı veya arsaları geçici konut olarak kullanırlar. Türkiye'de Suriyeli mültecilerin terk edilmiş yapılara yerleşmesi bu duruma örnek teşkil etmektedir (Erder & Kaşka, 2012).

Üçüncü kategori *girişimci işgal* olup, ekonomik ya da sosyal bir ihtiyacı karşılamak amacıyla kullanılmayan bir yapının dönüştürülmesiyle ortaya çıkar. Topluluk için ucuz bar, kafe, kültürel üretim alanı veya ortak kullanım mekânı oluşturmak bu tür işgallere örnektir.

Dördüncü tür olan *tepki işgali*, kent yönetimlerinin ilgisizliği sonucu çürümeye terk edilen yapıların korunması ya da yeniden işlevlendirilmesi amacıyla gerçekleştirilen işgalleri ifade eder. Bu tür pratikler, kimi zaman kentsel mirasın informel yollarla korunması şeklinde de ortaya çıkmaktadır (Mayer, 2011).

Beşinci kategori *siyasal işgal* olup, protesto, dayanışma, hak talebi ya da alternatif kamusal alan oluşturma amacıyla kullanılan işgalleri kapsar. Bu tür işgallerde amaç barınma değil, mekân üzerinden politik bir söylem inşa etmektir. Pruijt'e (2013) göre siyasal işgal, toplumsal alan

eksikliğine bir tepki olarak ortaya çıkar ve kamusal tartışmanın mekânsal bir zemin kazanmasını sağlar. Bu sınıflandırma, işgal mekânlarının tek tip bir olgu olmadığını; ekonomik, sosyal, politik ve kültürel motivasyonların etkisiyle farklı biçimlerde ortaya çıkabildiğini göstermektedir. Mimarlık disiplini açısından bakıldığında ise işgal, kullanıcıların mekânı kendi ihtiyaçlarına göre dönüştürme kapasitesini açığa çıkaran önemli bir pratik olarak değerlendirilmelidir.

2.2.1. İşgal mekanlarında dönüştürme eylemi

Mimarlık disiplini, yalnızca mekân üretme eylemiyle sınırlı olmayıp aynı zamanda mevcut mekânların dönüştürülmesini de kapsayan geniş bir pratik alanına sahiptir. Choay'a (1969) göre mimarlık hem "yapma" hem "yeniden yapma" hem de "yorumlayarak dönüştürme" süreçlerini içerir. Bu bağlamda dönüştürme eylemi, işgal mekânlarının anlaşılmasında anahtar bir kavramdır; çünkü işgal çoğu zaman boş, terk edilmiş ya da işlevini yitirmiş mekânların kullanıcı tarafından yeniden anlamlandırılmasıyla ortaya çıkar. Lefebvre (1991), mekânın toplumsal pratiklerle sürekli yeniden üretildiğini vurgular; işgal mekânları da tam olarak bu yeniden üretim sürecinin en görünür örneklerinden biridir.

İşgal mekânlarında dönüşüm hem fiziksel müdahaleler (duvar ekleme, bölme, yapı tamiri vb.) hem de işlevsel uyarlamalar (barınma, ticaret, ortak kullanım alanı oluşturma) aracılığıyla gerçekleşebilir. Kullanıcıların kendi ihtiyaçlarına göre mekânı yeniden düzenlemesi, işgal ile dönüştürme arasındaki doğrudan ilişkiyi ortaya koymaktadır. Bu tür dönüşümler çoğu zaman barınma, güvenlik veya topluluk ihtiyacından kaynaklanan zorunlu eylemler olsa da, sonuçta ortaya çıkan mekânsal üretim kullanıcı odaklı özgün bir tasarım pratiği niteliği taşır. İşgalin mimarlık açısından önemli hale gelmesinin nedeni, bu mekânlarda ortaya çıkan dönüşüm süreçlerinin tasarım paradigmasını sorgulama potansiyelidir. De Carlo'nun (1969) savunduğu gibi mimarlık, kullanıcının müdahalesine açık olmayan, tamamen tasarımcı tarafından belirlenen bir süreç olmamalıdır; işgal mekânları ise tam tersine, kullanıcı eyleminin belirleyici olduğu esnek ve açık uçlu mekânsal örüntüler sunar. Bu nedenle işgal, sadece yasadışı yerleşim biçimi değil; aynı zamanda "tamamlanmamış mimarlık" (incomplete architecture) anlayışına karşılık gelen yaratıcı bir dönüşüm pratiği olarak da okunabilir.

Günümüzde mimarlar çoğu zaman yapının hem dış kabuğunu hem de iç mekânını ayrıntılı şekilde belirleyerek kullanıcıya sınırlı müdahale alanı bırakmaktadır. Oysa işgal mekânlarında kullanıcı, mekânı deneyimleyerek, dokunarak ve dönüştürerek kendi kimliğini mekâna yansıtır. Tuan'ın (1977) belirttiği gibi mekân, ancak kullanıcı müdahalesiyle "yer"e dönüşür. İşgal mekânlarında ortaya çıkan dönüşüm, tam da bu sürecin somutlaşmış hâlidir. Kullanıcının

mekânı kişiselleştirme ve sahiplenme isteği, işgal mekânlarını "özgür mekân" pratiklerinin doğal bir uzantısı hâline getirir. Dolayısıyla işgal mekânlarında dönüşüm eylemi, mimari tasarım açısından ele alındığında yalnızca bir zorunluluk değil; aynı zamanda kullanıcı odaklı, esnek, deneysel ve yerinden üretim (bottom-up) yaklaşımını görünür kılan alternatif bir paradigma olarak değerlendirilmelidir.

2.2.1.1. Gecekondu kavramı ve oluşum sebepleri

Türkiye'de 1950'li yıllarda ivme kazanan kentleşme süreci, Batı toplumlarının sanayi temelli kentleşme modelinden belirgin biçimde ayrılmaktadır. Batı'da sanayileşme ve kentleşme paralel ilerlerken, Türkiye'de sanayileşme yeterince gelişmeden kent nüfusunun hızla artması "önce kentleşme, sonra şehirlileşme" biçiminde tersine bir süreci ortaya çıkarmıştır (Karaman, 2003). Bu durum, kır ve kent arasındaki sosyo-kültürel benzerliğin uzun yıllar devam etmesine, topluluk temelli ilişkilerin ve geleneksel yaşam pratiklerinin kentlere taşınmasına yol açmıştır. Kentleşme yalnızca nüfusun kentlerde yoğunlaşmasından ibaret değildir; ekonomik, sosyal ve kültürel dönüşümleri içeren çok boyutlu bir süreçtir (Keleş, 1972; Kartal, 1978). Bu sürecin kültürel boyutu olan "şehirlileşme", kentte yaşayan bireylerin değerlerinde, davranışlarında ve yaşam biçimlerinde meydana gelen değişimi temsil eder (Sezal, 1992; Keleş, 1996). Ancak Türkiye'de yoğun kırsal göç nedeniyle şehirlileşme gecikmiş, kentler hızla artan nüfusu barındıracak konut, istihdam ve altyapı kapasitesine ulaşamamış; bu da gecekondulaşmayı kaçınılmaz kılmıştır.

Bu çerçevede gecekondulaşma, Türkiye'nin kentleşme sürecinin en belirgin mekânsal çıktılarından biri olarak ortaya çıkmıştır. Başlangıçta yalnızca "gece yapılan, izinsiz ve hızla inşa edilen konut" anlamına gelen gecekondu, zamanla sosyolojik bir içeriğe kavuşmuş; belirli bir yaşam biçimini, dayanışma ilişkilerini ve kültürel sürekliliği ifade eden bir kavrama dönüşmüştür (Keleş, 1998). Keleş'e (1998:53) göre gecekondu, bayındırlık ve yapı düzenlemelerine aykırı biçimde, malikinin izni olmadan kamu veya özel mülkiyet arazileri üzerine yapılan ve konut ihtiyacını devlet ya da yerel yönetimlerin karşılayamadığı düşük gelirli gruplarca kullanılan yapılardır. Gecekondu bölgelerinde hemşerilik ve akrabalık bağlarına dayalı kümelenme özellikle 1960'lardan itibaren belirginleşmiştir (Gökçe vd., 1977; Suher, 1991). Bu kümelenme, bir yandan göç eden bireylerin kent yaşamına uyumunu desteklerken, diğer yandan kırsal kökenli değerlerin kent içinde yeniden üretildiği bir geçiş alanı oluşturmaktadır.

Kıray'ın (1999) "tampon mekanizma" olarak tanımladığı bu yerleşmeler, göç eden bireyleri kentin yabancılaştırıcı yapısından korurken sosyo-kültürel bağların kopmadan sürdürülmesine

imkân tanır. Kongar (1982) da gecekonduların yalnızca bir konut biçimi değil; aynı zamanda kentle bütünleşmeyi sağlayan sosyal bir araç olduğunu vurgular. Dolayısıyla gecekondulaşma, hem bir zorunluluk sonucu doğan barınma pratiği hem de göç eden toplulukların kentle kurduğu ilişkide kültürel sürekliliği koruyan bir ara yüzdür.

Gecekondular, halkın hızlı üretim pratikleriyle ortaya çıkan, eklemlenebilir, dönüştürülebilir ve kullanıcı tarafından sürekli yeniden şekillendirilebilen yapılar olarak mimarlık açısından önemli bir inceleme alanıdır. Fiziksel olarak geçici ve standart dışı görünseler de, kullanıcıların mekânı kişiselleştirme ve dönüştürme kapasitesi bu mekânları esnek ve özgün kılmaktadır. Bu nedenle mimarlık açısından sorgulanması gereken, gecekondunun yalnızca fiziksel formu değil; gecekondulaşma sürecinin ortaya çıkardığı kullanıcı üretimli, esnek, açık uçlu mekânsal kurgulardır.

Kentleşme literatürü gecekonduları yalnızca barınma sorununun sonucu olarak değil, aynı zamanda göç eden bireylerin kendi kültürel yapılarıyla kent arasında kurduğu bir uyum stratejisi olarak değerlendirir. Gökçe vd. (1977), gecekonduların göç eden ailelerin "kendiliğinden örgütlenme modeli" yaratarak sosyal dayanışmayı ve ekonomik paylaşımı güçlendirdiğini belirtir. Kıray (1999), gecekondu bölgelerini "çift yönlü bağlılık alanı" olarak tanımlar; bireyler hem köyle olan bağlarını sürdürür hem de kentte tutunma imkânı yaratır. Kartal (1978) ise gecekondu oluşumlarında konut eksikliğinin yanı sıra gelir eşitsizliği, işsizlik ve kentlerde artan yaşam maliyetlerinin belirleyici olduğunu vurgular. Tüm bu değerlendirmeler gecekondunun yalnızca fiziksel bir yapı değil; ekonomik zorunluluklar, kültürel süreklilik, sosyal dayanışma, kentsel uyum ve mekânsal üretim süreçlerinin iç içe geçtiği çok boyutlu bir pratik olduğunu göstermektedir.

Tüm bu değerlendirmeler ışığında gecekondulaşma, Türkiye'de kentleşme sürecinin hem sonucu hem de dönüştürücü bir bileşeni olarak ortaya çıkmaktadır. Gecekondu, yalnızca konut eksikliğinin ürettiği geçici bir barınma biçimi değil; kullanıcıların kendi ihtiyaçları doğrultusunda mekânı dönüştürdüğü, kültürel değerlerini yeniden ürettiği ve kentle kurduğu ilişkiyi kendi lehine yeniden tanımladığı dinamik bir mekânsal pratiktir. Bu nedenle gecekondular, mimarlığın geleneksel tasarım kalıplarının dışında, kullanıcı üretimli, esnek ve adaptif mekânların nasıl şekillendiğini gösteren özgün örnekler sunar. Gecekondu mekânlarında görülen bu dönüşüm pratikleri, işgal mekânlarının anlaşılması açısından da kritik öneme sahiptir; çünkü her iki olgu da kullanıcının mekânı sahiplenme, dönüştürme ve kendine ait kılma çabasının farklı görünümleridir. Bu bağlamda bir sonraki bölümde ele alınacak işgal mekânlarında dönüştürme eylemi**,** gecekondu deneyiminin mimarlık ve mekânsal üretim

açısından açığa çıkardığı bu yaratıcı potansiyelin daha kapsamlı biçimde değerlendirilmesini mümkün kılacaktır.

3. BULGULAR

Bu çalışmada incelenen üç örnek —Torre David, Kowloon Walled City ve Rocinha Favelası— işgal mekânlarının ve gayriresmî yerleşimlerin, kullanıcı odaklı mekânsal dönüşüm süreçlerini görünür kılan özgün mimari pratikler sunduğunu göstermektedir. Bu örneklerin ortak özelliği, mekânın merkezi bir planlamayla değil; kullanıcıların ihtiyaçları doğrultusunda "aşağıdan yukarıya" (bottom-up) örgütlenme modeliyle yeniden üretilmesidir. Her üç yerleşimde de barınma, güvenlik, ticaret ve sosyal yaşam gibi ihtiyaçların tamamen kullanıcılar tarafından karşılandığı; mekânın zaman içinde sürekli eklemlenerek, dönüştürülerek ve kişiselleştirilerek geliştiği görülmektedir. Bu nedenle çalışmada bu üç örneğin ele alınması, işgal ve gayriresmî mekân üretiminin mimarlık açısından nasıl bir dönüşüm ve tasarım potansiyeli barındırdığını anlamak için önemli bir çerçeve sunmaktadır.

3.1. Torre David (Caracas) – Dikey İşgal Mekânı

Torre David, Venezuela'nın ekonomik kriz döneminde yarım kalan ve 2007'den itibaren yaklaşık 750 aile tarafından işgal edilen 45 katlı bir gökdelen kompleksidir. Brillembourg ve Klumpner'in (2013) araştırmaları, kullanıcıların tamamlanmamış betonarme yapıyı kendi yaşam pratiklerine uygun şekilde dönüştürdüğünü, bağımsız barınma birimleri, ticari alanlar, ibadet mekânları, spor alanları ve kolektif hizmet birimleri oluşturduğunu göstermektedir. Böylece yapı, modernist bir gökdelenden çok, kendi kendine örgütlenen bir dikey mahalleye dönüşmüştür (Şekil 2).



Şekil 2. Torre David (URL 1)

Lefebvre'nin (1991) "mekânın toplumsal pratiklerle sürekli yeniden üretildiği" yönündeki yaklaşımı burada somutlaşmaktadır. Kullanıcılar, yapı içindeki boşlukları işlevlendirmiş; eksik güvenlik, su ve enerji sistemlerini kendi çözümleriyle oluşturmuş; katlar arasında kolektif bakım ve güvenlik örgütlenmeleri geliştirmiştir. Bu süreç, mimarlığın "tamamlanmış bir nesne" olma hâlinden çok, sürekli evrilen bir toplumsal üretim alanı olduğuna işaret etmektedir (Şekil 3-4).





Şekil 3. Torre David 'de iş merkezinin ortadai boşluğunun bugünkü kullanımı (URL 2) **Şekil 4.** Torre David'de küçük bir bakkal (URL 2)

Torre David, çalışmanın amacıyla doğrudan örtüşen biçimde, işgal eyleminin mimari tasarım açısından sadece bir mülkiyet ihlali değil, aynı zamanda esneklik**,** tamamlanmamışlık**,** kullanıcı odaklı dönüşüm **ve** özgür mekân üretimi bağlamında bir paradigma önerisi sunduğunu ortaya koyar (AlSayyad, 2014) (Şekil 5).



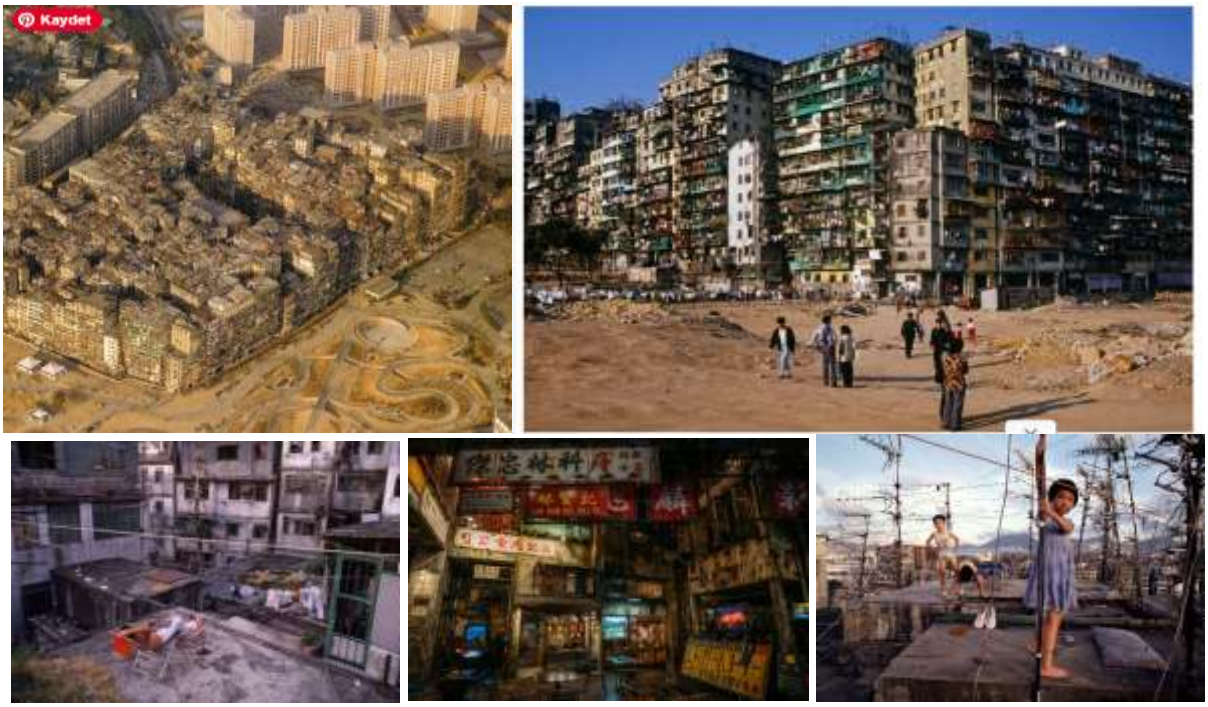


Şekil 5. Torre David 'de yaşam alanları (URL 2)

Torre David, mimarlık açısından "tamamlanmamışlık" ve "kullanıcı-sürdürümü" kavramlarının nasıl bir tasarım paradigmasına dönüşebileceğini göstermektedir. Kullanıcıların müdahalesiyle organik şekilde gelişen mekânlar, esnek ve uyarlanabilir tasarım modellerinin potansiyelini açığa çıkarmaktadır. Bu açıdan Torre David, gelecekte mimarın yalnızca tasarımcı değil; mekânı kullanıcının ortak üretimine açan kolaylaştırıcı bir rol üstlenmesi gerektiğine işaret eden paradigmatik bir örnektir.

3.2. Kowloon Walled City (Hong Kong) – Aşırı Yoğun Dikey Gayriresmî Kent

Kowloon Walled City, Hong Kong'da hukuki belirsizlik nedeniyle uzun süre devlet denetimi dışında kalan, 2,6 hektarlık alanda 33.000'den fazla insanın yaşadığı, dünyanın en yoğun gayriresmî yerleşimlerinden biridir (Girard, 2004). Yapı blokları, kullanıcıların ihtiyaçlarına göre sürekli yeni katlar eklenerek dikey yönde büyümüş, dar koridorlar, karmaşık sirkülasyon sistemleri, iç sokaklar ve havalandırması zayıf iç avlular ortaya çıkmıştır (Şekil 6).



Şekil 6. Kowloon Walled City (URL 3)

Bu yerleşimde konut, küçük imalat atölyeleri, dişçi klinikleri, restoranlar ve bakkallar gibi fonksiyonlar iç içe geçmiş; kent içi "çok katmanlı üretim–yaşam mekânı" oluşmuştur. Altyapının yetersiz olduğu noktalar ise mahalle örgütlenmeleri ve kullanıcı girişimleriyle çözümlenmiştir (Bristow, 2018). Kowloon Walled City, çalışmanın kapsamıyla uyumlu biçimde, işgal veya gayriresmî yerleşimlerin yalnızca barınma eksikliğinden değil; aynı zamanda **y**oğunluk baskısı**,** kentsel boşlukların belirsizliği**,** alternatif üretim biçimleri**,** özyönetim modelleri gibi faktörlerden beslendiğini göstermektedir. Torre David gibi dikey bir işgal mekânı olmakla birlikte, Kowloon çok daha karmaşık bir "kendiliğinden kentleşme laboratuvarı" sunmaktadır.

1993 yılında tamamen yıkıldıktan sonra Kowloon Walled City'nin bulunduğu alan, Hong Kong yönetimi tarafından bir kamusal park olarak yeniden düzenlenmiş ve 1995'te Kowloon Walled City Park adıyla hizmete açılmıştır. Bu dönüşüm, Smart'ın (2018) belirttiği gibi, kentin yoğun ve kaotik geçmişine karşılık "düzen, temizlik ve kültürel hafıza" vurgusuyla planlanmış bir yeniden işlevlendirme örneğidir. Günümüzde park, Qing Hanedanlığı dönemine ait mimari

referansların kullanıldığı peyzaj tasarımı, tematik bahçeleri, rekreasyon alanları ve restore edilmiş eski askeri yapı kalıntılarıyla bir kültürel miras alanı olarak hizmet vermektedir (Evans, 2019) (Şekil 7).



Şekil 7. Kowloon City Park'ın güney kapısının kalıntıları (URL 4)

Ayrıca alan, yıkımdan önceki döneme ait fotoğraflar, planlar ve maketlerin sergilendiği küçük bir hafıza mekânı işlevi de görmektedir. Yeh (2020), parkın güncel kullanımının iki yönlü olduğunu vurgular: bir yandan kentlilere rekreatif bir kamusal alan sunmakta, diğer yandan Kowloon'un aşırı yoğun gayriresmî yerleşim geçmişini hatırlatarak kentsel tarih bilincini canlı tutmaktadır. Bu nedenle yıkımdan sonra Kowloon Walled City, "tehlikeli ve kontrol dışı yerleşim" olarak damgalanan geçmişinden sıyrılarak, bugün Hong Kong'un en düzenli, en çok ziyaret edilen ve kolektif hafıza açısından en güçlü kamusal alanlarından birine dönüşmüştür.

3.3. Rocinha Favelası (Rio de Janeiro)

Rocinha, Rio de Janeiro'nun güney bölgesinde yer alan ve yaklaşık 100.000'den fazla nüfusuyla Latin Amerika'nın en büyük ve en yoğun favelalarından biri olarak kabul edilmektedir (Perlman, 2010). Yerleşim, başlangıçta 1930'lardan itibaren kırsal alanlardan Rio'ya göç eden düşük gelir gruplarının, kent merkezine yakın yamaçlarda kendi imkânlarıyla inşa ettikleri basit barınaklarla oluşmuştur. Zaman içinde nüfusun hızla artması, kısıtlı arazi yapısı ve topografik sınırlamalar nedeniyle Rocinha hem yatayda organik olarak yayılan hem de dikeyde katmanlaşan bir mekânsal morfolojiye dönüşmüştür. Bugün favela, üç ila beş katlı yapılardan on kata yaklaşan betonarme eklemelere kadar uzanan heterojen bir yapı stokuna sahiptir (Şekil 8).



Şekil 8. Rocinha, Rio de Janeiro (URL 5)

Yerleşimin büyüme mantığı büyük ölçüde kullanıcı üretimli mekânsal pratiklere dayanmaktadır. Su, elektrik ve kanalizasyon altyapısının uzun yıllar devlet tarafından sağlanmaması, sakinlerin kendi kolektif çözümlerini üretmesine yol açmış; sokaklar, merdivenler, ara bağlantılar ve altyapı ağları topluluklar tarafından zaman içinde eklemlenmiştir (Garmany, 2011). Bu nedenle Rocinha, mimarlık açısından "kendiliğinden gelişen, esnek ve adaptif kentsel sistem" kavramının önemli bir örneğidir. Yapılar, ihtiyaç oldukça genişletilmiş, yeni katlar eklenmiş, çatı terasları konut, depo veya ticari birimlere dönüştürülmüştür. Bu durum Lefebvre'nin (1991) "mekânın kullanıcılar tarafından sürekli yeniden üretildiği" düşüncesinin somut bir karşılığıdır (Şekil 9).



Şekil 9. Rocinha, Rio de Janeiro (URL 5)

Rocinha aynı zamanda yalnızca konut alanı değil, ekonomik ve sosyal işlevlerin iç içe geçtiği çok katmanlı bir kentsel ekosistem olarak çalışmaktadır. Mahalle içinde küçük işletmeler, atölyeler, marketler, ulaşım hatları, kültürel merkezler ve topluluk örgütlenmeleri bulunmaktadır. Perlman'ın (2010) belirttiği gibi Rocinha, dışarıdan "yoksulluğun mekânı" olarak algılansa da, kendi içinde güçlü sosyal ağlara, dayanışma yapısına ve içsel bir ekonomik döngüye sahiptir. Mekânsal esneklik ve topluluk temelli üretim süreci, Rocinha'yı sıradan bir çöküntü alanından ziyade kullanıcı davranışlarıyla şekillenen canlı bir kentsel organizma haline getirmektedir.

Mimarlık bağlamında Rocinha'nın önemi, devlet tarafından planlanmamış bir çevrenin, kullanıcı inisiyatifiyle nasıl işleyen bir kentsel form yaratabildiğini göstermesidir. Bu durum, işgal mekânları ve gecekondu yerleşimleri üzerine yapılan çalışmalara önemli açılımlar sunmakta; esnek, tamamlanmamış ve dönüştürülebilir mekânların geleceğin tasarım paradigmaları açısından değerini görünür kılmaktadır. Aşağıda üç örneğe ait karşılaştırmalı tablo yer almaktadır (Tablo 1).

Tablo 1. Üç Örnek İçin Karşılaştırmalı Tablo

Kriter	Torre David (Caracas)	Kowloon Walled City (Hong Kong)	Rocinha (Rio de Janeiro)
Tipoloji	Yarım kalmış gökdelenin işgali	Hukuki boşlukta gelişen aşırı yoğun dikey kent	Organik olarak büyüyen yaygın favela
Kullanıcı Müdahalesi	Çok yüksek – iç mekân dönüşümü, altyapı kurulumu	Çok yüksek – eklemler, dikey büyüme, karma fonksiyon	Çok yüksek – eklemler, kat çıkma, altyapı örgütlenmesi
Mekânsal Yoğunluk	Orta – dikey mahalle	Çok yüksek – dünyanın en yoğun yerleşimlerinden	Orta-yüksek – tepelik topoğrafyaya uyumlu
Fonksiyonlar	Konut + ticaret + ortak alan	Konut + imalat + sağlık + ticaret	Konut + ticaret + kültürel mekânlar
Örgütlenme	Kolektif, kat bazlı iç yönetim	Yarı-özyönetim, altkültür örgütlenmesi	Mahalle temelli dayanışma ağları
Mimari Değer	Tamamlanmamışlık, adaptasyon, esnek tasarım	Aşırı yoğunluk ve kaotik ama işleyen doku	Organik büyüme, yerel bilgi ile üretim
Temel Sorunlar	Altyapı eksiklikleri, güvenlik	Sağlık, ışık, hava sirkülasyonu	Altyapının sınırlılığı
Avantajlar	Esneklik ve kolektif mekân üretimi	Çok işlevli kompakt yaşam	Kentsel kültürün güçlü üretimi

İncelenen üç örnek, işgal mekânlarının farklı ölçek ve bağlamlarda benzer mekânsal üretim ilkeleri geliştirdiğini ortaya koymaktadır. Torre David'de dikey örgütlenme, Kowloon Walled City'de aşırı yoğunluk ve Rocinha Favelası'nda organik büyüme biçiminde ortaya çıkan bu yerleşimler, mekânın kullanıcı ihtiyaçları doğrultusunda sürekli dönüştürülebilen esnek bir yapıya sahip olduğunu göstermektedir. Her üç örnekte de barınma ihtiyacı temel bir motivasyon olmakla birlikte, mekânsal kurgu zaman içinde sosyal, ekonomik ve kültürel işlevleri kapsayan çok katmanlı bir yapıya evrilmiştir. Bu durum, işgal mekânlarının yalnızca geçici barınma çözümleri değil, kullanıcı temelli mekânsal üretimin mimari tasarım açısından önemli bir bilgi kaynağı olduğunu ortaya koymaktadır.

4. SONUÇ

Bu çalışma kapsamında incelenen Torre David, Kowloon Walled City ve Rocinha örnekleri, işgal mekânlarının ve gayriresmî yerleşimlerin yalnızca barınma krizinin sonucu olmadığını;

aynı zamanda alternatif mekânsal üretim biçimlerini görünür kılan özgün laboratuvarlar olduğunu ortaya koymaktadır. Üç örnekte de mekân, merkezi bir tasarım otoritesinin dışında, kullanıcıların ihtiyaçları, deneyimleri, topluluk pratikleri ve kolektif örgütlenmeleri doğrultusunda sürekli yeniden üretilmiş; böylece mimarlık disiplinine yeni paradigma önerileri sunan esnek, eklemlenebilir ve dönüşebilir mekânsal modeller ortaya çıkmıştır. Torre David, yarım kalmış bir gökdelenin kullanıcılar tarafından dikey bir yerleşime dönüştürülmesinin mümkün olduğunu gösterirken; Kowloon Walled City, aşırı yoğunluk ve plansızlığın dahi kendi içsel mantıklarıyla işleyen bir mekânsal organizma kurabildiğini göstermektedir. Rocinha ise yerel bilgi, topluluk dayanışması ve kullanıcı üretimli yapım tekniklerinin zaman içinde nasıl organik ve sürdürülebilir bir yerleşime dönüşebileceğini kanıtlamaktadır. Bu üç örnek, tamamlanmamışlık, sürekli değişim, kullanıcı müdahalesi, kolektif üretim ve deneysellik gibi kavramların mimarlık için ne kadar verimli bir tartışma alanı sunduğunu vurgulamaktadır.

Bu bulgular, günümüz mimarlığı açısından önemli çıkarımlara işaret etmektedir. Öncelikle mekânın yalnızca mimar tarafından değil, kullanıcı tarafından da üretildiği kabul edilmelidir. Kullanıcı deneyimini dışlayan, tamamlanmış ve kapalı mekân anlayışı yerine, zaman içinde gelişebilen, kullanıcının dokunuşunu mümkün kılan, eklemlenebilir ve esnek tasarım modelleri giderek daha merkezi bir önem taşımaktadır. Aynı şekilde, gayriresmî yerleşimlerde görülen topluluk temelli organizasyon ve dayanışma pratikleri, mimari tasarımın sosyal sürdürülebilirlik boyutunu güçlendiren önemli ipuçları sunmaktadır. Öte yandan, işgal mekânlarının yaygınlaşması, yalnızca mimari bir mesele değil; barınma hakkı, sosyo-ekonomik eşitsizlik ve kent yönetimi sorunlarıyla doğrudan ilişkilidir. Kente göç eden bireylerin uygun yaşam alanı bulamadığı durumda yasa dışı yollarla çözümler üretmek zorunda kalması, planlama ve konut politikalarındaki eksikliklerin bir sonucudur.

Yine de işgal mekânları, mimarlık için yalnızca sorun teşkil eden değil, aynı zamanda öğreten mekânlardır. Buradan geliştirilebilecek yeni paradigmalar; düşük maliyetli, malzemeden tasarruf eden, eklemlenebilir, dönüştürülebilir ve kullanıcıya alan bırakan tasarım modellerini içermektedir. Mimarlar, kullanıcı müdahalesine açık mekân tipolojileri geliştirerek hem sosyal çeşitliliği hem de mekânsal sürdürülebilirliği destekleyen çözümler üretebilir. Gecekondu örneklerinde olduğu gibi, kullanıcıların kendi imkânlarıyla ürettikleri mekânlar, mimarlığın katı sınırları içinde görünmeyen yaratıcı potansiyelleri ortaya koymaktadır. Sonuç olarak, bu çalışma işgal mekânlarını salt “yasadışı yerleşim” olarak değil; kullanıcı üretimli mimarlığın, katılımcı tasarımın ve esnek mekânsal kurguların geleceği için zengin bir referans alanı olarak değerlendirmektedir. Mekânı kimin ürettiğine dair temel soruyu yeniden gündeme getiren bu

üç örnek, mimarlığı daha kapsayıcı, daha duyarlı ve daha dönüştürülebilir tasarım modellerine yönlendirecek güçlü ipuçları sunmaktadır.

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FARKLI ŞEHİR İKLİMLERİNİN OFİS BİNALARINDA ISI KAYBI VE KAZANCI ÜZERİNDEKİ ETKİSİ: 6 CM YALITIM KALINLIĞI İÇİN KARŞILAŞTIRMALI BİR ANALİZ

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Özet

Binalarda enerji tüketiminin azaltılması hem çevresel sürdürülebilirlik hem de ekonomik verimlilik açısından günümüzde giderek daha önemli hale gelmiştir. Özellikle ofis binaları, yıl boyunca sürekli kullanımda olmaları nedeniyle ısıtma ve soğutma yükleri bakımından yüksek enerji talebine sahiptir. Bu çalışmada, Türkiye'nin farklı iklim bölgelerini temsil eden sekiz farklı şehir için (Hakkari, Ankara, Konya, İstanbul, Bursa, Muğla, Trabzon ve İzmir) 6 cm kalınlığında ısı yalıtımı uygulanmış bir ofis binasının yıllık ısı kaybı ve ısı kazancı oranları karşılaştırmalı olarak incelenmiştir. Analizler, bina enerji simülasyonu yaklaşımı kullanılarak gerçekleştirilmiş ve şehir bazlı iklim verilerinin enerji performansı üzerindeki etkileri ortaya konmuştur. Elde edilen sonuçlar, soğuk iklim koşullarının hâkim olduğu Hakkari, Ankara ve Konya gibi şehirlerde ısı kaybı oranlarının %95'in üzerinde olduğunu, buna karşılık ısı kazancı oranlarının oldukça düşük seviyelerde (%4–5) kaldığını göstermektedir. Bu durum, söz konusu bölgelerde enerji tüketiminin büyük ölçüde ısıtma yüklerinden kaynaklandığını ve ısı yalıtımının bu şehirler için kritik bir tasarım parametresi olduğunu ortaya koymaktadır. İstanbul ve Bursa gibi geçiş iklimine sahip şehirlerde ise ısı kazancı oranlarında belirgin bir artış gözlemlenmiş, Bursa'da bu oran yaklaşık %10 seviyesine ulaşmıştır. Bu bulgu, geçiş iklimlerinde hem ısıtma hem de soğutma yüklerinin birlikte değerlendirilmesi gerektiğini göstermektedir. Sıcak iklim özelliklerinin baskın olduğu Muğla ve İzmir şehirlerinde ise ısı kazancı oranlarının sırasıyla %11,28 ve %18,56 gibi yüksek değerlere ulaştığı görülmektedir. Özellikle İzmir için elde edilen sonuçlar, soğutma yüklerinin enerji tüketimi üzerinde belirleyici rol oynadığını ve yalnızca ısı kaybını azaltmaya yönelik yaklaşımların yeterli olmayacağını ortaya koymaktadır. Bu bağlamda, sıcak iklim bölgelerinde ısı yalıtımına ek olarak güneş kontrolü, cephe tasarımı ve pasif soğutma stratejilerinin önem kazandığı söylenebilir. Sonuç olarak, bu çalışma 6 cm yalıtım kalınlığının farklı iklim koşullarında ofis binalarının enerji dengesi üzerindeki etkisini net bir şekilde ortaya koymaktadır. Elde edilen bulgular, iklime duyarlı bina tasarımının gerekliliğini vurgulamakta ve bölgesel iklim koşullarına bağlı olarak

yalıtım stratejilerinin optimize edilmesi gerektiğini göstermektedir. Bu yaklaşım, enerji verimli ve sürdürülebilir bina tasarımlarına katkı sağlayacaktır.

Anahtar Kelime: TRNSYS, Simülasyon, Isı Yalıtımı, Isı Kazancı.

İSTANBUL KONUT MİMARİSİNDE YALILAR

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ÖZET

1700'lü yılların sonlarından itibaren, Osmanlı konut mimarisi yapıları arasında yerini alan ve geleneksel Türk Evi tipolojisi ile arasında bir köprü bulunan yalılar; Boğaziçi kıyısında konumlanarak Osmanlı sivil mimarisinin suyla ilişki kuran, özgün mekânsal organizasyona ve mimari özelliklere sahip bir konut tipolojisini temsil etmektedir. Osmanlı Döneminde özellikle 18. ve 19. yüzyıllarda önemi giderek artan yalılar Batılılaşma hareketlerinin getirdiği devinimlerle birlikte giderek değişmiş ve dönemin kültürel, siyasi, sosyo-kültürel ve mimari üsluplarını yansıtarak tarihe tanıklık etmişlerdir. Her ne kadar Batılılaşma yolundaki dönemsel üsluplardan etkilenip değişmiş olarak yorumlansalar da bu değişimlerin doğrusal ve geri dönülemez geçişler olmak yerine yalı tipolojisinin gelişmesine katkı sağladığı ve Boğaziçi'nin mekânsal kimliğini oluşturduğu söylenebilmektedir. Yalılar bugün Türk Evi kavramına ışık tutan sayılı örnekler arasında yer almaktadırlar. Öte yandan, zaman içerisinde artan kentleşme baskısı neticesinde pek çok defa el değiştiren, kimi zaman sahipsiz veya metruk kalan, özgün mimarisine uygun olmayan restorasyon ve uygulamalar nedeniyle niteliğini yitiren, kimi zaman da farklı işlevler yüklenen ve ihmallere kurban giden yalılar zamana karşı direnmeye çalışmaktadır. Bu çalışma, Boğaziçi yalılarını kültürel miras kapsamında değerlendirmeyi amaçlamaktadır. Bu kapsamda, çalışmada yalıların mimari özellikleri, Türk Evi tipolojisiyle olan ilişkileri ve tarihsel süreçte geçirdikleri değişimler incelenecektir. Çalışma, yalıların bu değişimlerini dönemin siyasi, sosyo-kültürel ve mimari dönüşümleriyle ilişkilendirerek kıyı yerleşim kültürünü ve yalı mimarisinin sosyal hayatla nasıl biçimlendiğini göstermeyi hedeflemektedir.

Anahtar Kelimeler: Boğaziçi yalıları, geleneksel konut mimarisi, yalı mimarisi

YALIS IN ISTANBUL RESIDENTIAL ARCHITECTURE

ABSTRACT

From the late 1700s onwards, yalıs (waterfront mansions) took their place among Ottoman residential architecture, bridging the gap between traditional Turkish houses and the Bosphorus. Located along the Bosphorus coast, they represent a unique residential typology within Ottoman civil architecture that connects with water, possessing distinctive spatial organization

and architectural features. Increasing in importance, particularly during the 18th and 19th centuries, these mansions gradually changed with the upheavals brought about by Westernization movements, reflecting the cultural, political, socio-cultural, and architectural styles of their time and bearing witness to history. Although they are interpreted as having been influenced and changed by the styles of the period on the path to Westernization, it can be argued that these changes, rather than being linear and irreversible transitions, contributed to the development of the yalı typology and shaped the spatial identity of the Bosphorus. Today, yalıs are among the few examples that shed light on the concept of the Turkish house. On the other hand, due to increasing urbanization pressures over time, these yalıs have changed hands many times, sometimes becoming ownerless or derelict, losing their original character through restorations and applications that are not in accordance with their original architecture, sometimes being given different functions, and sometimes falling victim to neglect, thus struggling to withstand the test of time. This study aims to evaluate the Bosphorus yalıs within the scope of cultural heritage. In this context, the study will examine the architectural features of the yalıs, their relationship with the Turkish house typology, and the changes they have undergone throughout history. By relating these changes to the political, socio-cultural, and architectural transformations of the period, the study aims to show how coastal settlement culture and yalı architecture were shaped by social life.

Keywords: Bosphorus yalıs, traditional residential architecture, the architecture of the yalıs

GİRİŞ

Boğazın incileri olarak anılan yalılar, 33 km uzunluğuna sahip olan İstanbul Boğazı'nın iki yakası boyunca inci gibi sıra sıra dizilerek görsel bir şölen sunmaktadır. Bugün, sayıları toplamda 600'ü bulan yalıların sadece 366 tanesi tarihi yapı niteliğinde olup, özgün yapılarını tamamıyla koruyamasalar da varlıklarını sürdürmektedir (Erdenen, 1993; Sevinç, 2000; İlhan, 2018). Bir yapının yalı statüsünde sayılabilmesi için başlıca; su kenarında konumlandırılması, çoğunlukla ahşap malzemeden yapılmış süslemeli, oymalı, desenli kısaca özel işçilikli cephelerden oluşması, ihtişamlı bir dekorasyona sahip yüksek tavanlı geniş iç mekanlara ve büyük bahçeler ile avlulara sahip olması gerektiği söylenebilmektedir (Erdenen, 1993; Dursun, 2010).

Yalılar bugün yaz-kış konut yapıları olarak kullanılırken Osmanlı İmparatorluğu döneminde ise, şehirden uzak olmaları nedeniyle yazlık konutlar olarak kullanımı yönünde bir eğilim gözlemlenmektedir (Kuban, 1970), Özellikle, Tarihi Yarımada'ya (şehre) daha yakın olması

nedeniyle Boğaziçi'nin güneyine konumlandırılan yalılara ulaşımın kayıklarla sağlandığı bilinmektedir. Ulaşımın güç olması nedeniyle yazın gelmesiyle birlikte belirli tarihlerde hane halkı ve beraberlerindeki hizmetlileri topluca bu yazlık konutlara göç ettiğine ilişkin literatürde bilgiler bulunmaktadır (Alan, 2005). Zamanla kentin nüfusunun artması ve Boğaziçi'ne vapurların inmesi yalıların sayısındaki artışını tetiklemiş ve İstanbul'un sınırlarının kuzey yönünde ilerlemesine neden olmuştur (Kuban, 1970; Dursun, 2010).

Osmanlı döneminde yalıların sadece yazlık konutlar olarak değil, aynı zamanda bir güç ve sosyal statü sembolü olarak da görüldüğü olgusuna rastlanmaktadır. Yalılar; Osmanlı döneminde özellikle devlet adamları ve dönemin ileri gelen varlıklı aileleri tarafından ilgi gördüğü bilinmektedir (Kuban, 1970). Yalıların tarih sahnesine çıktığı 18. ve 19 yy. ekonomik, siyasi ve sosyal koşullarına bakılması da önem oluşturmaktadır. Osmanlı Devleti'nde Batılılaşma kavramının etkilerinin giderek daha etkin hissedildiği tarihlerde, bu dönemin ürünleri olan yalıların da etkilendiği anlaşılmaktadır (Ertuğrul, 2009; İlhan, 2018). Osmanlı'nın İstanbul'unda Batılılaşma yolunda ilk olarak çevresel düzenlemeler yapılmaya başlanmış ve ömrünü tamamladığı düşünülen her yapının yerine yenisinin getirilmesi amaçlanmıştır. Eski ve yeninin sürekli olarak çatıştığı bu dönemde kentte de büyük halk hareketleri ve isyanlar baş göstermiş olup, bu devinimler şehre dalga dalga yayılmıştır (Ertuğrul, 2009; Güncan, 1993). 1700'lerin sonundan itibaren Boğaziçi'nin yakasına işlenmeye başlanan yalılar başlarda yerel ve geleneksel mimari üslupta inşa edilirken, Tanzimat dönemine gelindiğinde ise, Batılılaşmanın etkilerinin daha da artması nedeniyle başta Barok olmak üzere dönemin Avrupa'da hâkim olan mimari üsluplarından oldukça etkilenmişlerdir. 19. yy. sonlarına doğru ise yapılarda neo-klasik bir üslubun hâkim olduğu ve yerel mimariden uzaklaşmaya başlandığı görülebilmektedir (Kuban, 1970; Erdenen, 1993; Güncan, 1993). Hem şehirden uzak oluşu hem de kalabalık hane halkı ve dönemin getirdiği gerekliliklerden ötürü yalılar bugün göründüklerinden daha da büyük yapılar olarak Boğaziçi'nde göze çarpmaktadır (Alan, 2005).

1.2 Geleneksel Türk Evi Kavramı ve Yalılar

Osmanlı Dönemi'nin özgün ve egemen konut yapılarının ilk örneklerinin 17. yüzyıldan itibaren ortaya çıktığı bilinmektedir (Kuban, 1970; Bektaş, 2016). Bu özgün konut mimarisinin en gelişmiş örnekleri ise dönemin başkenti olan İstanbul'da yer almaktadır. Ahşap; sıcak bir malzeme oluşu, konar-göçerliği hatırlatması ve bu dünyanın gelip geçici bir yer olduğunu sembolize etmesi nedeniyle özellikle konut yapılarında sıklıkla tercih edilen bir malzeme olarak öne çıktığı bilinmektedir (Bektaş, 2016). Öte yandan, İstanbul'un yangınlarıyla ünlü ve adeta ahşaptan bir şehir olması; konut yapılarının çok büyük bir kısmının yangınlar neticesinde yok

olmasına neden olmuş ve günümüze yalnızca sınırlı sayıda Osmanlı dönemi konut mimarisine ait özgün örnekler görülmektedir (Güncan, 1993).

Geleneksel Türk konut mimarisinde zemin katın genellikle taştan kagir olarak yapıldığı ve üst katların ise ahşap strüktürden oluşturulduğu bilinmektedir (İlhan, 2018). Zemin katta genellikle; mutfak, servis ve kiler gibi depolama alanları bulunmaktadır. Konut planlarında ise Anadolu'daki kırsal bölgelerdeki örneklerde "hayat" adı verilen avlulara sahip ev tipolojilerine rastlanırken özellikle, İstanbul gibi kentlerde ve yalılarda ise ana kapıdan girildiğinde insanı karşılayan ve ortak yaşamın geçtiği ana mekân olan "sofa" merkezli konut tipolojilerine rastlanmaktadır (Eldem, 1954; Bektaş, 2016). Sedat Hakkı Eldem, "Türk Evi" hakkında yaptığı çalışmalarda konut tipolojilerini sofa çerçevesinde sınıflandırmış olup, sofasız plan tipini en ilkel tip olarak tanımlarken, ilk olarak dış sofalı evlerin ortaya çıktığını ve zamanla sofaların evin içine alındığı gelişmiş bir tür olan "karnıyarık" tipinin yaygınlaştığını belirtmektedir (Eldem, 1954). Merkezi sofalı evlerde, sofanın etrafı odalarla çevrelenmiş olsa da gün ışığı ve dış dünya ile bağlantılar eyvanlar kullanılarak sağlanmıştır (Özlem, 2015; Bektaş, 2016; Ilhan, 2018). Eyvanlar yani bir başka ifadeyle "divanhaneler" ise genel olarak yüksek tavanlı, büyük ve ferah iç mekanlar olarak tanımlanabilmektedir. Eyvanlar, avluya veya bahçeye bakan büyük pencerelerle çevrili olup, bu pencereler ise odanın aydınlatılmasını sağlarken aynı zamanda güzel manzaralardan da yararlanılmasını sağlamaktadır. Eyvanlar, dış dünyayla iç mekânı birleştirerek ferah ve açık bir atmosfer de sunmaktadır. Bu alanlar, aile toplantıları, misafir ağırlama, sosyalleşme ve dinlenme amaçlı kullanılmaktadır. Özellikle kentlerde ekonomik ve pratik karnıyarık tipli konutlar daha yaygınken, yalılar gibi varlıklı ve kentin ileri gelenlerinin kişilerin yaşadığı alan sınırlamasının olmadığı konutlarda merkezi sofalar da bulunabilmektedir. (Atalan, 2015; Eldem, 1954; Güncan, 1993). Zaman içerisindeki yenilik arayışları ve Batı kaynaklı üslup değişimlerine rağmen yalılarda genellikle sofa merkezli konut tipolojine sadık kalındığı söylenebilmektedir. Bunlara ek olarak, yalılar giriş ve sofanın yanı sıra; yapının ön tarafında konumlandırılan ve erkek misafirlerin ağırlandığı selamlık bölümü, kadınlar ve hane halkının günlük aktiviteleri için ayrılmış olan, mahremiyete özen gösterilen haremlik bölümü, genellikle zemin katta konumlandırılan geniş mutfak bölümü, bazı örneklerde çatı katından manzaranın panoramik olarak izlenebildiği cihannüma, avlu ve peyzaj bölümlerini de barındırmaktadır (Erdenen; 1993; Güncan, 1993; Atalan, 2015; Ilhan, 2018). Günümüze kadar ulaşabilen yalı örnekleri çoğunlukla özgün planlarına göre çok daha küçülmüştür. Zamanla değişen ihtiyaçlar ve yaşam şekilleri yalıların bölünmesine, kimi zaman bir yerine birkaç aile tarafından kullanılmasına ve giderek küçülmesine sebep olmuştur (Alan,

2005). 18. yüzyılın başlarında tarih sahnesine çıkan yalılara özgün bir karakter kazandıran ahşap strüktür ise yerini özellikle 19. yüzyılın sonlarında Batılı etkilerle birlikte taş ve tuğla gibi daha dayanıklı malzemeler kullanılarak yapılan kagir yapıya bırakmıştır (Erdenen, 2006; Atalan, 2014).

Batılılaşma yolundaki ilk adımların atıldığı ve buna paralel olarak yalıların sayılarının da hızla arttığı 1718-1730 yılları arasındaki Lale Devri döneminde ise Türk evi odalarının klasik bir düzende tasarlandığını söylemek mümkündür (Özkeçeci vd., 2018). Lale devrinin en bilinen motifi olan saksı ya da vazo içinde yer alan çiçek ve meyve motifleri ile alçıdan yapılmış renkli kabartmalar dönemin süsleme desenleri arasında yer almaktadır. Yalılarda iç mekanlarında süsleme amaçlı çini, ahşap ve alçı oymalarla bezemeler yapılmıştır (Özkeçeci, vd., 2018) Bahsi geçen süslemeler, İstanbul Köprülü Yalısı'nda ise ahşap malzeme üzerine düz satıhlı olarak görülebilmektedir. Cephelerde ise ince ve uzun şeritler halinde kesilerek hazırlanan yalı baskısı ahşap kaplama kullanılarak estetik bir görünüm kazandırırken aynı zamanda koruma sağlaması amaçlanmıştır. Ahşap kaplama üzerinde, pencere ve kapı kenarlarında da ahşap oymalara ve süslemelere rastlanabilmektedir (Ünver ve Eldem, 1970).

Osmanlı geleneksel konut mimarisinde tavan süslemelerine de ağırlık verilmiştir. Tavanlar, ahşap kirişler üzerine, tahta kaplanarak yapılmaktadır. Literatürde şu ana kadar yapılmış olan çalışmalarda tavan yapım yöntemleri dört gruba ayrıldığı bilinmektedir. Bu tavan yapım yöntemleri ise; ters tavan (süslemesiz, mertekli), düz tavan (süslemeli ya da süslemesiz olarak düz yüzey), tekne tavan (süslemeli, pervazlı) ve kırlangıç örtü (dikdörtgen kesitli ahşap kirişlerin köşegenlere yerleştirilmesi) olarak kendi içlerinde ayrışmaktadır (Ünver ve Eldem, 1970; Özkeçeci, vd., 2018).

Yalılarda süsleme yapım tekniği olarak kalem işine rastlanmaktadır. Kalem işi alçı ve ahşap kaplama üzerine yapılan aşı boyası ile renklendirilen ve şekiller verilerek yapılan bir bezeme tekniğidir (Ünver ve Eldem, 1970). Bu tekniğin uygulamasına İstanbul'daki Amucazade Hüseyin Paşa, Köprülü yalısı örnek gösterilebilmektedir (Özkeçeci, vd., 2018).

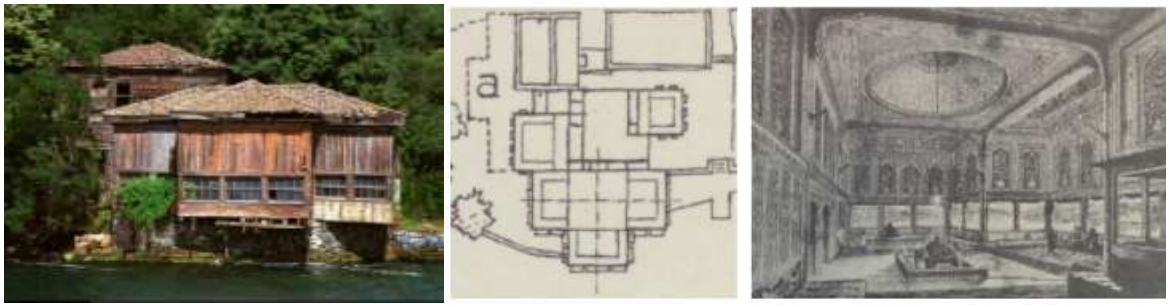
2. TARİHSEL SÜREÇTE YALI TİPOLOJİSİNİN DÖNÜŞÜMÜ

Çalışmanın devamında 18 yüzyıl erken dönem yalı örneklerinden Köprülü Yalısı ve 19 yüzyıl geç dönem örneklerinden olan Said Halim Paşa Yalıları ele alınarak, yalı tipolojisinin tarihsel süreç içerisinde yaşadığı değişimler ele alınacaktır.

2.1 Köprülü Yalısı (Amucazade Hüseyin Paşa Yalısı)

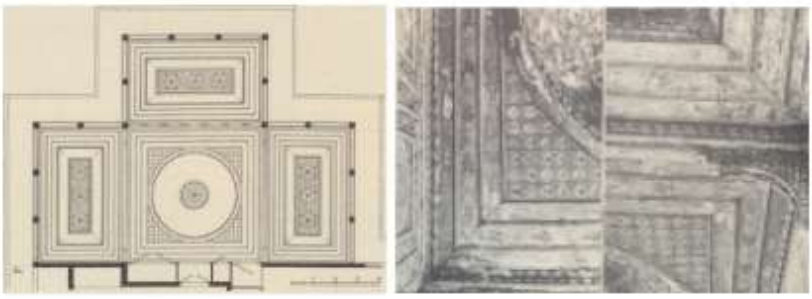
Sultan II. Mustafa devri sadrazamlarından Amucazade Hüseyin Paşa tarafından yaptırılmış olan Köprülü Yalısı (Amucazade Hüseyin Paşa) Boğaziçi'nin en eski tarihli ahşap evi olarak

bilinmektedir (Ünver ve Eldem, 1970). Günümüzde yalnızca selamlık bölümünün divanhanesi kalmış olan yalı, 1699 yılında yapıldığı bilinmektedir. T şeklindeki üç eyvanın meydana getirmiş olduğu yapıda merkezi kare mekânın üstünde yer alan kubbe ile ön plana çıkmaktadır. Divanhane, batıya yönelen ve eliböğründelerle desteklenen yapısıyla denize doğru uzanan bir şekilde planlanmıştır (Ünver ve Eldem, 1970; Özkeçeci vd., 2018). Yapının cephesinde süslemeler açısından herhangi ekleme görülmezken, iç mekanda ise bezemelerle donatıldığı görülmektedir. Divanhane, Osmanlı mimarisinin oldukça erken devrinin bir temsilcisi olup, ahşap Türk evi formunun temel formuna örnek teşkil etmektedir (Şekil 2.1).



Şekil 2.1 Köprülü Yalısı'na ait (soldan sağa) fotoğraf, plan tipi ve Lattenacci tarafından yapılmış yapı içinden bir gravür (Archnet; Ünver ve Eldem, 1970; Özkeçeci vd., 2018).

Köşk odasının üç tarafını çeviren pencereler mukarnaslı bir silme üzerine oturan bir raf ile örtülmüştür. Oda duvarları oymalı ve altın yaldızlı kirişlerle bölünmüş çiçekli panolarla dekore edilmiştir. Binanın en önemli özelliklerinden birisi de bu panoların hemen alt kısmında denizi ve karşı kıyıları bütün yönlerden görebilen bir dizi pencerenin bulunmasıdır. Odadaki panolar, lale ve karanfil desenleriyle süslenmiştir. Oda içi tamamıyla ahşap kaplama ve nakışlıdır. Sadece kapı ve dolap cephesi tel ve fildişi kakma ve boyasız olduğu görülmektedir (Şekil 2.2).



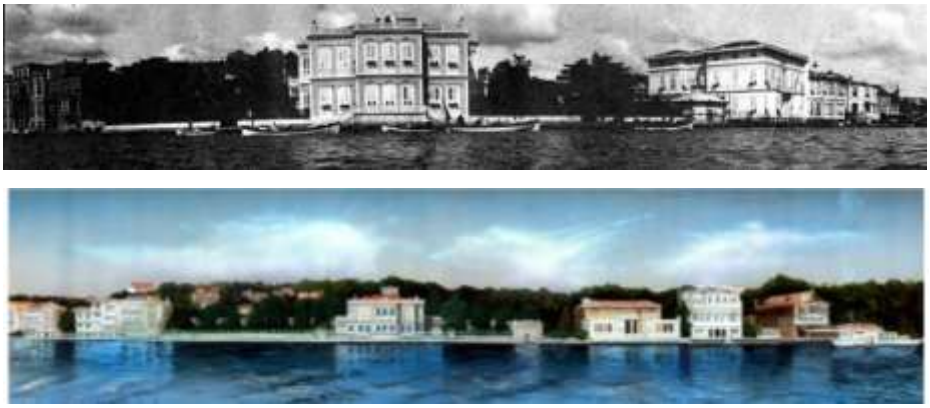
Şekil 2.2. Köprülü Yalısı'na ait tavan rölevesi ve görselleri (Ünver ve Eldem, 1970; Özkeçeci vd., 2018).

Köprülü yalısı, mukarnas silmeleri ve çıtalar gibi mimarî taksimat altın varak kaplı veya tezhiplidir. Oda ortasında, havuz ve fıskiye yer almaktadır (Ünver ve Eldem, 1970). Keten bezi

ile kaplı ahşap kubbeler boya ve altın yaldızla süslenmiştir. Tavandan askılar ve tavan ortasından avize sarkmaktadır. Tavan, alçı ve ahşap kaplama üzerine yapılan aşı boyası ile renklendirilmiş ve şekillendirilerek kalem işine yer verilmiştir. Tavan ve pencere üzerlerinde Türk vazolu buket resim ve nakışları yer almaktadır. Tavanlar birbirinden ayrılarak üç çerçeve ile çevrilmiş, ortada kalan kısımların orta şahında kubbe, kanatlarda aynalı teknelerle örtülmüştür. Kubbe ve teknelerin göbekleri hurda perçin tarzında geometrik taksimat ve mukarnaslı sarkma topuzlarla süslenmiştir. Orta kubbe ile çerçeveler arasında kalan üçgenler ince şişlerle birer gül resmiyle süslü karelerle bezenmiştir (Ünver ve Eldem, 1970).

2.2 Said Halim Paşa Yalısı

Adını Prens Abdulhalim Paşa'nın oğlu olan ve Osmanlı'da bir dönem sadrazamlık yapmış olan Sait Halim Paşa'dan alan yalının 1800'lerin başlarında Düzoğulları Hanesi olarak anıldığı bilinmektedir. Prens Abdulhalim Paşa 19. yüzyılın son çeyreğinde harap olan yalıyı yıktırarak mimar Petraki Adamandidis'e tekrar yaptırmıştır. Prens Abdulhalim Paşa'nın vefatının ardından Said Halim Paşa tarafından diğer varislerinden satın alınan yalı neo-klasik (ampir) üslupta cephe ve pencereleriyle, denizden geri çekilerek rıhtım üzerine inşa edilmiştir (Akozan, vd., 1988; Erdenen, 2007; İlhan, 2018), (Şekil 2.3).



Şekil 2.3. Said Halim Paşa Yalısı ve yakın çevresinin Boğaz'dan görünümlerinin zaman içerisinde geçirdiği değişimler (Avunduk Mimarlık, t.y.)

Binanın formu, cephede cumbaların bulunmaması ve sofa yerine merdiven holü bulunması inşa edildiği dönemin mimari alandaki yenilikleri arasında sayılabilir. Yalı, iki kat olarak yükselmiştir ve güneyi selamlık, kuzeyi harem olarak düzenlenmiştir. Selamlık bahçesine açılan kapının önünde bulunan iki aslan heykeli sebebiyle yalı "Aslanlı Yalı" olarak anılmaktadır (Akozan, vd., 1988). Şekil 2.4'te yapının 1. kat planı restitüsyon planı yer almaktadır.



Şekil 2.4. Said Halim Paşa Yalısı 1. kat planı restitüsyonu (Avunduk Mimarlık, t.y.)

Yalı, Yeniköy'de deniz kıyısında büyük bir bahçe içinde yer alır ve bahçenin kuzey ucunda, üç yönden denize girilebilen bir deniz hamamı bulunmaktadır. Selamlık bahçesinde bir kayıkhane yer alırken, yolun üst kısmında yer alan yalıya ait koru, yalının üst katından, altından yol geçen kafesli bir koru köprüsü ile bağlanmaktaydı ancak, 1958 yılında cadde genişletilirken bu köprülerin yıkıldığı bilinmektedir (Erdenen, 2007) (Şekil 2.5).



Şekil 2.5 Said Halim Paşa Yalısı'na ait Kuzeydoğu ve Güneydoğu cephe görünüşlerinin restitüsyonları (Avunduk Mimarlık, t.y.)

Yalı, geleneksel Boğaziçi yalısı tipinde, orta sofa çevresinde sıralanmış odalardan oluşmaktadır. Sait Halim Paşa tarafından yaptırılan onarımlar sonrasında orta sofa, bir merdiven holüne dönüştürülmüştür (Akozan, vd., 1988). Yalının iç dekorasyonunda eklektik üslup açıkça görülmektedir ve zengin altın yaldızlı bezemeler içerisinde alçı kaplamalar, kabartmalar, sedef bağa ağaç işçiliği, bitkisel geometrik şekiller, yazı ve resimler bir arada kullanılmıştır. Osmanlı, Mısır ve XVI. Louis üslubu mobilyalar, Murano avizeleri ve çeşitli sanat eserleri de yalıyı tamamlamaktadır (Erdenen, 2007) (Şekil 2.6).



Şekil 6. Said Halim Paşa Yalısı'na ait iç mekân görselleri (Avunduk Mimarlık, t.y.)

1994 yılında çıkan yangın yalıda önemli hasarlara neden olmuş ve yapı yeniden restore ettirilmiştir. Zaman içerisinde pek çok kez el değiştiren ve önemli tarihi olayların gerçekleştiği bir konut, eğlence mekanı veya film platosu olarak kullanılan ve talihsiz olarak etiketlenen yalı bugün çeşitli organizasyonlara ev sahipliği yaparak varlığını sürdürmektedir (İlhan, 2018) (Şekil 7).



Şekil 2.7 1994 yılında yapıda meydana gelen yangın ve yalının bugünkü fonksiyonu (Bosphourus Yacht, t.y.;Kılıç, A t.y.)

SONUÇ VE TARTIŞMA

Osmanlı mimarisinde 19. yüzyılla birlikte Batı kaynaklı neo-klasik üslubun etkin olması sonucunda konut mimarisinin bir türü olan yalıların mimari biçimlenişlerinde ve iç dekorasyonlarında da radikal değişikliklere gidildiği görülmektedir. Yapı strüktürünü oluşturan malzemelerin ahşaptan taş veya tuğlaya dönüşümü, merdiven hollerinin sofaların yerlerini alması ve kimi zaman da ihtişamın yapıların en ince detaylarında bile vurgulanması dönemin getirilerinden ötürü şehrin geçirdiği devinimlerinin birer yansıması olarak ortaya çıkmaktadır. Değişen hayat tarzları, buna bağlı olarak farklılaşan ihtiyaçlar ve artan nüfus yoğunluğu İstanbul'un çeperlerinin tarihi yarımadadan itibaren esneyerek Boğaziçi'nin kuzeyi yönünde

ilerlemesine neden olmuştur. Bu nedenle, yalılar da bu talebe çözüm olarak bölünmüş veya tek bir aile yerine farklı ailelerin yaz-kış kullanmak üzere kiralayabildikleri bir konut yapısı haline bürünmüşlerdir. Buna ek olarak, Boğaziçi'ndeki yer alan yalıların önemli bir kısmı ise yangın, bakımsızlık ve çeşitli sebeplerden ötürü meydana gelen yıkımlar neticesinde günümüze kadar ulaşamamıştır. Günümüzde sadece 366 adet yalı tarihi yapı statüsünde olup, sahip oldukları hikayeler ve geçirdikleri dönüşümlerle birlikte Osmanlı Dönemi'nin 18. ve 19. yüzyıllarına hâkim olan kültürel, siyasi, sosyal ve mimari gibi farklı disiplinlerde yaşanan gelişmeler ve devinimlere ilişkin kanıt sunmaktadırlar.

Yalılar, Osmanlı döneminden bu yana hem içinde bulundukları dönemin siyasi, sosyal, ekonomik ve kültürel bağlamlarını yansıtarak günümüze taşımaktadırlar. Her ne kadar Batılılaşma yolundaki dönemsel üsluplardan etkilenseler de bugün Türk evi kavramına ışık tutan sayılı örnekler arasında yer almaktadırlar.

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İÇ MİMARLIK EĞİTİMİNDE YAPAY ZEKÂ: GÜNCEL ARAŞTIRMALAR ÜZERİNE BİR DEĞERLENDİRME

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ÖZET

Son yıllarda üretken yapay zekâ teknolojilerindeki hızlı gelişim, iç mimarlık eğitimini geleneksel "deneyim odaklı" stüdyo yapısından "veri odaklı" ve dinamik bir sürece doğru yönlendirmektedir. Bu çalışmanın amacı; iç mimarlık eğitiminde yapay zekâ kullanımını ele alan ulusal ve uluslararası literatürü sistematik bir yaklaşımla inceleyerek, alandaki güncel eğilimleri, pedagojik odakları ve temel bulguları bütüncül bir perspektifle değerlendirmektir. Araştırmada Sistematik Literatür Taraması modeli benimsenmiş; Web of Science, Scopus, Google Scholar ve TR Dizin veri tabanları 2015–2025 dönemini kapsayacak şekilde taranmıştır. Belirlenen dahil etme ölçütlerini karşılayan ve tam metnine erişilebilen 56 çalışmanın tamamının 2022–2025 yılları arasında yayımlandığı görülmüş ve bu kaynaklar nitel içerik analizine tabi tutulmuştur. İnceleme sonucunda, yapay zekâ entegrasyonunun literatürde son yıllarda belirgin bir artış gösterdiği ve çalışmaların ağırlıklı olarak konsept geliştirme ile görselleştirme aşamalarında yoğunlaştığı saptanmıştır. Bulgular, yapay zekâ araçlarının öğrencilerin fikir üretme hızını ve alternatif tasarım senaryoları geliştirme kapasitesini artırdığını kanıtlarken; aynı zamanda teknik yetkinlik kaybı, etik belirsizlikler ve tasarım öznelliği gibi kritik tartışma alanlarını da beraberinde getirdiğini ortaya koymaktadır. Sonuç olarak bu çalışma; yapay zekânın tasarımcıyı ikame eden bir güçten ziyade, eleştirel düşünme ve teknik bilgiyle dengelenmiş bir bilişsel ortak olarak konumlandırılması gerektiğini savunmaktadır. Elde edilen çıkarımlar, iç mimarlık müfredatına yapay zekânın pedagojik açıdan verimli ve etik bir çerçevede entegre edilebilmesi adına eğitimcilere stratejik bir yol haritası sunmaktadır.

Anahtar Kelimeler: İç mimarlık eğitimi, yapay zekâ, dijital tasarım, sistematik inceleme

ARTIFICIAL INTELLIGENCE IN INTERIOR DESIGN EDUCATION: AN EVALUATION OF CURRENT RESEARCH

ABSTRACT

In recent years, the rapid development of generative artificial intelligence technologies has shifted interior architecture education from the traditional "experience-focused" studio structure towards a "data-driven" and dynamic process. The aim of this study is to systematically review the national and international literature addressing the use of artificial intelligence in interior architecture education, evaluating current trends, pedagogical focuses, and key findings in the field from a holistic perspective. The Systematic Literature Review model was adopted for the research; the Web of Science, Scopus, Google Scholar, and TR Dizin databases were searched for the period 2015–2025. It was observed that all 56 studies that met the inclusion criteria and were available in full text were published between 2022 and 2025, and these sources were subjected to qualitative content analysis. The review revealed that the integration of artificial intelligence has shown a marked increase in the literature in recent years and that studies have focused primarily on the concept development and visualization stages. The findings show that artificial intelligence tools increase students' idea-generation speed and capacity to develop alternative design scenarios; however, they also reveal critical areas of debate, such as the loss of technical competence, ethical uncertainties, and design subjectivity. Consequently, this study argues that artificial intelligence should be positioned as a cognitive partner balanced with critical thinking and technical knowledge rather than a force that replaces the designer. The findings provide educators with a strategic roadmap for integrating artificial intelligence into the interior architecture curriculum in a pedagogically effective and ethically sound manner.

Keywords: Interior design education, artificial intelligence, digital design, systematic review

Bu çalışma, Selçuk Üniversitesi Sosyal Bilimler Enstitüsü Tasarım Anabilim Dalı'nda kabul edilen "*Yapay Zekâ Kullanımının İç Mimari Stüdyo Dersi Kapsamında Değerlendirilmesi*" başlıklı doktora tezinden türetilmiştir.

1. GİRİŞ

21. yüzyıl, insan yaşamının pek çok alanında olduğu gibi tasarım dünyasında da yapay zekâ teknolojilerinin devrimsel etkilerine tanıklık etmektedir (Ismail, 2024). İç mimarlık, estetik, işlevsellik ve psikolojiyi birleştiren çok boyutlu bir disiplin olarak, dijital devrimin bu yeni dalgasıyla birlikte köklü bir dönüşüm sürecine girmiştir (Ansari, 2025; El Machichi, 2025). Geleneksel iç mimarlık eğitimi tarihsel olarak usta-çırak ilişkisine ve insan sezgisine

dayanırken; günümüzde üretken yapay zekâ araçlarının entegrasyonu, eğitim metodolojilerini "deneyim odaklı" bir yapıdan "veri odaklı" ve dinamik bir sürece doğru yönlendirmektedir (Gao vd., 2025; Samad vd., 2024). Bu teknolojik ilerleme, yapay zekânın yalnızca teknik bir araç değil, aynı zamanda stüdyo kültürünü, tasarım sahipliğini ve yaratıcı öznelliği yeniden şekillendiren bir "eş yaratıcı ortak" (co-creative partner) olarak kabul edilmesine yol açmıştır (El Machichi, 2025; Karadağ, 2025; Karadağ ve Ozar, 2025). Bu dönüşüm, iç mimarlık disiplininde yalnızca kullanılan araçların değişimini değil; tasarım düşüncesinin üretim biçimini, karar alma süreçlerini ve tasarımcı–araç ilişkisini yeniden tanımlayan yapısal bir paradigma değişimini işaret etmektedir.

Tasarım eğitiminin omurgasını oluşturan tasarım stüdyoları, bu teknolojik evrimin merkezinde yer alan dinamik ortamlardır (Kahraman vd., 2023; Özorhon vd., 2025). Lale Başarır (2022) gibi araştırmacılar, iç mimarlık müfredatlarının yapay zekâ konseptlerini içerecek şekilde güncellenmesi gerektiğini savunarak, bu teknolojilerin tasarımın girdi, süreç ve çıktı aşamalarında tasarımcı farkındalığını artırdığını belirtmektedir. Bu durum tasarım stüdyosunun yalnızca sonuç odaklı bir üretim alanı olmaktan çıkarak, veriyle beslenen, iteratif ve çoklu denemeye dayalı bir öğrenme ortamına dönüşmesini beraberinde getirmektedir. Özellikle metinden görüntüye dönüştüren Midjourney, DALL-E ve Stable Diffusion gibi araçlar ile ChatGPT gibi büyük dil modelleri, öğrencilerin soyut kavramları anında görselleştirmesine, hızlı örnekler oluşturmasına ve problemleri başarılı şekilde aşmasına olanak tanımaktadır (Deval vd., 2025; Karadağ ve Ozar, 2025; Meddain, 2025). Bu araçlar, karmaşık tasarım senaryolarının kurgulanmasında ve sürdürülebilirlik analizlerinin yapılmasında geleneksel yöntemlere kıyasla önemli bir zaman tasarrufu ve verimlilik artışı sağlamaktadır (Ansari, 2024; Buldaç, 2024; Hafiz, 2024; Jin vd., 2024). Ancak bu hız ve verimlilik artışı, tasarım sürecinin pedagojik niteliği açısından ele alındığında, öğrenmenin derinliği, sürecin sorgulanabilirliği ve tasarım kararlarının gerekçelendirilmesi gibi temel kazanımların nasıl korunacağı sorusunu da gündeme getirmektedir.

Yapay zekânın eğitim süreçlerine bu denli hızlı dahil olması, beraberinde ciddi pedagojik ve etik tartışmaları da getirmektedir (Huh vd., 2025; Karadağ, 2025). Tasarım öznelliği, telif hakları, veriye dayalı önyargılar ve öğrencilerin bu araçlara aşırı bağımlılık geliştirerek eleştirel düşünme becerilerini kaybetme riski akademik literatürde en çok vurgulanan kriz alanlarıdır (Deval vd., 2025; Huh vd., 2025; Karadağ ve Ozar, 2025). Bu riskler, iç mimarlık eğitiminde yapay zekânın hangi aşamada, hangi pedagojik çerçeveyle ve hangi sınırlamalarla

kullanılacağına dair net bir konumlandırma ihtiyacını ortaya koymaktadır. Yapılan çalışmalar, yapay zekânın sunduğu görsel çıktıların sıklıkla mekânsal ölçek, ergonomi ve yapısal tutarlılık açısından hatalar barındırabildiğini; bu nedenle insan uzmanlığının ve tasarımcı yorumunun vazgeçilmez olduğunu ortaya koymaktadır (El Machichi, 2025; Hafiz, 2024; Küçük vd., 2025; Sungur, 2025). Bu bağlamda, yapay zekâ destekli tasarım süreçlerinin iç mimarlık eğitiminde nasıl yapılandırılması gerektiği sorusu, yalnızca teknolojik yeterlilikler üzerinden değil, pedagojik hedefler ve öğrenme çıktıları üzerinden de değerlendirilmelidir. Yapay zekânın tasarımcıyı ikame eden bir güçten ziyade, yaratıcı potansiyeli artıran yardımcı bir asistan olarak konumlandırılması gerektiği savunulmaktadır (Küçük vd., 2025).

Güncel literatürde, yapay zekânın iç mimari görselleştirme ve kavramsal tasarım üzerindeki etkilerine dair çalışmalar hızla artarken, iç mimarlık eğitimine özgü bileşenleri bütüncül bir yaklaşımla ele alan değerlendirmelerin hala gelişmekte olduğu görülmektedir (Deval vd., 2025; Harmanbasi, 2025; Tien ve Chen, 2024).

2. YÖNTEM

Bu çalışma, iç mimarlık eğitiminde yapay zekâ kullanımını ele alan nitel bir araştırma olarak kurgulanmıştır. Araştırma tasarımı, alandaki akademik üretimi bütüncül, sistematik ve tekrarlanabilir biçimde incelemek amacıyla Sistematik Literatür Taraması modeline dayandırılmıştır. Veri toplama süreci; Web of Science, Scopus, Google Scholar ve TR Dizin veri tabanlarında, 2015–2025 yılları arasındaki akademik üretimi kapsayacak şekilde yürütülmüştür. Tarama sürecinde anahtar kelime olarak “iç mimarlık eğitimi” ve “yapay zekâ” kullanılmıştır. 2015 yılından itibaren yapılan kapsamlı taramaya rağmen, dahil etme ölçütlerini karşılayan, tam metnine erişilen ve iç mimarlık eğitimiyle doğrudan ilişkili 56 çalışmanın tamamının 2022–2025 yılları arasında yayımlandığı tespit edilmiştir.

Verilerin çözümlenmesinde, nitel verilerin sistematik bir biçimde tasnif edilmesine ve tematik olarak sentezlenmesine olanak tanıyan içerik analizi yöntemi benimsenmiş; tüm analiz süreci MAXQDA yazılımı üzerinden yönetilmiştir. Araştırma kapsamında örneklemde yer alan her makale, özgün olarak geliştirilen bir "Analitik Değerlendirme Matrisi" doğrultusunda kapsamlı bir incelemeye tabi tutulmuştur. Bu çerçevede çalışmalar; bibliyometrik veriler, araştırma yöntemi ile örneklem yapısını tanımlayan metodolojik kurgu ve odaklanılan tasarım evresini belirleyen iç mimari bağlam başlıkları altında kodlanmıştır. Analiz süreci ayrıca, hedeflenen beceri gelişimi ile uygulanan eğitim modelini kapsayan pedagojik kurgu, kullanılan yapay zekâ aracı ve teknolojinin tasarım sürecindeki rolünü tanımlayan yapay zekâ entegrasyonu ile son

olarak süreçten elde edilen pozitif/negatif bulgular, genel sonuçlar ve öneriler üzerinden derinleştirilmiştir. Böylece iç mimarlık eğitimi bağlamında yapay zekâ kullanımının odaklandığı alanlar, pedagojik yönelimler ve tartışma eksenleri bütüncül bir perspektifle ortaya konmuştur.

3. BULGULAR VE TARTIŞMA

Tablo 1'de görüldüğü gibi, araştırma kapsamında incelenen çalışmaların betimsel analizi, yapay zekâ teknolojilerinin iç mimarlık eğitimine entegrasyonunda son yıllarda yoğun bir artış yaşandığını ortaya koymaktadır. Kronolojik dağılım incelendiğinde, literatürdeki üretimin yarısından fazlasının (%51,8) 2025 yılına ait olduğu, bu oranın 2024 yılı verileriyle (%35,7) birleştiğinde toplam çalışmaların %87,5'ini oluşturduğu görülmektedir. 2022 (%3,6) ve 2023 (%8,9) yıllarındaki sınırlı üretimden, son iki yıldaki bu yoğunlaşmaya geçiş; üretken yapay zekâ araçlarının erişilebilirliğinin artmasıyla tasarım eğitiminde yaşanan paradigmatik dönüşümü ve akademinin bu yeni teknolojiye hızlı adaptasyonunu kanıtlar niteliktedir.

Tablo 1. İç Mimarlık Eğitiminde Yapay Zekâ Kullanımına İlişkin Çalışmaların Tanımlayıcı Dağılımı

Çalışmaların Yürütüldüğü Yıl						
2022	**2023**	**2024**	**2025**			
n=2	n=5	n=20	n=29			
%3,6	%8,9	%35,7	%51,8			
Örneklemin Eğitim Düzeyi*						
Lisans 1. Sınıf	**Lisans 2. Sınıf**	**Lisans 3. Sınıf**	**Lisans 4. Sınıf**			
n=3	n=10	n=10	n=13			
%8,3	%27,8	%27,8	%36,1			
İç Mimari Bağlam**						
Teknik Uygulama		**Görselleştirme ve Sunum**		**Konsept ve Fikir Geliştirme**		
n=5		n=30		n=48		
%6,0		%36,1		%57,9		
Kullanılan Yapay Zekâ Araçları						
Midjourney	**ChatGPT**	**DALL-E**	**Stable Diffusion**	**PromeAI**	**OpenArt**	**Diğer*****
n=33	n=16	n=15	n=13	n=9	n=4	n=29
%27,7	%13,4	%12,6	%10,9	%7,6	%3,4	%24,4

Not: Veriler frekans (n) ve yüzde (%) olarak sunulmuştur.
*Eğitim düzeyi verisi, incelenen çalışmalarda belirtilmediği veya raporlanmadığı için bu kategorideki toplam sayı (*n*=36) genel örneklemden düşüktür.
**Tasarım süreci ve yapay zekâ araçları kategorilerinde birden fazla kodlama yapıldığı için toplamları örneklem sayısından fazladır.
***Diğer kategorisi; ControlNet, Adobe Firefly, Gemini, Copilot, LookX AI, LeonardoAI, Craiyon, Autodesk Forma, TextFX, Planner 5D, DecorMatters, ReimagineHome, Foyr Neo, Homestyler, Finch 3D, Canva, Bing Image Creator, AI-Architectures ve EasyBIM-S araçlarını kapsamaktadır.

Pedagojik düzey bağlamında veriler incelendiğinde, yapay zekâ kullanım sıklığının eğitim seviyesine paralel olarak arttığı dikkat çekmektedir. Lisans birinci sınıf düzeyindeki çalışmaların %8,3 gibi düşük bir oranda kalması, temel tasarım eğitiminde önceliğin manuel

beceriler ve malzeme algısına verilmesiyle açıklanabilirken; dördüncü sınıf düzeyindeki %36,1'lik yoğunlaşma, mezuniyet aşamasındaki öğrencilerin karmaşık tasarım problemlerini yönetmede yapay zekâyı stratejik bir araç olarak kullandıklarını göstermektedir. Ara sınıflardaki dağılımın %27,8 seviyesinde dengelenmiş olması ise, dijital yetkinliklerin eğitim müfredatına kademeli bir entegrasyon izlediğine işaret etmektedir.

İç mimarlık disiplininin tasarım süreçleri açısından bakıldığında, yapay zekâ araçlarının homojen bir dağılım göstermediği; kullanımın %57,9 gibi baskın bir oranla "Konsept ve Fikir Geliştirme" aşamasında yoğunlaştığı tespit edilmiştir. Bunu %36,1 ile "Görselleştirme ve Sunum" izlerken, "Teknik ve Uygulama" aşamasının %6,0 gibi oldukça sınırlı bir paya sahip olması kritik bir bulgudur. Bu veriler, mevcut teknolojilerin tasarımın erken evrelerindeki yaratıcı süreçleri desteklemede güçlü bir potansiyele sahip olduğunu, ancak kesinlik gerektiren teknik detaylandırma süreçlerinde henüz yeterli olgunluğa erişemediğini ve tasarımcılar tarafından daha çok bir esinlenme ortağı olarak konumlandırıldığını doğrulamaktadır.

Dijital araç tercihleri incelendiğinde ise, iç mimarlık eğitiminin görsel doğasına uygun olarak metinden-görsele üretim yapan platformların öne çıktığı görülmektedir. Özellikle atmosfer ve doku yaratımındaki başarısıyla Midjourney, %27,7'lik kullanım oranıyla en sık tercih edilen araç konumundadır. Metin tabanlı ChatGPT'nin %13,4 oranında kalması, mekânsal tasarım süreçlerinde görsel çıktının önceliğini vurgularken; %24,4 oranındaki "Diğer" kategorisi, alandaki araştırmacıların tek bir platforma bağlı kalmayıp farklı dijital araçların potansiyellerini aktif biçimde deneyimlediğini göstermektedir.

3.1. Konsept Geliştirme ve Yaratıcı Süreçler

İç mimarlık stüdyolarında üretken yapay zekâ, özellikle erken tasarım evresinde fikir üretimini hızlandıran ve soyut kavramların görselleşmesini sağlayan stratejik bir destek mekanizması olarak öne çıkmaktadır (Kayaoğlu Yaman, 2025; Özorhon vd., 2025). Bu teknoloji, zaman baskısını azaltarak öğrencinin keşif alanını genişletmekle birlikte (Hussein & Noman, 2023), çıktı niteliğinin doğrudan "istem" (prompt) yazma becerisine bağlı olması, kavramsal düşüncenin sözel ifadeye döküldüğü yeni bir yetkinlik alanı tanımlamaktadır (Karadağ & Ozar, 2025; Özorhon vd., 2025). Bu bağlamda, üretken yapay zekâ kullanımı, tasarım sürecinde yalnızca görsel çıktı üretimini değil, tasarımcının düşünceyi yapılandırma, kavramı dilsel olarak çözümleme ve niyetini açık biçimde ifade etme kapasitesini de belirleyici bir faktör hâline getirmektedir. Üretilen görsellerin teknik ve yapısal çözümlere dönüştürülmesinde, yapay zekâ çıktılarının doğrudan uygulanabilir olmaması ve yapısal tutarsızlıklar barındırması

nedeniyle insan müdahalesi vazgeçilmezliğini korumaktadır (Özorhon vd., 2025; Hussein & Noman, 2023). Bu durum, yapay zekâ destekli üretim süreçlerinde tasarımcının rolünün zayıflamadığını; aksine, değerlendirme, dönüştürme ve bağlama yerleştirme sorumlulukları üzerinden yeniden tanımlandığını göstermektedir. Özgünlük ve kültürel temsil bağlamında ise bu araçların görsel üretim başarısına karşın, mekânsal kalite ve özgünlük noktalarında zayıf kalabildiği; veri setlerinden kaynaklanan kültürel etkileri aşmak için tasarımcının "eleştirel düzenleyici" bir rol üstlenmesi gerektiği vurgulanmaktadır (Seyman-Guray & Uyan, 2025; Kahraman vd., 2023). Dolayısıyla, yapay zekâ tarafından üretilen imgelerin kültürel bağlamdan kopuk, genelleştirilmiş ya da tekrara dayalı temsiller üretme riski, tasarım eğitiminde eleştirel farkındalık ve bağlamsal okuma becerilerinin önemini daha da artırmaktadır.

Kullanılan yapay zekânın tasarım düşüncesini yönlendirme gücü de dikkate alındığında (Çelik, 2025), yapay zekânın stüdyo sürecindeki başarısı; dijital üretimin eskiz ve teknik çizim gibi geleneksel yöntemlerle harmanlandığı hibrit eğitim modellerine bağlıdır (Karadağ & Ozar, 2025; Seyman Guray & Uyan, 2025). Bu hibrit yapı, tasarım sürecinin sezgisel, deneyimsel ve eleştirel boyutlarını korurken; yapay zekânın sunduğu hız, çeşitlilik ve veri temelli üretim olanaklarının pedagojik olarak dengeli biçimde kullanılmasına imkân tanımaktadır. Bu denge, yapay zekâyı bir otomasyon aracından ziyade, tasarımcının eleştirel süzgecinden geçen yaratıcı bir paydaş konumuna yerleştirmektedir.

3.2. Görselleştirme ve Temsil Stratejileri

İç mimarlık eğitiminde yapay zekâ destekli görselleştirme araçları, tasarım sürecini hızlandırarak temsil kapasitesini genişleten ve görselleştirmeyi pasif bir sunum aracından aktif bir üretim alanına dönüştüren stratejik bir güç sunmaktadır (Harmanbaşı, 2025; Yıldırım & Erol, 2025). Bu dönüşüm, görselleştirmeyi yalnızca tasarımın temsil aşamasına ait bir çıktı olmaktan çıkararak, karar alma süreçlerini etkileyen ve tasarım düşüncesinin yönünü belirleyen bir bilişsel araç hâline getirmektedir. Nicel analizler, öğrencilerin mekânsal kurguda özgün stratejiler geliştirmelerine rağmen, malzeme ve doku kararlarında yapay zekâ çıktılarını taklit etme eğiliminde olduklarını; bu durumun yaratıcı özerklik ile teknik temsildeki bağımlılık arasında bir ikilik yarattığını göstermektedir (Harmanbaşı, 2025). Bu ikilik, yapay zekâ destekli görselleştirmenin öğrenci yaratıcılığını destekleyici bir araç mı yoksa tasarım kararlarını yönlendiren baskın bir referans mı hâline geldiği sorusunu gündeme getirmektedir. Ayrıca, Midjourney gibi araçların spesifik kullanıcı grupları için daha başarılı görseller üretebilmesi, temsil başarısının doğrudan kullanılan aracın nitelikleriyle ilişkili olduğunu kanıtlamaktadır

(Hoşer & Köymen, 2023). Bu durum, iç mimarlık eğitiminde kullanılan yapay zekâ araçlarının pedagojik hedeflerle uyumlu biçimde seçilmesinin, elde edilen görsel çıktının niteliği kadar öğrenme sürecinin kalitesi açısından da belirleyici olduğunu ortaya koymaktadır.

Yapay zekânın karmaşık form üretimindeki hız avantajına karşın, manuel modelleme süreçleri ölçü, detay ve revizyon kontrolü açısından üstünlüğünü korumaktadır (Yıldırım & Erol, 2025). Bu karşıtlık, yapay zekâ temelli üretim ile geleneksel modelleme yöntemleri arasında bir rekabetten ziyade, farklı tasarım aşamalarına hizmet eden tamamlayıcı bir ilişki olduğunu göstermektedir. Özellikle mobilya tasarımı gibi malzeme fiziği ve strüktürel mantık gerektiren alanlarda yapay zekânın sergilediği teknik eksiklikler, bu görsellerin fiziksel prototiplere dönüştürülmesini zorlaştırmakta ve üretim bilgisiyle desteklenmediğinde önemli riskler doğurmaktadır (Şekerci vd., 2025). Sonuç olarak; kontrol edilebilirlik, teknik doğruluk ve malzeme gerçekliği noktalarında insan tasarımcının eleştirel rolü vazgeçilmezdir. Bu bağlamda, yapay zekâ destekli görselleştirmenin eğitimde etkin bir araç olabilmesi, öğrencinin görsel çıktıyı sorgulayan, teknik bilgiyle değerlendiren ve tasarım kararlarını bilinçli biçimde yeniden üreten bir yaklaşım geliştirmesine bağlıdır. Yapay zekâ destekli görselleştirmenin pedagojik verimliliği, öğrencilerin çıktıları doğrudan uygulamak yerine, teknik bilgiyle yorumlayıp yeniden yapılandırdıkları bir yaklaşıma bağlıdır (Harmanbaşı, 2025; Yıldırım & Erol, 2025; Şekerci vd., 2025).

3.3. Teknik Performans ve Analitik Değerlendirmeler

İç mimarlıkta yapay zekâ, estetik görselleştirmenin ötesine geçerek planlama, modelleme ve sürdürülebilirlik analizlerinde teknik bir katman oluşturmakta; ancak "hız ve varyasyon üretimi" ile "mühendislik hassasiyeti" arasında bir gerilim yaratmaktadır (Ansari, 2025; Gong, 2023). Bu gerilim, yapay zekâ temelli araçların erken tasarım aşamalarında güçlü bir keşif ve alternatif üretme potansiyeli sunarken, ileri aşamalarda teknik doğruluk ve uygulanabilirlik açısından insan denetimine duyulan ihtiyacı artırdığını göstermektedir. Eğitimde Midjourney, AI-Architectures ve Prome-ai gibi araçların hibrit kullanımı, öğrencilerin enerji etkin karar verme eğilimini ve iterasyon hızını artırmaktadır (Ansari, 2025). Bu yaklaşım, iç mimarlık eğitiminde yapay zekânın pedagojik değerinin, öğrencinin mekânsal düşünme, problem çözme ve teknik karar alma becerilerini desteklediği ölçüde anlam kazandığını ortaya koymaktadır. Buna karşın, teknolojiye aşırı bağımlılığın temel mekânsal düşünme becerilerini zayıflatma riski ve veri yanlılığı gibi etik sorunlar, yapay zekânın "yaratıcıyı ikame eden" değil, kararları

hızlandıran "tamamlayıcı bir araç" olarak konumlandırılmasını zorunlu kılmaktadır (Ansari, 2025).

Teknik derinlik açısından yapay zekâ; röleve analizi, nesne geometrisinin yeniden inşası ve simülasyon doğruluğunun artırılmasında kritik bir rol üstlenmektedir (Gong, 2023). ArchiGAN gibi GAN tabanlı sistemler ise kat planı üretiminde kesin çözümler yerine tasarımcıyla müzakere eden olasılık senaryoları sunan bir "varyasyon motoru" gibi çalışmaktadır (Kurtuluş, 2025). Bu tür sistemler, tasarımcıyı belirli bir çözüme yönlendirmekten ziyade, olası mekânsal senaryolar arasında eleştirel bir değerlendirme yapmaya teşvik eden keşif odaklı bir tasarım ortamı oluşturmaktadır. Ancak yüksek hesaplama gücü gereksinimi, çıktıların CAD/BIM ortamına aktarımındaki teknik zorluklar ve çok katlı yapılardaki strüktürel süreklilik sorunları, mevcut sistemlerin teknik sınırlarını belirginleştirmektedir (Gong, 2023; Kurtuluş, 2025). Bu sınırlılıklar, yapay zekânın iç mimarlıkta kullanımını dışlayan engellerden ziyade, teknoloji–tasarım entegrasyonunun henüz olgunlaşma sürecinde olduğunu gösteren yapısal eşikler olarak değerlendirilebilir.

Sürdürülebilirlik ve sertifikasyon bağlamında ChatGPT ve Midjourney stratejik öneriler ve estetik potansiyeller sunmasına rağmen yüksek hassasiyetli teknik detaylarda uzman doğrulamasına ihtiyaç duyulmaktadır (Wijaya vd., 2025). Sonuç olarak yapay zekâ, iç mimarlıkta analiz kapasitesini genişleten güçlü bir "teknik ortak" potansiyeli taşımaktadır; fakat beceri erozyonu, etik kaygılar ve standartlara tam uyum zorunluluğu nedeniyle insan denetimi sistemin merkezinde kalmaya devam etmektedir (Ansari, 2025; Kurtuluş, 2025; Wijaya vd., 2025). Bu durum, iç mimarlıkta yapay zekâ kullanımının teknik kapasite artışı kadar, etik sorumluluk, mesleki yetkinlik ve tasarım bilgisinin korunmasıyla birlikte ele alınması gerektiğini ortaya koymaktadır.

3.4. Eğitimde Yapısal Değişimler ve Etik Boyutlar

İncelenen çalışmalar, yapay zekânın iç mimarlık eğitiminde tasarım pedagojisinin epistemolojik temellerini dönüştürdüğünü; geleneksel usta-çırak ilişkisinin yerini veri destekli ve analitik düşünmeyi teşvik eden hibrit modellere bıraktığını göstermektedir (Gao vd., 2025; Karadağ, 2025; Lescop & Mangasaryan, 2024; Jin vd., 2024; Liu vd., 2025). Bu değişim, iç mimarlık eğitiminde bilginin aktarımına dayalı öğretim anlayışından, bilginin tasarım süreci içerisinde üretildiği ve sorgulandığı bir öğrenme epistemolojisine geçişi ifade etmektedir. Bu süreçte yapay zekâ; öğrencilerin hesaplamalı düşünme, problemlere çözüm üretme ve sistematik karar verme becerilerini güçlendirerek tasarımı son ürün odaklı bir faaliyetten,

sürekli geri beslenen bir düşünme sürecine dönüştürmektedir (Albakry vd., 2025; Komatina vd., 2024). Ancak öğretim elemanlarının hazırlıksızlığı ve yapılandırılmamış kullanım stratejileri, öğrencilerin yüzeysel çıktılara yönelmesine ve kavramsal bütünlüğün zayıflamasına neden olabilmektedir (Elere vd., 2023; Karadağ, 2025; Jin vd., 2024). Bu durum, yapay zekâ destekli stüdyo ortamlarında öğretim elemanının rolünün bilgi aktarıcıdan çok, süreci yönlendiren, eleştirel düşünmeyi teşvik eden ve tasarım kararlarını yapılandıran bir rehbere dönüştüğünü göstermektedir.

Etik boyut, pedagojik dönüşümün en kritik eksenlerinden birini oluşturmaktadır. Araştırmalar, öğrencilerin yapay zekâyı erken tasarım evrelerinde etik açıdan kabul edilebilir bulurken, teknik geliştirme aşamalarında özgünlük ve tasarım sahipliği kaygılarıyla bu kabule mesafeli yaklaştıklarını göstermektedir (Ismail, 2024; Tien & Chen, 2024). Bu farklılaşan tutumlar, yapay zekâ kullanımının tasarım sürecindeki aşamasına bağlı olarak değişen etik algıların, eğitim ortamında açık biçimde tartışılması ve yapılandırılması gerektiğine işaret etmektedir. Veri gizliliği, algoritmik önyargı ve mesleki gelecek kaygıları, etik meseleleri bireysel tercihlerden öte pedagojik tasarımın ayrılmaz bir parçası hâline getirmektedir (Komatina vd., 2024; Samad vd., 2024). Bu bağlamda literatür, teknolojinin yasaklanması yerine şeffaflık, atıf ve insan denetimi ilkeleri çerçevesinde, yapay zekânın yönlendirilen bir "bilişsel ortak" olarak konumlandırılmasını önermektedir (Ismail, 2024; Karadağ, 2025). Bu yaklaşım, yapay zekâyı karar verici bir otorite yerine, insan düşüncesini genişleten ve eleştirel süzgeçten geçirilmesi gereken bir destek mekanizması olarak ele alan insan merkezli bir pedagojik anlayışı yansıtmaktadır.

İncelenen çalışmalar, yapay zekânın iç mimarlık eğitiminde köklü bir paradigma değişimini tetiklediğini ortaya koymaktadır. Bu dönüşümün sürdürülebilirliği; mesleki ve etik sınırların net çizildiği, insan merkezli değerleri önceleyen ve eleştirel düşünmeyi güçlendiren pedagojik modellerin geliştirilmesine bağlıdır (Lescop & Mangasaryan, 2024; Albakry vd., 2025). Bu çerçevede, yapay zekânın iç mimarlık eğitimine entegrasyonu, teknolojik olanakların benimsenmesinden ziyade, tasarım kültürünün, mesleki etik değerlerin ve insan merkezli yaklaşımın yeniden tanımlandığı bütüncül bir eğitim vizyonu gerektirmektedir.

3.5. Özelleşmiş Tasarım Uygulamaları

İncelenen çalışmalar, yapay zekânın mobilya tasarımı, biyomimikri ve çok duyulu mekân kurgusu gibi özelleşmiş alanlarda soyut kavramları somutlaştıran ve yaratıcı sorunları aşan işlevsel bir araç olduğunu kanıtlamaktadır (Buldaç, 2024; Şekerci vd., 2024). Bu bulgular,

yapay zekânın iç mimarlık eğitiminde yalnızca genel tasarım problemlerine değil, yüksek düzeyde uzmanlık, soyutlama ve çok katmanlı düşünme gerektiren alanlara da entegre edilebilir bir potansiyel sunduğunu göstermektedir. Buldaç (2024), biyomimikri temelli mobilya tasarımında Midjourney'nin organik ve karmaşık formları hızla üreterek çeşitliliği artırdığını; ancak bu çıktıların ergonomi ve strüktürel uygulanabilirlik açısından insan denetimine ihtiyacı olduğunu belirtmektedir. Bu süreçte istem oluşturma becerisi, tasarımın niteliğini belirleyen temel unsur olarak öne çıkmaktadır.

Çok duyulu mekân tasarımına odaklanan Şekerci vd. (2024) ise Google TextFX ve Midjourney'nin bütünleşmiş kullanımının; koku, ses ve doku gibi soyut duyusal katmanların bütüncül bir tasarım senaryosuna dönüştürülmesini kolaylaştırdığını vurgulamaktadır. Bu yaklaşım, iç mimarlık eğitiminde görsel merkezli temsil alışkanlıklarının ötesine geçilerek, duyusal deneyimin kavramsal bir tasarım girdisi olarak ele alınmasına imkân tanımaktadır. TextFX'in duyusal kavramları sözel istemlere dönüştürmedeki başarısına rağmen, bu verilerin atmosferik temsillere aktarılmasının yoğun deneme-yanılma ve zaman gerektirdiği ifade edilmektedir. Bu zaman alıcı süreç, pedagojik açıdan değerlendirildiğinde, öğrencilerin soyut duyusal kavramları mekânsal kararlara dönüştürme becerisini geliştiren deneyimsel bir öğrenme alanı olarak da okunabilir.

Bu çalışmalar, yapay zekânın iç mimarlık eğitiminde yalnızca genel stüdyo üretimlerini desteklemekle kalmayıp, farklı ölçek ve içeriklerde uyarlanabilir bir tasarım arayüzü işlevi gördüğünü kanıtlamaktadır (Buldaç, 2024; Şekerci vd., 2024). Bu bağlamda yapay zekâ, farklı ölçeklerde ve tematik derinliklerde çalışan stüdyo kurguları için esnek bir üretim ortamı sunarken, tasarım probleminin niteliğine göre yeniden yapılandırılabilen bir pedagojik araç hâline gelmektedir. Ancak yaratıcı ufku genişleten bu teknolojik desteğin nitelikli bir çıktıya dönüşmesi, insan tasarımcının teknik, ergonomik ve duyusal bağlamdaki eleştirel denetimine bağlı kalmaktadır.

SONUÇ

Bu çalışma, iç mimarlık eğitiminde yapay zekâ entegrasyonuna yönelik literatürü sistematik bir yaklaşımla inceleyerek, disiplinin dijital bir eşiğin tam merkezinde durduğunu doğrulamaktadır. Bulguların işaret ettiği temel eğilim, üretken yapay zekânın stüdyo pedagojisinde yalnızca yardımcı bir araç olmanın ötesine geçerek; tasarım düşüncesinin üretim ritmini, temsil mantığını ve karar alma süreçlerini yeniden düzenleyen dinamik bir öğrenme arayüzü hâline gelmesidir. Bu dönüşüm, özellikle erken tasarım evrelerinde hız, çeşitlilik ve

keşif kapasitesi üzerinden güçlü bir pedagojik kazanım potansiyeli sunarken; tasarımın nitelik kazanmasının ancak öğrencinin bu çıktıları eleştirel bir süzgeçten geçirmesi, dönüştürmesi ve teknik bilgiyle yapılandırmasıyla mümkün olduğu anlaşılmaktadır.

Literatürün bütüncül okuması, yapay zekâ entegrasyonunun en verimli biçiminin "ikame" değil "tamamlama" mantığıyla kurulabileceğini kanıtlamaktadır. Yapay zekâ, yaratıcı tıkanıklıkları aşmada önemli bir katalizör işlevi görse de teknik doğrulama, malzeme gerçekliği, ölçek ve ergonomi tutarlılığı gibi iç mimarlığın çekirdek yeterlikleriyle dengelenmediğinde, yüzeysel bir üretim ve teknolojik bağımlılık riski doğurmaktadır. Bu noktada, istem yazma pratiği, basit bir dijital beceri olmanın ötesinde, kavramsal niyetin dilsel ve analitik olarak kurulmasını gerektiren yeni bir temsil okuryazarlığı alanı olarak müfredatın bir parçası haline gelmelidir.

Çalışmanın öne çıkardığı bir diğer kritik sonuç, etik tartışmaların teknolojik entegrasyona eklemlenen ikincil bir unsur değil, pedagojik dönüşümün kurucu bir bileşeni olduğudur. Özgünlük, tasarım sahipliği ve veri önyargısı gibi başlıklar, eğitim ortamlarında çıktı odaklı performans ölçümü yerine; süreç odaklı izlenebilirlik ve beyan ilkelerini güçlendiren bir etik çerçeveyi zorunlu kılmaktadır. Öğrencinin yapay zekâyı hangi aşamada, hangi amaçla ve ne ölçüde kullandığını açıklayabildiği; ayrıca bu çıktıları hangi tasarım gerekçeleriyle dönüştürdüğünü ortaya koyabildiği bir stüdyo kurgusu hem akademik dürüstlüğü hem de mesleki yetkinlik gelişimini destekleyecektir.

Sonuç olarak, iç mimarlık eğitiminde yapay zekâ, insan merkezli tasarım değerlerini ve eleştirel düşünmeyi merkeze alan öğretim modelleriyle desteklendiğinde dönüştürücü bir öğrenme ortağına dönüşebilmektedir. Gelecek çalışmaların, iç mimarlığa özgü duyusal deneyim, malzeme davranışı ve uygulama gerçekliği gibi boyutları yapay zekâ destekli süreçlerle ölçen; öğrenci kazanımlarını ise yalnızca nihai ürün kalitesi üzerinden değil, karar gerekçesi ve süreç olgunluğu üzerinden değerlendiren araştırma tasarımlarına yönelmesi, alanın kuramsal derinliğini artıracaktır.

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GÖZ TAKİBİ TEKNOLOJİSİNİN DİSİPLİNLERARASI KULLANIMI ÜZERİNE BİBLİYOMETRİK BİR İNCELEME

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ÖZET

Endüstri 4.0 paradigması ile birlikte gelişen insan–makine etkileşimi odaklı dönüşüm, mimarlıktan sağlığa, ergonomiden bilişsel bilimlere kadar geniş bir yelpazede, kullanıcı odaklı ve veri temelli araştırma yaklaşımlarının yaygınlaşmasına olanak sağlamıştır. Bu bağlamda Göz Takibi (Eye-Tracking) teknolojisi, bireylerin görsel dikkat, algı, öğrenme ve karar verme süreçlerini doğrudan ve nesnel verilerle analiz edebilen güçlü bir yöntem olarak öne çıkmaktadır. Bu çalışma, kullanıcı deneyimi ile doğrudan ilişkili olan Göz Takibi teknolojisinin başta tasarım olmak üzere çeşitli uygulama alanlarında mevcut kullanım durumunun analiz edilmesi, sağladığı katkıların belirlenmesi ve gelişim potansiyelinin değerlendirilmesini inceleyen sistematik ve bibliyometrik bir analiz sunmaktadır. Göz Takibi, insan davranışına ilişkin soyut ve öznel kavramların ölçülebilir hale gelmesini mümkün kılması nedeniyle, kullanıcı etkileşiminin kritik olduğu farklı disiplinlerde giderek daha yaygın biçimde kullanılmaktadır. Bu kapsamda, Web of Science (WoS) veri tabanında belirlenen anahtar kelimeler aracılığıyla elde edilen 33 bilimsel makale bibliyometrik analiz yöntemiyle sistematik olarak incelenmiştir. Analizler, Bibliometrix ve VOSviewer yazılımları kullanılarak belirlenen zaman aralığındaki yayınlar üzerinden gerçekleştirilmiş; öne çıkan disiplinler, anahtar kelime örüntüleri ve araştırma odakları tablolaştırılarak değerlendirilmiştir. Elde edilen bulgular, Göz Takibi teknolojisinin yalnızca bir ölçüm aracı olmanın ötesinde, dikkat, biliş ve davranış süreçlerini anlama, göz hareketlerinden elde edilen verileri kullanarak disiplinler arası bir araştırma altyapısı olarak konumlandığını göstermektedir. Literatürde, Göz Takibi uygulamalarının farklı sektörlerde benzer veri üretme potansiyeline sahip olduğu; buna karşın araştırma soruları ve analiz yaklaşımlarının disipline özgü biçimde çeşitlendiği görülmektedir. Çalışma sonuçları, Göz Takibi teknolojisinin ortak veri setleri, yöntemsel standartlar ve çoklu veri entegrasyonları ile desteklenmesi durumunda, bilimsel ve uygulamalı araştırmalardaki etkisinin daha da güçleneceğini ortaya koymaktadır.

Anahtar Kelimeler: Göz Takibi, Bibliyometrik Analiz, Bilişsel Süreçler, Endüstri 4.0

A BIBLIOGRAPHIC ANALYSIS ON THE INTERDISCIPLINARY USE OF EYE TRACKING TECHNOLOGY

ABSTRACT

The transformation focused on human-machine interaction, which has developed alongside the Industry 4.0 paradigm, has enabled the proliferation of user-centred and data-driven research approaches across a wide range of fields, from architecture to health, ergonomics to cognitive sciences. In this context, Eye-Tracking technology stands out as a powerful method that can directly analyse individuals' visual attention, perception, learning, and decision-making processes with objective data. This study presents a systematic and bibliometric analysis examining the current state of use of Eye-Tracking technology, which is directly related to user experience, in various application areas, primarily design, determining its contributions and evaluating its development potential. Eye Tracking is increasingly used in different disciplines where user interaction is critical because it enables abstract and subjective concepts related to human behaviour to be made measurable. In this context, 33 scientific articles obtained through keywords identified in the Web of Science (WoS) database were systematically examined using bibliometric analysis methods. The analyses were conducted on publications within the specified time frame using Bibliometrix and VOSviewer software; prominent disciplines, keyword patterns, and research focuses were tabulated and evaluated. The findings reveal that Eye Tracking technology is positioned as an interdisciplinary research infrastructure that goes beyond being merely a measurement tool, enabling the understanding of attention, cognition, and behavioural processes using data obtained from eye movements. The literature shows that Eye Tracking applications have the potential to generate similar data across different sectors; however, research questions and analytical approaches vary depending on the discipline. The results of the study reveal that the impact of Eye Tracking technology in scientific and applied research will be further strengthened if it is supported by common data sets, methodological standards, and multi-data integration.

Keywords: Eye Tracking, Bibliometric Analysis, Cognitive Processes, Industry 4.0

1. GİRİŞ

Tarih öncesi dönemden itibaren insanoğlu ilerleme ve gelişme ideolojisiyle hareket etmiştir. Zamanın şartlarına uygun olarak her dönemde bilim ve teknolojide ilerlemeler meydana gelmiş olup ihtiyaçların artması da bunun doğal sonucu olmuştur. Bu kapsamda en büyük değişim Sanayi Devrimi ile başlamış; insanlık tarihinde büyük gelişmelere öncülük etmiş bir atılım

olmuştur [1]. 18. yüzyılda buharlı makinelerin icadı ile başlayan değişimler, kronolojik ve aşamalı bir gelişim süreci izlemekte olup günümüze kadar halen devam etmektedir. Buharlı makinelerin icadıyla Birinci Sanayi Devrimi olarak adlandırılan dönemde toplumun odağı tarımdan sanayiye doğru yönlenmiştir [39]. Bu süreci takiben 18. yüzyıl sonları ile 19. yüzyıl başlarında elektrik, elektronik ve mekaniz cihazların kullanılması ile birlikte İkinci Sanayi Devrimine geçilmiş olup ekonomi ve sanayi alanında büyük gelişmeler yaşanmıştır. Montaj, seri üretim hattı kullanılarak arz-talep dengesi kurulmaya çalışılmıştır[39]. Elektriğin kullanımı ile birlikte teknolojik gelişmelerin önünü açılmıştır. İnternetin kullanımıyla 20. yüzyılda Üçüncü Sanayi Devriminde bilgisayar ve otomasyon hayatın içerisinde kendine yer bulmuştur. Bu dönem makineleşmeden bilgisayara geçişe yönlendirdiği için 'Dijital Devrim' olarak adlandırılmaktadır[39]. Günümüzde 21. yüzyıl teknolojisi ile içerisinde bulunduğumuz dördüncü sanayi devrimi çağına girilmiştir.[1] Endüstri 4.0 2011 yılında Almanya'da Hannover Ticaret Fuarında kullanılan bir terim olarak karşımıza çıkmıştır. Üretim sektöründe küresel rekabet gücünü artırmayı amaçlayan vizyonla hareket ederek dijital dönüşüm dönemine geçilmiştir. Devrim niteliğinde olan bu dönüşüm siber-fiziksel sistemler ve ağ bağlantılı akıllı makineler üzerine kurulur [2].



Şekil 1 Endüstri Devrimleri ve Dönemleri [3]

Endüstri 4.0'ın ortaya çıkışında, toplumsal ve ekonomik değerlerle birlikte kişiye özel taleplerin karşılanması, esnek üretim ihtiyacı ve üretim verimliliğin artırılması, daha küçük alanlarda daha etkili sonuçlar ortaya çıkarma, karar alma mekanizmasını hızlandırma ve dijitalleşme etkili olmuştur[2]. Bu kapsamda Endüstri 4.0'ün getirdiği yenilikler; büyük veri (big data), AR (arttırılmış gerçeklik), IoT (nesnelerin interneti), RFID-RTLS gibi akıllı sensör teknolojileri, siber güvenlik, sanal gerçeklik, bulut bilişim, yapay zeka ve otonom robotlar olarak

sayılabilmektedir [3, 4]. Bu dijital dönüşümler, mimarlıktan sağlığa, ergonomiden bilişsel bilimlere kadar geniş bir yelpazede, kullanıcı odaklı ve veri temelli araştırma yaklaşımlarının yaygınlaşmasına olanak sağlamıştır. Bu bağlamda Göz Takibi (Eye-Tracking) teknolojisi, bireylerin görsel dikkat, algı, öğrenme ve karar verme süreçlerini, kişiye özgü kalibrasyonlarını doğrudan ve nesnel verilerle analiz edebilen, göz bebeği hareketlerinin belgeleme amacıyla kullanılan güçlü bir yöntem olarak öne çıkmaktadır.

Göz takibi nitel ve nicel araştırmalarda görsel uyarana verilen tepkileri ölçmede kullanılmaktadır.[8]. 1970'ler ve 1980'lerde tek bir yüzeye sabitlenmiş sistemler araştırmalarda kullanılırken son 10 yılda ise teknoloji destekli kullanımın artmasıyla bileşenlerin küçülmesi ve pil teknolojilerindeki gelişmeler sayesinde mobil göz izleme sistemleri yaygınlaşmıştır [8]. Taşınabilir özelliği ve kişisel verileri objektif ölçümlerle yüksek doğuluk payına ulaştırması araştırmacıların ilgisini çekmektedir.

Göz Takibi yöntemi psikolojiden eğitim bilimlerine, sağlıktan ergonomiye, pazarlamadan bilgisayar bilimlerine kadar sanatta, sporda, kültürde, tasarımda birçok alanda araştırma konusu olmuştur. Bu teknoloji yalnızca algısal sürecin değerlendirilmesiyle ilişkili olmayıp kullanıcı davranışlarının mekansal ve işlevsel faktörlerini, yön bulma, estetik algı, bakış farklılıklarını ve dikkat ölçmede göz hareketlerine verilerinin objektif değerlendirilmesine katkı sağlamaktadır. Mimarlıkta tasarım ve uygulama aşamasında kullanıcın mekanda neye odaklandığına, odaklanma süresine, mimarlar-mimar olmayanlar arasındaki bakış farklılıkların ölçülmesine olanak tanır [6] . Yapılan çalışmalarda amaca bağlı olarak, bağlamda oluşan uyarılma ölçümleri toplanarak duygusal, bilişsel ve davranışsal içgörüler elde dilen bulgular göz takibi verileriyle ilişkilendirilebilir[5]. Böylece mimarlık öğrencileri, mimarlar ve tasarımcılar, tasarım sürecinin farklı aşamalarında veri temelli kararlar alabilecek sağlam bir temel inşa etmiş olurlar. Mevcut yapılara yönelik araştırmalarda ise biyometrik veriler, kullanım sonrası değerlendirmelerde değerli bilgiler sunmakta olup gelecek tasarımlar için ışık tutucu nitelikte olmaktadır [5].

Göz Takibi, insan davranışına ilişkin soyut ve öznel kavramların ölçülebilir hale gelmesini mümkün kılması nedeniyle, kullanıcı etkileşiminin kritik olduğu farklı disiplinlerde giderek daha yaygın biçimde kullanılmaktadır. Ayrıca Göz takibi teknolojisi göz hareketi esaslı verilerle mekansal planlama, kentsel tasarım, arayüz geliştirme ve online temelli web tasarımı gibi konularda ürün tasarımını iyileştirmeye de odaklanmaktadır. Farklı alanlarda Göz takibi kullanımının getirdiği katkılar bu çalışmada incelenmiştir.

2. MATERYAL VE METOTLAR

Bu çalışma, kullanıcı deneyimi ile doğrudan ilişkili olan Göz Takibi teknolojisinin başta tasarım olmak üzere çeşitli uygulama alanlarında mevcut kullanım durumunun analiz edilmesi, sağladığı katkıların belirlenmesi ve gelişim potansiyelinin değerlendirilmesini inceleyen sistematik ve bibliyometrik bir analiz sunmaktadır. Bu kapsamda, Web of Science (WoS) veri tabanında belirlenen anahtar kelimeler aracılığıyla elde edilen 33 bilimsel makale bibliyometrik analiz yöntemiyle sistematik olarak incelenmiştir(Şekil2).Analizler, Bibliometrix ve VOSviewer yazılımları kullanılarak 2015-2025 yılları aralığındaki yayınlar üzerinden gerçekleştirilmiştir.

All Fields	A Topic	B Topic
('eye-tracker and gaze behaviour' OR 'eye movement')	'Eye-Tracking and design'	('Design' OR 'Environmental design' OR 'Spatial design' OR 'Design elements' OR 'Design features' OR 'Morphology' OR 'Aesthetic design' OR 'Visual design' OR 'Urban design' OR 'Design typology')

Şekil 2 Anahtar Kelime Dizgesi

3. BULGULAR VE TARTIŞMA

Bu çalışmada Göz takibi kullanımının farklı disiplinlerdeki kullanımına ilişkin analiz yapılmıştır. Disiplinlere ilişkin her alanın sorusu ve özellikleri farklı olduğundan her çalışma kendine özgü değerlendirilmiştir. Öne çıkan disiplinler, anahtar kelime örüntüleri ve araştırma odakları tablolaştırılarak değerlendirilmiştir.

Tablo 1. Mimarlık-Tasarım-İnşaat alanındaki çalışmaların göz takibi kullanımına yönelik analizi

	Makale Adı	Keywords /Focus	Göz takibi Kullanım Amacı	Method	Ref.
Mimarlık-Tasarım-İnşaat	Eye-Tracking Advancements in Architecture: A Review of Recent Studies	Eye-Tracking,architectural design evaluation	İnceleme**, tasarım değerlendirmesi, yol bulma ve mekansal navigasyon, son kullanıcı deneyimi ve mimarlık eğitimine odaklanmıştır.** ET, kullanıcıların nereye, ne kadar süreyle ve hangi sırayla odaklandığını, Tasarımcı sezgisini ve geleneksel anketleri nesnel verilerle desteklemektedir.	75 araştırmanın bulgularını sentezleyen literatür araştırması	[6]
	A Systematic Review of Research on Urban Streets and Parks Based on Eye Tracking	streets,parks, Eye-Tracking technology,	Kentsel sokaklar ve peyzajlarda kullanıcıların **görsel tercihlerini** belirlemek, Görsel öğeler karşısında verilen psikolojik ve görsel tepkileri ölçerek **mekânların onarıcı etkilerini** ortaya koymak	WoS temelli literatür taraması	[7]
	Emergence of Eye Tracking in architectural research: a review of studies 1976-2021	Eye-Tracking,architecture, neuroarchitecture	İnsanların mimariyi ve yapılı çevreyi nasıl algıladıklarını belirlemek	Google Scholar, Scopus ve Norveç Ulusal Kütüphanesi Oria veri tabanları üzerinden Yarı Sistematik Literatür Tarama	[8]
	Empirical Insights into Eye-Tracking for Design Evaluation: Applications in Visual Communication and New Media Design	Eye-Tracking technology; design evaluation; visual attention;	ET teknolojisi bakış kalıpları, görsel algı ve dikkat üzerine derin içgörüler sunarak tasarım stratejilerini anlamlı şekilde yönlendirebilmektedir.	Sistematik İncelemeler ve Meta-Analizler için Tercih Edilen Raporlama Öğeleri(PRISMA) çerçevesiyle birlikte yapılan literatür taraması	[9]
	A Systematic Review of Eye-Tracking Studies of Construction Safety	Eye-Tracking,construction safety,hazard,recognition	İnşaat işçilerinin tehlike algılama sırasında görsel dikkat dağılımını incelemek	Sistematik inceleme, mevcut literatürden ikincil verileri toplamak ve analiz etmek için tekrarlanabilir analitik yöntemler uygulayan bir inceleme türünü	[11]

Göz Takibi teknolojisi kullanıcıların bulundukları ortamda nereye, ne kadar süre odaklandığını ve bakış sırasını objektif verilerle sunarak dikkat ve algı süreçlerine ilişkin analizler yapılmasını mümkün kılmaktadır. Literatür taraması sonucu Tablo 1'de yer alan mimarlık-tasarım-inşaat kategorisinde yer alan makaleler incelendiğinde; mimarlık ve mekansal tasarım, sokak ve kentsel tasarım, davranış bilimleri ve medya tasarımı ile inşaat güvenliğinde bağlamı oluşturan tasarım ögelerinin görsel dikkate etkisinde ve yönlendirme sürecinde kritik önem taşıdığı görülmektedir. Bu teknoloji ile ortaya çıkan veriler, tasarım bileşenleri arasında görsel algıya etki eden unsurlara dair öncelik sıralaması yapılmasına ve kullanıcının psikolojik konforuna bağlı olarak görsel tercihlerini ve risk unsurlarını belirlemede kullanılabilecektir. Ayrıca disiplinlere özgü ortaya çıkan ürünlerde tasarımın iletmeyi hedeflediği anlamın; zihinsel karşılığı, kullanıcı deneyiminin değerlendirilmesi ve psikolojik iyileştiriciliğine ilişkin iç görü sunmaktadır. Bulgular sosyal etkileşimde bireylerin mekanda kalma, eylemlerin sürdürülebilir olması ile birlikte performans ve risk yönetimine ilişkin davranışsal sonuçlara dönüştüğünü göstermektedir.

Tablo 2. Eğitim-Öğrenme alanındaki çalışmaların göz takibi kullanımına yönelik analizi

	Makale Adı	Keywords	Göz takibi Kullanım Amacı	Method	Ref.
Eğitim-Öğrenme	Assessing Cognitive Load Using EEG and Eye-Tracking in 3-D Learning Environments: A Systematic Review	3-D learning, EEG, Eye-Tracking;	3D öğrenme ortamlarında bilişsel yükü ölçmek için EEG ve göz-takibi yöntemlerinin nasıl kullanıldığını incelemek.	Sistematik tarama; 2009–2025 arası 51 çalışmanın analizi; EEG + ET karşılaştırmaları.	[12]
	Eye Tracking Technology in Mathematics Education Research: A Literature Review	eye tracking,mathematics education,visual attention	Matematik eğitiminde ET'nin nasıl kullanıldığını incelemek, ET kullanımının araştırmacılar için getirdiği kısıtlılıkları belirlemek, Geri bildirim alarak nesnel sonuçlara ulaşmak	Deneysel ET çalışmalarının kapsam taraması.	[13]
	Eye-Tracking Research on Teachers' Professional Vision: A Scoping Review	Education,Gaze behaviour,Visual attention,	Öğretmenlerin mesleki görgüsünü (sınıfta neleri fark ettiklerini ve nasıl yorumladıklarını) ET yöntemiyle değerlendirmek	2014-2022 yılları arasında yayınlanmış çalışmalardan elde edilen bulguları inceleyen kapsam taraması	[14]
	Investigating Visual Perception in Teaching and Learning with Advanced Eye-Tracking Methodologies: Rewards and Challenges of an Innovative Research Paradigm	Professional vision, Eye-Tracking,Teacher expertise	Öğretim ve öğrenme süreçlerinde gelişmiş göz izleme metodolojilerinin kullanılmasını, getirdiği fırsatlar ve zorluklarla değerlendirmektedir.	Literatür Taraması	[15]
	A review of eye tracking research on video-based learning	Instructional video,Video-based learning, Eye tracking, Multimedia learning,	ET öğrencilerin eğitim videolarını izlerken sergiledikleri görsel dikkat süreçlerini video izlerken hangi öğelere odaklandığını ve dikkatlerinin ne zaman dağıldığını incelemektedir.	Verileri özetlemek, analiz etmek ve açıklamak için anlatı sentezi yaklaşımını benimsemiştir.	[16]
	Eye tracking and artificial intelligence for competency assessment in engineering education: a review	eyetracking, artificial intelligence, engineering education	Yapay zekâ (AI) ve göz izleme (ET) teknolojilerinin birlikte kullanılarak mühendislik eğitimindeki değerlendirme süreçlerini nasıl geliştirebileceğini incelemek, Öğrenci davranışları ve eğitmen değerlendirmesine yeni bakış açıları kazandırmaktır.	Web of Science, IEEE Xplore, EBSCOhost ve Google Scholar veri tabanların Literatür Taraması ve AI–ET içeren uygulamalarla analiz	[17]

Tablo 2'de yer alan incelemede; öğrenme, öğretim ve performans tabanlı ortamlarda uyaranların bireylerin dikkat dağılımında etkisi olduğu görülmüştür. Göz takip teknolojisiyle görsel ve mekânsal uyaranların dikkati nasıl yönlendirdiğine, öğrencilerin ders esnasında nereye, ne kadar süre odaklandığına ilişkin nicel veriler elde edilmektedir. Fiziki ortamlardan 3D öğrenme ortamlarına kadar öğrencilerin ve öğretmenlerin algı ve bakış süresi, uzman-uzman olmayan eğiticiler arasında bakış farklılıkları ölçülebilmektedir. Görsel dikkatin; öğrenmeye etkisi, ders anlatımı ve mesleki yeterlilik süreçlerindeki rolü incelendiğinde bilgi edinme, bilgiyi akılda tutma, problem çözme, planlama ve bilişsel aktivitelerin değerlendirilmesi gibi süreçler hakkında bulgular ortaya koymaktadır. İncelenen makalelerde, göz takibi ile elde edilen verilerin her zaman bilinçli olarak ifade edilemeyeceği duygusal süreçlerle birlikte ele alınması gerektiği vurgulanmaktadır. Algı ve biliş süreçlerinin öğrenme performansı,

öğretmenlerin ders verme eylemi ve sınıf içi uygulamalara nasıl dönüştüğü araştırma konusu olmaktadır.

Tablo 3. Psikoloji – Davranış – Sosyal Biliş alanındaki çalışmaların göz takibi kullanımına yönelik analizi

	Makale Adı	Keywords	Göz takibi Kullanım Amacı	Method	Ref.
Psikoloji – Davranış – Sosyal Biliş	The Use of Eye Gaze Data and Personality Traits: A Scoping Review	eye,personality,review,tracking,trait	İş görüşmeleri, eğitim ve öğretim, insan-robot etkileşimi ve kullanıcı arayüzü tasarımı da dahil olmak üzere çeşitli alanlarda kişilik araştırmalarında göz hareket takibinin kullanımını incelemektedir.	Sistematik İncelemeler ve Meta-Analiz için Tercih Edilen Raporlama Öğeleri (PRISMA)	[25]
	Historical descriptions of nystagmus and abnormal involuntary eye movements in various ancient cultures	antiquity; historical observations;	Antik dönem metinlerinde istem dışı göz hareketlerine ilişkin tarihsel tanımları incelemek.	Antik metinlerin uzman çevirileri; tarihsel analiz.	[10]
	Interpersonal Eye-Tracking Reveals the Dynamics of Interacting Minds	ET,social attention,social interaction,naturalistic experimental design	ET yöntemiyle kişiler arasındaki etkileşim sırasında göz hareketlerini eşzamanlı olarak takip ederek, zihinlerin dinamiklerini incelemektedir.	Deneysel sosyal ET çalışmaları analizi.	[26]
	A review of experimental task design in psychophysical eye tracking research	ET,visual psychophysics,preferential looking	Yüksek düzeyli algısal süreçlerin incelenmesinde göz izleme yönteminin nasıl optimize edilebileceğini tartışmaktadır.	Kategorik sınıflandırma	[27]
	You Like It and We Can See It: Spatial and Temporal Rules to Explain the Sense of Liking	Painting,Gaze tracking,Biological system modeling,Feature extraction,Brain modeling,	ET ve pupillometri verilerinden çıkarılan özelliklerin, makine öğrenimi modelleri aracılığıyla bir tablonun kişinin öznel beğenisini tahmin etmekte kullanılabileceğini göstermektir	175 katılımcıdan toplam 3438 deneme boyunca resimlere bakarken oluşan göz hareketleri ve göz bebeği tepkileri kaydedilerek deneysel çalışma yapılmıştır	[21]
	Review of Studies on User Research Based on EEG and Eye Tracking	EEG, Eye-Tracking,user research,research method	Kullanıcı araştırmalarında kullanıcıların nesnel davranışlarının ardındaki derin bilişsel durumları keşfetmek amacıyla EEG ve göz izlemenin birlikte kullanımına ilişkin çalışmaların analizini yapmaktır.	Web of Science (WoS) ve China National Knowledge Infrastructure (CNKI) veri tabanlarında yapılan taramaları içeren PRISMA 2020 akış şeması kullanılmıştır.	[28]

Tablo 3'de Psikoloji, Sosyal Biliş ve Davranış kategorilerinde incelenen makaleler, göz hareketleri ölçümleri aracılığıyla bireylerin sosyal ve doğal ortamlarda bakış yönü, fiksasyon süreleri, gözbebeği hareketleri, göz kırpma gibi çoklu okülomotor göstergeler aracılığıyla görsel dikkatin izlenebilirliğini ortaya koymaktadır. Göz takibi yöntemi, dikkat ile uyaran arasındaki ilişkinin incelenmesi, estetik değerlerin yorumlanması, insan-bilgisayar etkileşimi, sosyal ilişkilerde dikkatin nasıl koordine edilmesi ve farklı ortamlarda bakış davranışlara ilişkin nesnel veriler sunmaktadır. Kişilik özellikleri, bilişsel eğilimler ve psikolojik durumların EEG sinyalleri üzerinden dolaylı olarak anlaşılması; göz hareketlerinin algılama, ayrım ve tespit performansı ile ilişkilendirilmesini, algı ve karar verme süreçlerinin değerlendirilmesi, kafa karışıklığı, merak gibi bilişsel durumların sosyal bağ kurma,kullanıcı ve kullanıcı arayüzleri ve

pazarlama, reklamcılık gibi uygulama alanlarında kullanılması davranışsal süreçte ortaya çıkan sonuçları olmaktadır. Bu bağlamda algı ve karar süreçlerinin; kişisel beğenilerin değerlendirilmesi, psikolojik değişkenlerle eşlenmesi kapsamlı bir araştırma konusu olmaktadır.

Tablo 4. Ulaşım-Sürüş alanındaki çalışmaların göz takibi kullanımına yönelik analizi

	Makale Adı	Keywords	Göz takibi Kullanım Amacı	Method	Ref.
Ulaşım-Sürüş	The Mind-Wandering Phenomenon While Driving: A Systematic Review	mind wandering; driving; safety	Dalgınlığın sürüş performasındaki etkilerini incelemek Sürücünün zihninin başka yerlere kaydığı anları tespit etmek	ProQuest ve Scopus veritabanlı bulguları PRISMA çerçevesinde meta-analiz incelemesi	[18]
	Eye Tracking Measures of Bicyclists' Behavior and Perception: A Systematic Review	Eye-Tracking,Cycling experiments,Gaze metric	ET yöntemiyle bisiklet süren bireylerin sürüş esnasında nereye baktığını, çevresel uyarılara nasıl tepki verdiğini ve potansiyel tehlikelere karşı görsel farkındalık düzeyini objektif olarak ölçmek	Sistematik derleme	[19]
	Situational Awareness Assessment of Drivers Boosted by Eye-Tracking Metrics: A Literature Review	situational awareness,eye tracking, gaze behavior, simulation-based experiments	ET sürüş esnasındaki dikkat düzeyine dair anlık göstergeler sunarak göz hareketlerinin analizinin sürüş sırasında durumsal farkındalığı ortaya koymaktır.	Sistematik ve tanımlayıcı bir analiz İnceleme üç aşamadan oluşur: tanımlama, tarama ve kayıtların dahil edilmesi.	[20]

Tablo 4'de Ulaşım-sürüş alanında incelenen makalelerde, uyaranların görsel dikkat üzerinde etkisi, sürücülerin dikkatinin ne zaman ve nasıl dağıldığı bakış ölçümü analizi ile ele alınmıştır. Sürüş ortamlarında sürücülerin görsel uyaranlara karşı gösterdiği bakış davranışı objektif ve subjektif yöntemlerin birlikte kullanılması, bağlamsal tetikleyiciler ve durumsal farkındalığı ortaya koymaktadır. Bu da riskli durumlarda sürüş davranışı, stres altındaki sürüş performansı ve sürüş destek sistemleriyle ilişkisinde daha güvenli davranışların teşvik edilmesini ve zihin dağılmasının anlık tespiti sonucu kaza risklerini düşürmeye yardımcı olmaktadır.

Tablo 5. Radyoloji-Nörofizyoloji-Rehabilitasyon alanındaki çalışmaların göz takibi kullanımına yönelik analizi

	Makale Adı	Keywords	Göz takibi Kullanım Amacı	Method	Ref.
Radyoloji-Nörofizyoloji-Rehabilitasyon	How visual search relates to visual diagnostic performance: a narrative systematic review of Eye-Tracking research in radiology	Eye tracking,Image interpretation,Medical education Radiology	Göz izleme araştırmalarının radyolojide görsel arama stratejileri ile tanı başarısı arasındaki ilişkisini incelemek	1994–2015 arasında yayımlanan göz izleme çalışmalarını içeren 22 makale sistematik olarak taranmış, kalite değerlendirmesi yapılmış ve tematik analiz uygulanmıştır.	[22]
	Virtual Reality and Eye-Tracking Assessment, and Treatment of Unilateral Spatial Neglect: Systematic Review and Future Prospects	Eye-Tracking,unilateral spatial neglect,virtual reality	İnme sonrası ortaya çıkan tek taraflı ihmal sendromunun değerlendirilmesi ve rehabilitasyonunda sanal gerçeklik (VR) ve göz izleme entegrasyonunu incelemek	Sistematik İncelemeler ve Meta-Analiz için Tercih Edilen Raporlama Öğeleri (PRISMA)	[23]
	Vision Toolkit Part 1: Neurophysiological Foundations and Experimental Directions	Eye-Tracking,experimental settings, control	Görsel sistemin nörofizyolojik temellerini ve araştırma yönelimlerini açıklamak.	Derleme makalesi; nörofizyolojik veri sentezi	[24]

Radyoloji-Nörofizyoloji-Rehabilitasyon alanında çalışılan makalelerde; uzmanlık düzeyi, klinik durum, doğal ve laboratuvar ortamlarda fiksasyon sayısı, süresi ve sakkad özellikleri üzerinden dikkat örüntülerinin dağılımı incelenmiştir. Klinik ortamlarda mekânsal dikkat ölçümleri VR ve ET entegrasyonuyla hastaya özgü gerçekleştirilmiştir. Göz hareketleri davranışlarının bilgi ve deneyimlerle yönlendirilmesi nörofizyolojik temelli göz hareketlerinin vücut hareketleriyle etkileşimi değerlendirilmiş olup uzman-acemi arasında hipotezlerin ortaya çıkma süresinde, bireylerin semptonlara özgü tedavisinde sağladığı fayda ele alınmıştır. Elde edilen veriler Tanısal performans iyileştirmesi, doğal ortamlarda görev odaklı görsel davranışın kaydedilmesinde,görsel araştırma koşullarının uzman ve acemi peformansına yansımasında yeni çalışma alanlarının oluşturulmasında katkı sağlamıştır.

Tablo 6. HCI – Kullanılabilirlik – Arayüz Tasarımı – Bilgisayar Bilimleri alanındaki çalışmaların göz takibi kullanımına yönelik analizi

	Makale Adı	Keywords	Göz takibi Kullanım Amacı	Method	Ref.
Hcı – Kullanılabilirlik – Arayüz Tasarımı – Bilgisayar Bilimleri	Online Performance and Interface Design Implications Among Older Adults	Online performance,Older adults,Eye tracking, Interface design	Yaşlı bireyler çevrimiçi ortamlardaki performansını ve arayüzlerle etkileşimini inceleyen göz izleme çalışmalarını bir araya getirmek.	ET + davranış ölçümleri ile deneysel çalışma.	[29]
	Advanced Sensory Hardware for Intelligent Eye-Machine Interfacing	eye-machine interfacing, Eye-Tracking,human-machine interaction,	Göz hareketlerini kullanarak makinelerle etkileşimi geniş bir yelpazede ele almaktadır	Donanım incelemesi ve teknoloji karşılaştırması.	[30]
	Bi-Directional Gaze-Based Communication: A Review	gaze interaction,machine learning,eye tracking	İnsan–makine iletişiminde iki yönlü bakış etkileşimini incelemek. Kullanıcı bakışındaki niyeti ölçmek ve geri bildirim almak, Göz izleme verilerin sisteme işlenmesi ve sistemden geri dönüş alınma sürecini incelemektedir.	Derleme makalesi	[31]
	Eye Tracking, Usability, and User Experience: A Systematic Review	Eye tracking,UX,machine learning,usability	Kullanıcı deneyimi, göz takibi ve makine öğrenimi arasındaki ilişkinin değerlendirilmesinde ve iyileştirilmesini incelemektir.	144 çalışmadan 90'ı sistematik incelemeye dahil edilerek tematik analiz yapılmıştır.	[32]
	The Use of Eye-Trackingin Information Systems Research: A Literature Review of the Last Decade	Eyetracking,NeuroIS, Information Systems,	Son on yılda bilgi sistemleri alanında göz izleme kullanımını irdelemek, Geçmiş araştırmaların göz izlemeyi gelecek araştırmalara nasıl aktardığını incelemektedir.	2008 sonrası IS alanında yayımlanan 113 ampirik Göz takibi çalışması sistematik biçimde incelenmiş ve yöntem ile deney tasarımları karşılaştırılmıştır.	[33]
	Eye-Tracking Studies of Web Search Engines: A Systematic Literature Review	Eye-Tracking,search engines,literature review	Web arama motorlarında Göz takibi kullanımını analiz etmek ve bu alandaki metodolojik eğilimleri ile araştırma boşluklarını ortaya koymak.	2004–2019 yılları arasında yayımlanan 56 ampirik Göz takibi araştırması içerik analizine tabi tutularak 12 öğeli bir kodlama matrisi geliştirilmiştir.	[34]

Tablo 6'da yer alan çalışmalarla yapılan incelemeler; kullanıcı ara yüzleri, yapay zeka sistemleri ve görsel uyanların görsel dikkati nasıl yönlendirdiğini ve dağıttığını kapsamaktadır. Göz izleme ölçümleri tabanlı veriler bakış yönelimi, fiksasyonlar ve görsel inceleme süreçlerine dair incelemelerde kullanılmaktadır. Görsel bileşinlerin oluşturulması, değerlendirilmesi, sezgisellik ve göz izleme verilerinin makine etkileşimi ile entegrasyonu dikkat süreçlerin anlamlandırılarak davranışsal süreçlere altlık oluşturmuştur. Kullanıcıların ara yüzleri kullanarak yaptıkları arama, inceleme, tıklama etkileşimi verimliliği gibi kullanıcı deneyimi verileri; performans, memnuniyet, güven ve kullanılabilirlik gibi ölçülebilir sonuçlarla ilişkilendirilebilir. Bu da kullanıcı davranışına dayalı tasarımların oluşturulmasında ışık tutucu nitelikte olduğu fakat mevcut çalışmaların sınırlılıklarını ve geliştirilmesi gereken yönlerinin belirlemesinde araştırma boşluğu olduğu değerlendirilmiştir.

Tablo 7. Vr / Xr – Görsel Algı – Teknoloji/ Pazarlama – Tüketici Davranışı/ Dil Bilimi alanındaki çalışmaların göz takibi kullanımına yönelik analizi

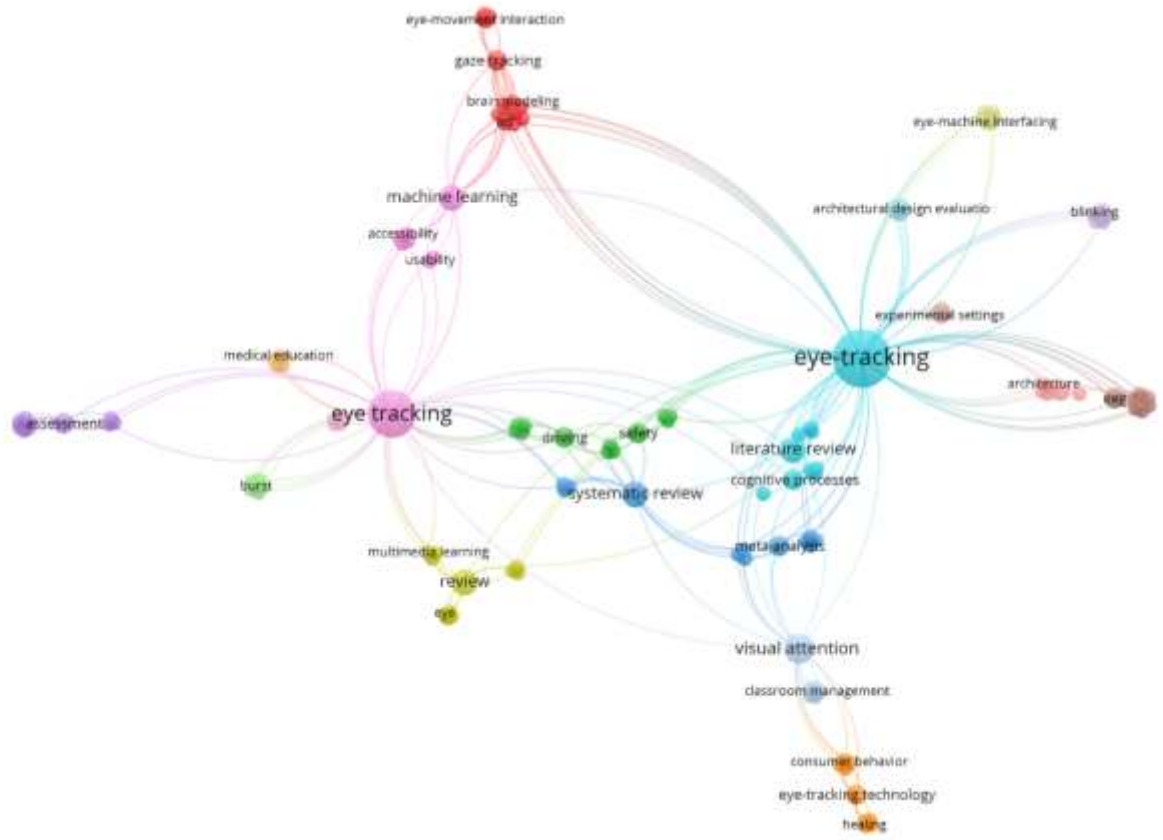
	Makale Adı	Keywords	Göz takibi Kullanım Amacı	Method	Ref.
Dil Bilimi	Phonological Prediction During Comprehension: A Review and Meta-Analysis	Phonological prediction,Meta-analysis, Visual world paradigm,	Katılımcıların konuşulan bir sözcüğü dinlerken göz hareketlerini takip ederek, zihnin yaklaşan sözcükleri önceden tahmin edip etmediği değerlendirilmektedir.	Meta-analiz + literatür taraması.	[35]
	Exploring the Frontiers of Eye Tracking Research in Language Studies	Burst,CiteSpace,cluster ,eye tracking	Dil alanında göz izleme araştırmalarının tarihsel gelişimini ve disiplinler arası etkisini büyük ölçekli bir perspektifle ortaya koymak	341 yayın + CiteSpace kümelenmesi.	[36]
Pazarlama – Tüketici Davranışı	A Systematic Review and Meta-Analysis of Eye-Tracking Studies for Consumers' Visual Attention in Online Shopping	Neuromarketing, Eye-Tracking, visual attention, consumer preference, online shopping,	İnternetteki ürün sayfaları ve e-ticaret arayüz tasarımına ilişkin dört yaygın faktör etrafında tüketicilerin görsel dikkat örüntülerini değerlendirmektedir.	Sistematik derleme ve meta-analiz	[37]
Vr / Xr – Görsel Algı – Teknoloji	A Review on Personal Calibration Issues for Video-Oculographic-Based ET Systems	personal calibration,video-oculographic,gazetracking	Video tabanlı ET sistemlerinde kişiye özgü kalibrasyon süreçlerinde kapsamlı bir genel bakış sağlamak, göz hareketleri temelli kullanıma teşvik etmektir	Derleme	[38]

Tablo 7'de yer alan çalışmalarla yapılan incelemeler; dikkat odağının zaman içerisindeki dağılımını sabitleme süresi, sabitleme sayısı ve ilk sabitlemeye kadar geçen sürenin odak değişimine etkisini, kişisel kalibrasyonların bakış hali, göz kırpma, sakkad gibi okülomotor olaylar sırasında toplanan görsel dikkat verileri üzerinden ele alınmasını kapsamaktadır. Dikkat unsurları uyuran türüne, tasarım unsurlarına ve araştırma bağlamanına göre farklılık göstermektedir. Kişisel kalibrasyonların bu farklılıklara entegre olması ile birlikte meydana gelen bilişsel kararların; günlük dil kullanımı, çevrimiçi alışveriş, kullanıcı etkileşimi, araştırma

üretimi ve endüstriyel uygulamalara akademik yönelimler ve doğal etkileşimi destekleyen sistem davranışlarına kaynaklık etmektedir.

İncelenen çalışmalar bakış davranışı analizi ve göz takibi üzerine literatüre değerli katkılar sunmaktadır. Göz takibi incelemesine ilişkin çalışmalar; kullanıcıların görsel tercihlerine, hem dijital hem de fiziksel ortamlarda kurulan etkileşimin nasıl algılandığına, mekansal ve kentsel planlamada kullanıcıların odak noktasını yönlendiren unsurların belirlenmesinde ve tasarımda dikkat edilmesi hususların açığa çıkarılmasına, bireyin ihtiyaçlarına uyumlu çözümlerin önerilmesine, ortak anlayışlı, işbirlikçi düşünceyi ve sosyal bağlantıyı destekleyen karşılıklı bilişsel süreçlere dair büyük referans değeri taşımaktadır.

Çalışmanın daha sonraki aşaması olan anahtar kelime oluşum analizi VOSviewer programı aracılığıyla, anahtar kelime kümeleri oluşturarak alanın gelişimine dair veriler elde etmemize olanak sağlamaktadır (Şekil3). Oluşturulan görsel harita, renklere göre incelendiğinde yoğunlaşan ana temalar ile birlikte Göz takibi alanının hangi alt temalar etrafında geliştiğini ortaya koymaktadır.



Şekil 4 Keywords küme oluşumu (co-occurrence analiz) (VOSviewer)

VOSviewer anahtar kelime ortak görülme analizi, göz izleme (Göz takibi) araştırmalarının literatürde beş tematik küme etrafında yoğunlaştığını göstermektedir. Haritadam mavi küme en yoğun ve merkezi küme olarak belirlenmekte olup 'systematic review', 'literature review', 'meta-analysis', 'cognitive processes' ve 'experimental settings' gibi kavramları içermektedir. Göz izlemenin deney tasarımı, bilişsel süreçlerin ölçümü ve değerlendirme yaklaşımlarının sistematik biçimde ele alındığı çalışmaların yoğunlaştığını göstermektedir.

Mor küme; 'medical education', 'assessment',' usability' ve 'accessibility' gibi kelimelerle göz izlemenin eğitim eğitim, öğrenme ve öğretme analizi gibi alanlarda etkili olduğunu göstermektedir.Haritada yer alan yeşil küme; 'driving', 'safety' gibi sözcüklerle temsil edilen sürüş, güvenlik araştırmalarında göz izlemenin trafik güvenliğini değerlendirmede kritik bir araç olduğunu göstermektedir. Kırmızı küme ise 'brain modeling' 'AI' anahtar kelimleri son yıllarda hızla gelişen yapay zekâ ve hesaplamalı modelleme tabanlı araştırmalarda göz izleme verilerinin makine öğrenmesiyle etkileşimde olduğuna işaret etmektedir. Ayrıca haritada mimarlık ve tasarım araştırmalarını temsil eden alanlarda mevcut olup bu alanda çalışmalara da yoğunlaşılması gerekmektedir. Genel olarak disiplinler arası literatür boşlukları belirleyerek daha sonra yapılacak çalışmalar için önemli bir araştırma potansiyeli sunmaktadır.

4.SONUÇLAR

Göz takibi; farklı disiplinlerde hızla genişleyen bir uygulama alanına sahip olup, kullanıcı davranışını doğrudan ölçebilme kapasitesi sayesinde araştırmalara büyük oranda doğruluk payı ve nesnellik kazandırmaktadır. Göz hareketlerini kaydetme teknolojilerinin giderek daha erişilebilir hale gelmesi, taşınabilir özellikleri sayesinde kullanım kolaylığı sağlaması çeşitli araştırma alanlarına entegre olmalarına katkı sağlamaktadır. Bununla birlikte, her alanın belirlediği hedef ve kullanım amacı, farklılık gösterdiği için metodolojiler ve bulgular genellikle alana özgü olmaktadır. Disiplinlerarası ortak çalışma alanlarının oluşturulamaması literatür boşluğu olarak değerlendirilmektedir.

Görsel veya işitsel uyaranlara bağlı olarak bireylerin nereye, ne kadar süre baktığı, neye odaklandığı, bakış sırasının ölçülmesine olanak veren süreçler; doğal ve kontrollü ortamlarda, bireysel farklılıklara, kullanım amacına, tasarım özelliklerine ve bağlamsal faktörlere bağlı olarak ilerlemektedir. Algısal verilerin yorumlanması, değerlendirilmesi, anlamlandırılması; bilişsel yük, uzman-acemi düzeyinin ölçülmesi, bağlamda ortaya çıkan algı süreçlerinin psikolojik iyileştiriciliği diğer bir süreç olarak ele alınmalıdır. Dikkat ve bilişsel süreçlerin

gözlemlenebilir davranışlara, etkileşim örüntülerine bağlı olarak otomasyon, ölçeklenebilirlik davranış süreçlere dönüşümünde etkili olmaktadır. Bulgular göz takip teknolojisinin görsel dikkat ölçümü ile sınırlandırılamadığını, algısal, bilişsel ve davranışsal düzeyleri birbirine bağlayan süreklilik içerisinde ele alınan çok katmanlı bir süreç yapısını ortaya koymaktadır.

Sonuç olarak göz takibi teknolojisinin ; sokakta yürüyen herhangi bir insanın bağlamla kurduğu ilişkiyi, sınıf ortamında ders dinleyen öğrencinin dikkatinin nereye yönelttiğini ve uzman-uzman olmayan öğretmenler arasındaki mesleki bakış farklılıkları değerlendirme, sürüş esnasında sürücülerin dikkatini dağıtan unsurları belirleyerek trafik kazalarını yüksek oranda engelleme, hastalıkların tedavisinde erken tanı, kişiler arası etkileşimde zihinden geçen düşüncelere odaklanma, konuşma esnasında kullanılan kelimelerin önceden tahmini yapma, online işlemler ve arama motorlarında kullanıcı odaklarını ölçme ve arayüz geliştirme gibi çok farklı alanlarda algısal, bilişsel ve davranışsal süreçler bütünü içerisinde kullanımı mümkün olmaktadır.

Çalışmalardan elde edilen verilerin birbiri ile ilişki içerisinde olan disiplinlerarası kullanımında güçlü bir altyapı oluşturması beklenmektedir. Yöntemsel yaklaşımlar mekansal algı, cephe okunabilirliği, tasarımda kullanıcı odaklı nesnel verilere yönelme ve karar verme süreçlerini hızlandırma açısından mimariye yeni perspektifler kazandırmaktadır. Ayrıca Göz Takibi teknolojisinin ortak veri setleri, yöntemsel standartlar ve çoklu veri entegrasyonları ile desteklenmesi durumunda, bilimsel ve uygulamalı araştırmalardaki etkisinin daha da güçleneceğini ortaya koymaktadır.

KAYNAKÇA

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HAVA KALİTESİ VE METEOROLOJİK VERİLERLE SAATLİK $PM_{2.5}$ TAHMİNİ: DERİN ÖĞRENME YAKLAŞIMI

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ÖZET

Hava kalitesinin düşmesi, özellikle ince partikül madde ($PM_{2.5}$) üzerinden insan sağlığı üzerinde ciddi fiziksel ve zihinsel olumsuz etkilere yol açmaktadır. $PM_{2.5}$ kirliliği; kardiyovasküler ve solunum sistemi hastalıkları ile güçlü bir şekilde ilişkilendirilmiş olup, yoğun nüfuslu kentsel alanlarda hava kalitesinin etkin biçimde yönetilmesini zorunlu kılmaktadır. Bu bağlamda, $PM_{2.5}$ gibi kritik kirleticilerin kısa vadeli tahminini sağlayan güvenilir modeller, karar vericiler için önemli bir araçtır. Bu çalışmada, kentsel bir bölgede saatlik $PM_{2.5}$ konsantrasyonlarının tahmini amacıyla üç farklı derin öğrenme mimarisi geliştirilmiştir: Konvolüsyonel Sinir Ağı (CNN), Uzun Kısa Süreli Bellek (LSTM) ağı ve hibrit CNN–LSTM modeli. Modeller, hava kalitesi verilerindeki zamansal bağımlılıkları yakalayabilmek amacıyla zaman penceresi (time-windowing) yaklaşımı kullanılarak oluşturulmuştur. Model girdileri, uzun dönemli ölçümlerden elde edilen hava kalitesi parametreleri ile meteorolojik değişkenlerden oluşmaktadır. Model performansları, belirleme katsayısı (R^2) ve hata temelli istatistiksel ölçütler kullanılarak değerlendirilmiştir. Elde edilen sonuçlar, tüm modellerin $PM_{2.5}$ konsantrasyonları ile giriş değişkenleri arasındaki doğrusal olmayan ilişkileri başarılı bir şekilde öğrenebildiğini göstermektedir. Modeller arasında hibrit CNN–LSTM mimarisi en yüksek tahmin başarısını sergileyerek, hem kısa süreli örüntüleri hem de uzun dönemli zamansal bağımlılıkları etkin biçimde yakalayabildiğini ortaya koymuştur. LSTM modeli de yüksek performans gösterirken, yalnızca CNN kullanılan model görece daha düşük doğruluk değerleri üretmiştir. Sonuç olarak, derin öğrenme tabanlı yaklaşımlar, özellikle hibrit modeller, karmaşık kentsel ortamlarda $PM_{2.5}$'nin kısa vadeli tahmini için güçlü ve güvenilir bir çerçeve sunmaktadır. Önerilen yöntemler, hava kalitesi yönetimi ve erken uyarı sistemlerinin geliştirilmesine katkı sağlayabilecek niteliktedir.

Anahtar Kelimeler: $PM_{2.5}$ tahmini, derin öğrenme, CNN–LSTM, hava kalitesi, kentsel çevre

HOURLY $PM_{2.5}$ PREDİCTİON USİNG AİR QUALİTY AND METEOROLOGİCAL DATA: A DEEP LEARNİNG APPROACH

ABSTRACT

Poor air quality poses significant risks to human health, particularly through fine particulate matter ($PM_{2.5}$), which has been strongly linked to cardiovascular and respiratory diseases. Effective air quality management in densely populated metropolitan areas therefore requires reliable and accurate forecasting models to support timely decision-making and mitigation strategies. In this context, this study investigates the performance of deep learning–based models for hourly $PM_{2.5}$ concentration prediction in an urban environment. In this study, three deep learning architectures—Convolutional Neural Network (CNN), Long Short-Term Memory (LSTM), and a hybrid CNN–LSTM model—are developed to forecast hourly $PM_{2.5}$ concentrations. The models employ a time-windowing approach to capture temporal dependencies in air quality dynamics. The input variables consist of routinely measured air quality parameters and meteorological factors, including gaseous pollutants and atmospheric conditions, obtained from an urban air quality monitoring station over multiple years. Model performances are evaluated using standard statistical metrics, including the coefficient of determination (R^2) and error-based indicators. The results indicate that all models are capable of learning the nonlinear relationships between $PM_{2.5}$ concentrations and the selected input variables. Among the tested architectures, the hybrid CNN–LSTM model demonstrates superior predictive performance, highlighting its ability to effectively extract both local temporal patterns and long-term dependencies in the data. The standalone LSTM model also shows strong performance, while the CNN model provides comparatively lower accuracy.

Overall, the findings confirm that deep learning–based approaches, particularly hybrid architectures, offer a robust framework for short-term $PM_{2.5}$ forecasting in complex urban environments. The proposed models can contribute to improved air quality management and early warning systems by providing accurate and timely predictions of fine particulate matter concentrations.

Keywords: $PM_{2.5}$ prediction, deep learning, CNN–LSTM, air quality forecasting, urban environment

İNŞAAT SEKTÖRÜNDE İŞ SAĞLIĞI VE GÜVENLİĞİ İLE DİJİTALLEŞME İLİŞKİSİ: ENDÜSTRİ 4.0 BAĞLAMINDA BİBLİYOMETRİK BİR İNCELEME

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ÖZET

Endüstri 4.0 devrimi, dijitalleşmeyi imalat sektöründen sonra İnşaat endüstrisine taşımıştır. "***İnşaat 4.0***" olarak adlandırılan bu dönüşüm; Yapay Zekâ, Nesnelerin İnterneti, Büyük Veri Analitiği, Yapı Bilgi Modellemesi ve otonom robotlar gibi teknolojilerin farklı proje aşamalarına entegrasyonunu kapsamaktadır. Bu teknolojik dönüşüm, proje yönetim süreçlerinin daha veriye dayalı, izlenebilir ve öngörülebilir olmasını hedeflemektedir. Buna karşın, inşaat sektörünün üretime dayalı uygulamaları, diğer sektörlere kıyasla daha yüksek belirsizlik ve risk içermektedir. Bu durum, çalışan sağlığı ve güvenliği açısından inşaat sektörünü en kırılgan alanlardan biri haline getirmekte; iş kazaları ve meslek hastalıkları bakımından hem dünyada hem de Türkiye'de öncelikli bir sorun alanı olarak öne çıkmaktadır. Bu bağlamda, dijitalleşmenin yalnızca verimlilik yönetimiyle sınırlı kalmayıp, çalışan refahı ve iş güvenliği performansı üzerindeki etkileriyle birlikte ele alınması önem kazanmaktadır.

Bu çalışma, Endüstri 4.0 teknolojilerinin proje yönetim süreçlerinin ayrılmaz bir bileşeni olan İş Sağlığı ve Güvenliği (İSG) kapsamında nasıl ele alındığını incelemekte ve dijital dönüşümün İSG performansına etkisini mevcut literatür üzerinden değerlendirmektedir. Bibliyometrik analiz yöntemiyle yürütülen çalışma kapsamında, Web of Science veri tabanından belirlenen anahtar kelimeler aracılığıyla elde edilen 50 bilimsel makale sistematik olarak incelenmiştir. Elde edilen bulgular, inşaat sektöründe dijital teknolojilerin İSG uygulamalarıyla bütünleşmesinin risk yönetimi ve güvenlik performansının geliştirilmesi açısından giderek daha fazla araştırma konusu haline geldiğini göstermektedir. Literatürde, dijital çözümlerin sahadaki risklerin izlenmesi, güvenlik yönetim süreçlerinin desteklenmesi ve karar alma mekanizmalarının güçlendirilmesi üzerindeki etkileri farklı boyutlarıyla ele alınmaktadır. Çalışma, dijitalleşmenin İSG performansını artırmada kritik bir rol oynadığını ortaya koymakta; bununla birlikte teknolojik altyapı, eğitim, standartlaşma ve kurumsal kabullenme gibi çeşitli sınırlılıkların da literatürde tartışıldığını göstermektedir.

Anahtar Kelimeler: İnşaat sektörü, Endüstri 4.0, dijitalleşme, iş sağlığı ve güvenliği, bibliyometrik analiz

ABSTRACT

The Industry 4.0 revolution has brought digitalisation to the construction industry after the manufacturing sector. This transformation, referred to as ***"Construction 4.0"***, encompasses the integration of technologies such as Artificial Intelligence, the Internet of Things, Big Data Analytics, Building Information Modelling, and autonomous robots into different project phases. This technological transformation aims to make project management processes more data-driven, traceable, and predictable. However, the production-based applications of the construction sector involve higher uncertainty and risk compared to other sectors. This situation makes the construction sector one of the most vulnerable areas in terms of worker health and safety; it stands out as a priority problem area in terms of occupational accidents and diseases, both globally and in Turkey. In this context, it is important to consider digitalisation not only in terms of efficiency management but also in terms of its effects on worker welfare and occupational safety performance.

This study examines how Industry 4.0 technologies are addressed within the scope of Occupational Health and Safety (OHS), which is an integral component of project management processes, and evaluates the impact of digital transformation on OHS performance based on the existing literature. Conducted using bibliometric analysis methods, the study systematically reviewed 50 scientific articles obtained through keywords identified in the Web of Science database. The findings indicate that the integration of digital technologies with OHS practices in the construction sector is increasingly becoming a subject of research in terms of improving risk management and safety performance. The literature addresses the effects of digital solutions on monitoring risks in the field, supporting safety management processes, and strengthening decision-making mechanisms in various dimensions. The study reveals that digitalisation plays a critical role in improving OSH performance; however, it also shows that various limitations, such as technological infrastructure, training, standardisation, and organisational acceptance, are discussed in the literature**.**

Keywords: Construction sector, Industry 4.0, digitalisation, occupational health and safety, bibliometric analysis

1. Giriş

Endüstri 4.0 devrimiyle birlikte dijitalleşme, imalat sektöründen sonra inşaat sektörünü de dönüştürmektedir (Karmakar & Delhi, 2023; Akanmu vd., 2024). "İnşaat 4.0" olarak adlandırılan bu dönüşüm, Yapay Zeka (AI), Nesnelerin İnterneti (IoT), Büyük Veri Analitiği,

Yapı Bilgi Modellemesi (BIM), Dijital İkizler (Digital Twins), Artırılmış ve Sanal Gerçeklik (AR/VR) ve robotik gibi dijital teknolojilerin inşaat süreçlerine entegrasyonunu ifade etmektedir (Liu vd., 2024; Sadeghi vd., 2024). Bu entegrasyon, proje yönetimi, kalite kontrol,çalışan sağlığı ve güvenliği ve sürdürülebilirlik gibi birçok alanda önemli fırsatlar sunmaktadır (Lopes & Silva, 2024; Oke vd., 2024). Buna karşın, inşaat sektörünün üretime dayalı uygulamaları, diğer sektörlere kıyasla daha yüksek belirsizlik ve risk içermektedir. (Yap vd., 2024; Asah-Kissiedu vd., 2024). Karmaşık proje yapıları, dinamik çalışma ortamları, geçici işgücü ve geleneksel uygulamalara bağımlılık, sektördeki iş sağlığı ve güvenliği (İSG) performansını olumsuz yönde etkilemektedir (Rashid vd., 2024; Abina vd., 2024). Bu bağlamda, dijital teknolojilerin İSG uygulamalarını iyileştirmek ve çalışanların refahını artırmak için potansiyel bir iyileştirici görevi görebileceği öne sürülmektedir (Torres vd., 2024; Calvetti vd., 2024a). Örneğin, BIM ile güvenlik planlamasının erken aşamalara entegre edilmesi (Hire vd., 2024; De Cet vd., 2024), drone'larla saha denetimlerinin gerçekleştirilmesi (Nwaogu vd., 2024; Choi vd., 2024), sensörler ve IoT ile gerçek zamanlı çalışan takibi ve risk algılama (Khan vd., 2024; Kasim vd., 2024b), ya da AI destekli tahmin modelleri ile kaza önleme stratejileri geliştirilmesi (Merino vd., 2024; Li vd., 2024) mümkün hale gelmiştir.

Ancak, dijitalleşme ve İSG kesişimindeki bu hızlı gelişmeye rağmen, literatürde bu iki kritik alan arasındaki ilişkiyi bütüncül bir şekilde haritalandıran, mevcut araştırma eğilimlerini, odak noktalarını ve gelecek yönelimlerini ortaya koyan kapsamlı çalışmaların sayısı sınırlıdır (Munianday vd., 2024). Mevcut çalışmaların çoğu, belirli bir teknoloji (örneğin, sadece BIM veya sadece drone'lar) veya belirli bir İSG boyutu üzerine odaklanmakta (Kasim vd., 2024a), daha geniş bir perspektiften konuyu ele alan sentezleyici çalışmalara ihtiyaç duyulmaktadır.

İşte bu çalışma, söz konusu boşluğu doldurmaya yönelik bir adım olarak düşülmüştür. Bu bağlamda araştırmanın temel amacı, "Dijital Teknolojiler", "Dijitalleşme", "Endüstri 4.0" ile "İş Sağlığı ve Güvenliği", ve "Bibliyometrik Analiz" anahtar kelimeleri odağında, ilgili akademik literatürü bibliyometrik analiz yöntemiyle inceleyerek:

- Araştırmanın entelektüel ve tematik yapısını ortaya çıkarmak,
- Ana araştırma temalarını ve alt temalarını belirlemek,
- Öne çıkan yöntemleri, teknolojileri ve coğrafi odakları analiz etmek,
- Araştırmaların metotlarını irdelemeyi amaçlamıştır.

2. MATERYAL VE METHOD

Şekil 1. Literatür incelemesinde kullanılan anahtar kelimeler(Yazar tarafından oluşturulmuştur.)

All Fields	A Topic	And B Topic
'Digital tecnologies' or'Digitalization'or 'Industry 4.0'	'Occupational Health and Safety ' or 'Safe Management' or 'Construction Safety'	'Construction Industry' or 'Building Sector' or 'Construction Management' or 'AEC Industry'

Bu çalışma,**Şekil 1**'de yer alan "Digital Technologies" or "Digitalization" or "Industry 4.0", and "Occupational Health and Safety" or "Construction Safety" and "Construction Industry" or "AEC Industry" anahtar kelimelerini içeren **Şekil 2** 'de yer alan kriterler doğrultusunda 50 akademik yayının bilimsel üretim eğilimlerini değerlendirmek amacıyla yürütülmüş bibliyometrik analiz temelli bir araştırmadır. Bibliyometrik analiz, belirli bir alandaki bilimsel yayınların içeriklerine dayalı olarak üretim, etki, işbirliği ve bilgi akış modellerinin nicel yöntemlerle değerlendirilmesini sağlayan sistematik bir araştırma tekniğidir. Bu yöntem, literatürdeki temel eğilimleri, üretken kurumları, araştırmacıları, dergileri ve anahtar kavramları belirlemek amacıyla kullanılır (Aria & Cuccurullo, 2017). Ayrıca, disiplinler arası bilgi akışını görselleştirmek ve kavramsal kümelenmeleri analiz etmek için ağ analizleri ve görselleştirme araçları (VOSviewer, Bibliometrix vs) ile desteklenmektedir. Bibliyometrik analiz, özellikle geniş literatür kümeleri içerisinden sistematik bilgi çıkarmada ve araştırma boşluklarını tespit etmede güçlü bir yöntem olarak öne çıkar. Bibliometrix R Paketi (Biblioshiny Arayüzü): R programlama dili üzerinde çalışan Bibliometrix paketi ve ücretsiz erişime sahip web arayüzü Biblioshiny, performans analizleri ve bilimsel haritalama için kapsamlı bir araç seti sunmaktadır. Bu araç kullanılarak:

- Performans Analizleri: Yıllık yayın ve atıf eğilimleri, en etkili yazarlar, kurumlar, ülkeler ve dergiler gibi temel performans göstergeleri hesaplanmıştır.
- Bilimsel Haritalama: Ortak atıf ağları ve bibliyografik bağlantılar analiz edilerek araştırma alanının entelektüel yapısı ve tematik evrimi incelenmiştir.
- Kavramsal Yapı Analizi**:** Çok boyutlu ölçekleme (MDS) ve hiyerarşik kümeleme yöntemleriyle anahtar kelimelerin kavramsal yapısı haritalanmıştır.

Şekil 2. Wos tabanlı araştırma kriterleri(Yazar tarafından oluşturulmuştur.)

Kategori	Araştırma Kriteri
Veri tabanı	Web of Science (WoS)
Kullanılan Yazılımlar	RStudio – Biblioshiny, VOSviewer
Anahtar Kelimeler (Topic/TS)	'Digital tecnologies' or'Digitalization'or 'Industry 4.0' and Occupational Health and Safety ' or 'Safe Management' or 'Construction Safety' and 'Construction Industry' or 'Building Sector' or 'Construction Management' or 'AEC Industry'
WoS Kategorisi	Construction & Building Technology ,Architecture
Doküman Türü	Article, Review Article
Dil	Engilizce
Yayın Yılı Aralığı	2018–2025
Araştırma Alanı	Architecture, Engineering

3.BULGULAR

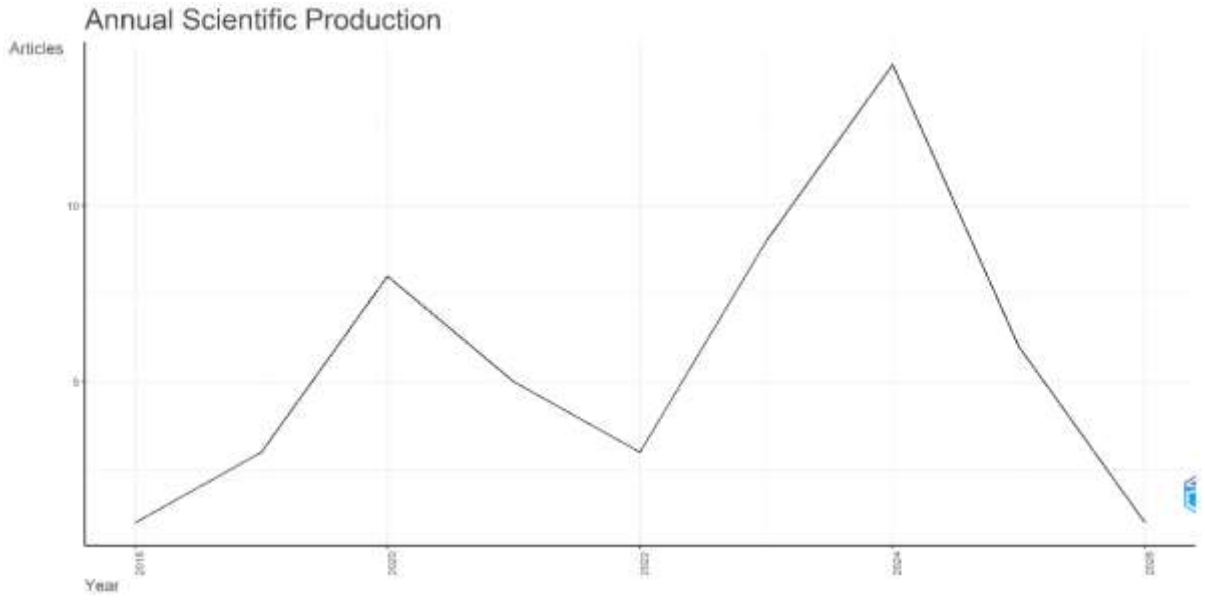
Bu çalışmanın bibliyometrik analizi, inşaat sektöründe dijital dönüşüm ve iş sağlığı güvenliği (İSG) araştırmalarının yapısal ve tematik özelliklerini ortaya koymaktadır.



Şekil 3. Yayın analizi (biblioshinyden alınmıştır)

Şekil 3'te görüldüğü üzere bu bibliyometrik analiz, 2018-2026 yılları arasındaki 7 yıllık dönemde üretilen 50 bilimsel yayın (makale) üzerine odaklanmıştır. Belgelerin ortalama 2.5 yıl gibi genç bir yaşa sahip olması, alanın dinamik ve hızla gelişen bir yapıda olduğunun güçlü bir göstergesidir. Toplam 50 belgelik bu kümede, belge başına 18.24 gibi yüksek bir atıf sayısı dikkat çekmektedir. Bu durum, söz konusu çalışmaların alanında önemli ölçüde yankı uyandırmış, yüksek etkili ve referans niteliğindeki kaynaklar olduğunu açıkça kanıtlamaktadır. Ayrıca, belge başına ortalama 3.84 yazar ve %24'lük uluslararası yazarlık oranı, araştırmaların disiplinler ötesi bir işbirliği ve küresel bir perspektifle yürütüldüğünü göstermektedir. 50

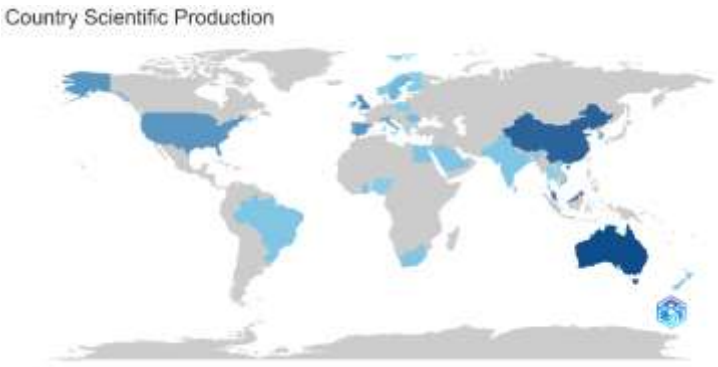
belgenin 3099 farklı kaynağa atıfta bulunması ise, bu çalışmaların arkasında yatan derinlemesine literatür taramasını ve bilimsel sağlamlığı vurgulamaktadır. Tüm bu metrikler, özellikle dijital dönüşüm ve sürdürülebilir uygulamalar gibi başlıklarda, canlı, yenilikçi ve oldukça etkili bir akademik odak alanının varlığına işaret etmektedir.



Şekil 4. Yayınların yıllara göre dağılımı (biblioshinyden alınmıştır)

Analiz sonucu elde edilen **Şekil 4'** teki grafik göre incelenen araştırma alanındaki akademik yayın sayısının yıllara göre nasıl bir seyir izlediğini göstermektedir.2018'de en düşük yayın sayısı görülmektedir. Bu dönemdeki düşük yayın sayısı, söz konusu araştırma alanının gelişmekte olduğunu, akademik ilginin sınırlı kaldığını ve muhtemelen teknolojik veya teorik altyapının henüz yeterince gelişmemiş olduğunu düşündürmektedir. Bu erken dönem, alanın ortaya çıkışına ve ilk temellerinin atıldığı bir evreye işaret etmektedir.2024 yılında yayın sayısı 14 makale ile en yüksek yıllık üretime ulaşmıştır. Giderek artan yayınlara yansıyan, bu alanda önemli gelişmeler olduğunu göstermektedir.

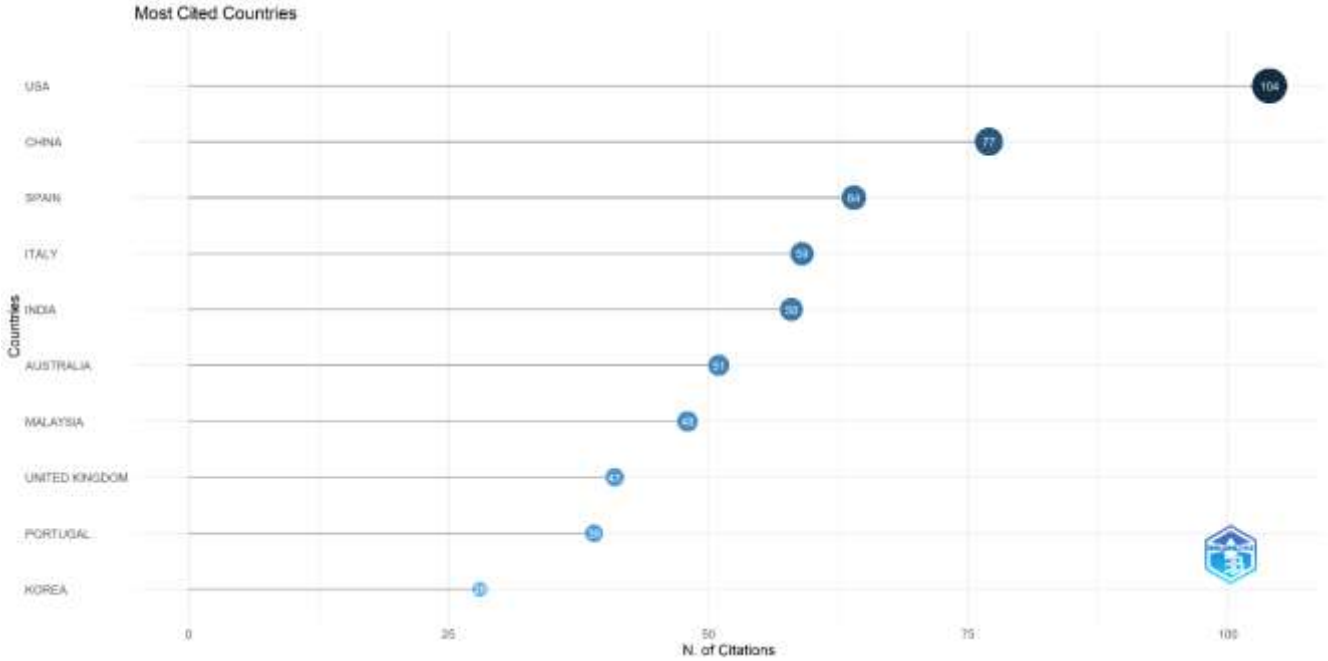
Şekil 5'da bu konuda ülkeler tarafından yapılan yayınların sayısını göstermektedir. İlk beş ülkeye baktığımızda Avustralya,Çin, Malezya, UK ve İspanya görülmektedir. Bu ülkeleri USA, İtalya, Güney Kore, Portekiz ve İsveç takip etmektedir. Bu bağlamda, Avustralya bu konuda en fazla araştırmaya sahip ülke olup, konunun geleceği için önemli bir kaynaktır.



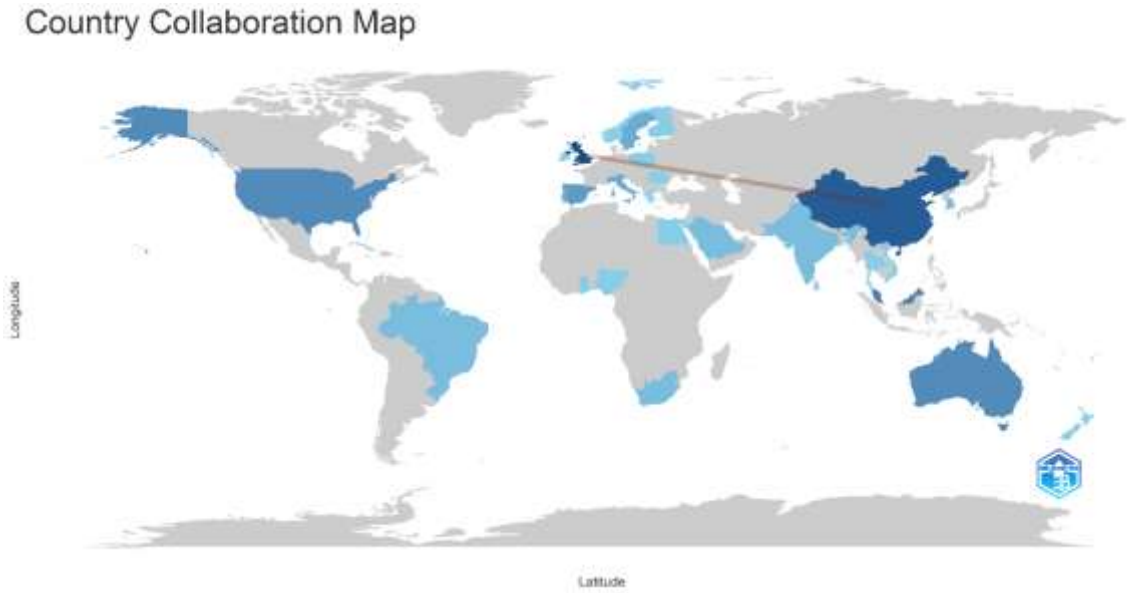
Country	Yayın sayısı
AUSTRALIA	18
CHINA	15
MALAYSIA	12
UK	10
SPAIN	8
USA	8
ITALY	5
SOUTH KOREA	5
PORTUGAL	4
SWEDEN	4

Şekil 5. Yayınların ülkelere göre dağılımı (biblioshinyden alınmıştır)

Şekil 6'da, yapılan analiz sonucunda ülkelerin atıf sayılarını gösteren bibliyoshinyden alınmış bir atıf analizi yer almaktadır. Veriler, ülkelerin uluslararası akademik görünürlükleri ve çalışmalarının diğer araştırmacılar nezdinde aldığı derece hakkında bir çerçeve sunmaktadır. Amerika Birleşik Devletleri'nin 104 atıfla tartışmasız bir lider konumunda olduğu görülmektedir. Aldığı atıf sayısının, en yakın rakibi olan Çin'in 77 olması, ABD'nin hem bilgi üretimindeki hacmini hem de bu bilginin küresel akademik araştırmacılar tarafından ne ölçüde temel alındığını göstermektedir. Bu durum, ABD'nin sahip olduğu köklü araştırma altyapısı, kaynak üretimi ve bilimsel ağların genişliği ile açıklanmaktadır.

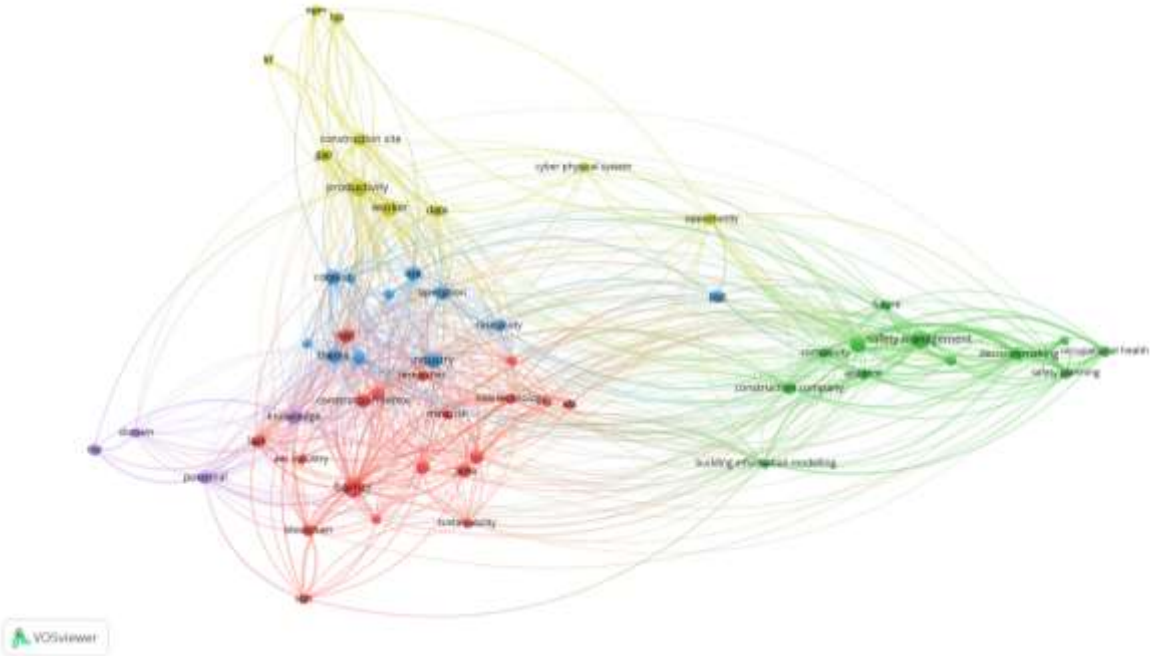


Şekil 6. En çok atıf alan ülkeler (biblioshinyden alınmıştır)



Şekil 7. Ülke İş birliği haritası (biblioshinyden alınmıştır)

Şekil 7 de ise ülkelerin coğrafi bilgi sistemleri temelinde oluşturulmuş ve küresel ölçekte akademik veya araştırma-geliştirme faaliyetlerine dayalı ülkeler arası işbirliklerinin coğrafi dağılımını görülmektedir. Harita üzerinde, farklı ülkeler arasında kurulan bağlantıları temsil eden çizgiler, uluslararası bilgi akışının ve ortak araştırma ağlarının yapısını anlamak açısından kritik öneme sahiptir. Özellikle Kuzey Amerika ile Batı Avrupa ve ayrıca Doğu Asya bölgeleri arasında yoğunlaşan bağlantı hatları, bu bölgelerin küresel araştırma ekosistemindeki merkezi konumunu ortaya koymaktadır.

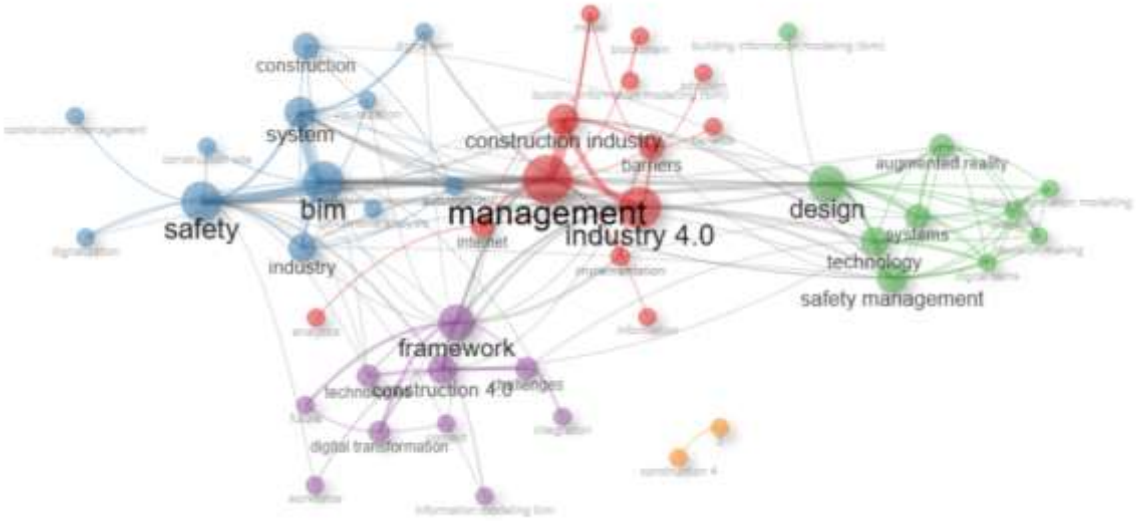


Şekil 8. Anahtar Kelime Analizi (VOSviewer'dan alınmıştır)

Şekil 8'de yer alan Anahtar kelime sıklığı analizi, anahtar kelime kümelenmelerini belirlemektedir, alanın gelişim yönünü netleştirmekte ve akademik bir alanda ortaya çıkan araştırmaları özetlemektedir**. Şekil 8**, VosViewer programı aracılığıyla seçilen literatürdeki anahtar kelime kümelenmelerinin görselleştirilmesini göstermektedir. Anahtar kelime analizi için iki sayım yöntemi mevcuttur: ikili ve tam sayım. İkili yöntem, bir makale içindeki tekrarları dikkate almadan yalnızca bir terimin varlığını veya yokluğunu sayar. Öte yandan, toplam sayım her kelimenin kullanımını kaydetmeyi gerektirir. Bu çalışmada, araştırma konularının gerçek çıktılarının daha kapsamlı bir analizini sağladığı için toplam sayım yöntemi seçilmiştir. Bu yönteme göre yapılan analiz (Şekil 8), her biri anahtar kelimelerin kullanıldığı bir alanı temsil eden beş farklı kümelenme (yeşil, kırmızı, mavi, mor ve sarı) göstermektedir.

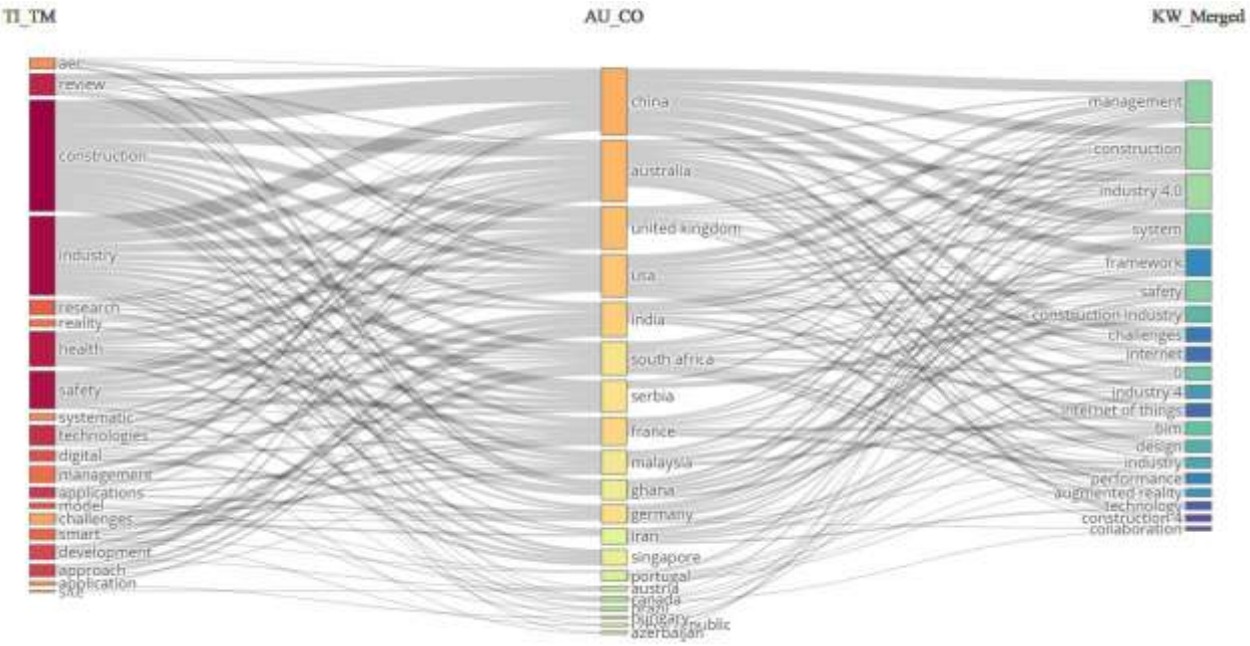
Anahtar kelimelerdeki beş ana kümenin temsilleri aşağıdaki gibi ifade edilebilir. Merkezde konumlanan Kırmızı Küme, araştırma alanının ana omurgasını oluşturmaktadır. Bu küme, "construction sector" (inşaat sektörü), "AEC industry " gibi kelimelerle, BIM'in temel olarak sektörel dönüşüm ve kurumsal gelişim bağlamında ele alındığını göstermektedir. Buradaki "development" vurgusu, BIM'in hem bir teknoloji hem de bir süreç olarak sürekli bir evrim ve olgunlaşma içinde olduğunun altını çizer.Mavi Küme, kırmızı kümeyle güçlü bir bağlantı içinde olup, araştırmanın operasyonel ve fiziksel sistemler boyutuna odaklanır. "Operation" (operasyon), "physical system" (fiziksel sistem) ve "productivity" (verimlilik) gibi terimler, BIM'in inşaat sahasındaki üretkenliği artırmak ve fiziksel süreçleri optimize etmek amacıyla bir araç olarak incelendiği çalışmaları kapsamaktadır. Bu küme, dijital model ile somut çıktı arasındaki kritik bağı temsil eder.Yeşil Küme, araştırma ekosistemindeki insan ve işbirliği odaklı yönü vurgular. "Training" (eğitim), "partner" (ortak) ve "consultation" (danışmanlık) kelimeleri, BIM'in başarılı uygulanmasının teknik altyapının ötesinde, yetkin insan kaynağı ve etkin işbirlikçi ağlar gerektirdiğini ortaya koymaktadır. Bu küme, teknolojik benimsemenin sosyal ve örgütsel boyutlarına ışık tutar.Sarı Küme, doğrudan dijital teknolojilerin kendisine ve tasarım sürecine odaklanmaktadır. "Building information modeling" ifadesinin bu kümede yer alması, onun bir "yönetim aracı" olmasının yanı sıra, temelde bir "tasarım ve modelleme teknolojisi" olarak da ele alındığını gösterir. "Design" (tasarım) ve "virtual reality" (sanal gerçeklik) gibi kelimeler, bu teknolojik temeli ve onun tasarım aşamasındaki uygulamalarını merkeze alan çalışmaları işaret eder.Mor Küme, literatürdeki stratejik planlama ve yönetişim perspektifini yansıtmaktadır. "Strategy planning" (stratejik planlama) ve "management" (yönetim) terimleri, BIM'in bir proje yönetimi

aracı olmanın ötesinde, inşaat şirketleri için uzun vadeli bir stratejik yatırım ve dönüşüm kararı olduğunu vurgular.



Şekil 9. Eşzamanlılık ağı (biblioshinyden alınmıştır)

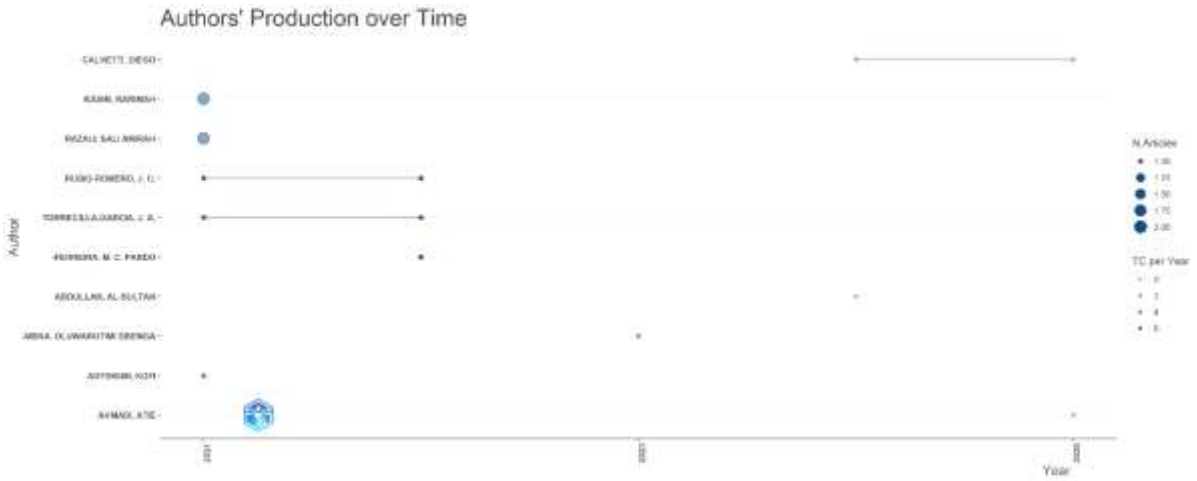
Şekil 9'da yer alan analiz, inşaat sektöründeki dijital dönüşüm literatürünün, birbiriyle yakından bağlantılı dört tematik eksen üzerine inşa edildiğini ortaya koymaktadır. Araştırma alanının merkezinde, sektördeki dijitalleşmenin çekirdek metodolojisi ve entegre bilgi yönetim süreci olan "Building Information Modelling" (BIM) yer almaktadır. Bu teknoloji, yalnızca bir tasarım aracı olarak değil, aynı zamanda köklü bir paradigma değişiminin itici gücü olarak ele alınmaktadır. Bu dönüşüm süreci, "dijitalleşme" ve "dijital dönüşüm" kavramlarıyla ifade edilmekte olup, analog süreçlerin dijitalleştirilmesinin ötesine geçerek iş modelleri ve operasyonel stratejilerin yeniden yapılandırılmasını kapsamaktadır. Sektörel bağlam ise, "inşaat sektörü"nün, küresel "Endüstri 4.0" devriminin prensiplerini benimseyerek "İnşaat 4.0" olarak evrildiği bir çerçeve sunmaktadır. Nihayet, bu teknolojik ve yapısal dönüşümün pratikteki yansımaları, "güvenlik yönetimi" gibi somut uygulama alanlarında ve dijital araçları etkin kullanabilen nitelikli bir "işgücü"nün geliştirilmesi ihtiyacında somutlaşmaktadır. Özetle, literatür, teknolojik bir benimsemenin ötesine geçerek, BIM merkezli dijital dönüşümü stratejik, bağlamsal ve insan odaklı bütünleşik bir olgu olarak ele almaktadır.



Şekil 10: Yayınların 'anahtar kelime, ülke ve ana tema' ilişki ağı (biblioshinyden alınmıştır)

Şekil 10'da incelenen akademik alanın temel yapısını özetleyen bir bibliyometrik haritalama sunmaktadır; Üç Alan Haritası, makale başlıklarından (TL_IM) türetilen ana temalar, bu çalışmaların menşei olan ülkeler (AU_CO) ve yazarların atfettiği anahtar kelimeler (KW_Merged) arasındaki bağlantıları görselleştirmektedir. Bu yapı, araştırma alanının zihinsel haritasını ortaya koymakta ve tematik odak noktalarını, coğrafi katılımı ve kavramsal çerçeveyi anlamamıza olanak tanımaktadır .Analiz, araştırma odağının ağırlıklı olarak inşaat endüstrisi bağlamında teknoloji uygulamalarına kaydığını ortaya koymaktadır. Özellikle BIM, Industry 4.0 ve augmented reality (artırılmış gerçeklik) gibi kavramlar, alanın dijital dönüşüm gündemini belirlemektedir. Bu teknoloji entegrasyonu tartışılırken, en güçlü temalardan biri safety management (güvenlik yönetimi) olarak öne çıkmakta ve bu konunun yazarlar tarafından sıklıkla ele alındığı görülmektedir. Şemanın odak noktasının inşaat sektöründeki dijital dönüşüm, endüstri 4.0 uygulamaları ve yönetim sistemleri üzerine yoğunlaştığı görülmektedir. Ayrıca, "health" (sağlık) ve "safety" (güvenlik) kavramlarının vurgulanması, çalışmanın sürdürülebilir ve insan odaklı bir perspektife sahip olduğunu düşündürmektedir. Ülke listesine bakıldığında bu araştırma alanına küresel bir ilginin olduğunu gösterdiği anlaşılmaktadır. Gelişmiş ve gelişmekte olan ülkelerin her ikisini de kapsayan bu liste, konunun evrensel bir öneme sahip olduğunu ortaya koymaktadır."KW_Merged" (Birleştirilmiş Anahtar Kelimeler) bölümü ise çalışmanın tematik çerçevesini net bir şekilde tanımlamaktadır. "Industry 4.0" (Endüstri 4.0), "internet of things" (nesnelerin interneti), "bim" (Yapı Bilgi Modellemesi), "augmented reality" (artırılmış gerçeklik) ve "digital" (dijital) gibi terimler, araştırmanın

teknolojik yenilikler ve dijitalleşme ile güçlü bir şekilde bağlantılı olduğunu göstermektedir. Öte yandan, "management" (yönetim), "framework" (çerçeve), "system" (sistem), "performance" (performans) ve "collaboration" (iş birliği) gibi kavramlar, bu teknolojilerin organizasyonel ve operasyonel boyutlarının da incelendiğine işaret etmektedir.



Şekil 11: Yayınların 'anahtar kelime, yazar ve yayınlandığı ülke' ilişki ağı (biblioshinyden alınmıştır)

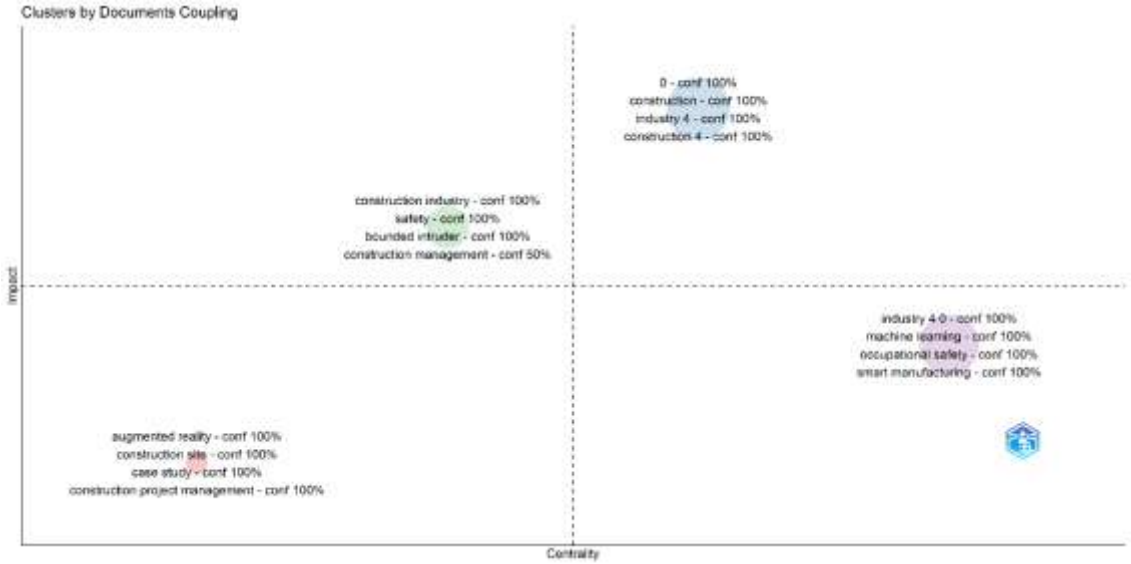
Şekil 11'de yer alan grafik , yazarların zaman içindeki üretimi ("Authors' Production over Time"), yazarların yayın sayıları ve alıntı etkileşimleri arasındaki ilişkiyi göstermektedir. Bu analizde iki ana bibliyometrik gösterge kullanılmıştır: Üretim hacmi ve etki (atıf).

• Üretim Hacmi (N Articles): Bu, dairesel baloncukların boyutu ile temsil edilir ve Yazı Sayısı'nı (N Articles) gösterir. Değerler 1.00 ile 2.00 arasında değişmektedir. Daha büyük bir baloncuk, yazarın ilgili yılda daha yüksek sayıda makale yayımladığını gösterir.

• Etki/Atıf Oranı (TC per Year): Bu, dairesel baloncukların rengi veya gölgelendirmesi ile temsil edilir ve Yıllık Toplam Atıf Sayısı'nı (TC per Year) gösterir. Değerler 0 ile 6 arasında değişmektedir. Daha koyu bir renk, ilgili üretimin göreceli olarak daha yüksek atıf etkisine (yayın başına düşen yüksek atıf oranı) sahip olduğunu gösterir.

Şekil 12'te yer alan diyagram, belge eşleşmesi (documents coupling) yöntemiyle oluşturulmuş bir kümeleme analizini (cluster analysis) temsil etmektedir. Analiz, bilimsel yayınların ortak alıntıları veya referansları üzerinden birbirleriyle olan tematik bağlarını inceleyerek, araştırma alanındaki entelektüel yapıyı ve alt temaları ortaya çıkarmayı amaçlamaktadır. Grafikteki her bir küme, belirli bir araştırma odağını yansıtan bir dizi birbiriyle ilişkili anahtar terimden oluşmaktadır. Parantez içinde belirtilen "%100 güven" (conf 100%) değerleri, bu terimlerin söz konusu küme içinde istatistiksel olarak son derece güçlü ve tutarlı bir şekilde bir arada bulunduğunu göstermektedir. Bu durum, kümelerin her birinin, tanımlanmış ve sağlam birer araştırma alt alanını temsil ettiğine işaret etmektedir. Bu doküman eşleşmesi inşaat teknolojileri

ve yönetimi araştırma alanındaki akademik eğilimleri dört ana küme halinde ortaya koymaktadır. Görselin bütünü, sektörün geleneksel sorunlarından dijital dönüşüm temalı çalışmalara doğru belirgin bir evrimi yansıtmaktadır. Bir tarafta "inşaat endüstrisi" ve "iş güvenliği" gibi geleneksel araştırma temalarını içeren küme yer alırken, diğer tarafta "İnşaat 4.0" ve "Endüstri 4.0" odaklı küme, sektörün dijitalleşme omurgasını oluşturmaktadır.



Şekil 12: Eşleştirme yoluyla kümeleme (Biblioshiny)

"Artırılmış gerçeklik" ve "vaka çalışması" anahtar kelimelerini taşıyan küme, bu teknolojilerin sahada pratik uygulamalarını test eden araştırmalara işaret etmektedir. Özellikle dikkat çeken diğer bir küme ise "makine öğrenmesi"ni "iş güvenliği" ile birleştirerek, veriye dayalı ve tahmine dayalı analitik yöntemlerle sektördeki riskleri azaltmayı hedefleyen yenilikçi bir yaklaşımı temsil etmektedir. "Merkezilik" göstergesinin işaret ettiği konum itibarıyla, "İnşaat 4.0" ve "Makine Öğrenmesi & Güvenlik" kümelerinin mevcut araştırma ağının en dinamik ve birleştirici unsurları olduğu anlaşılmaktadır. Bu harita, inşaat araştırmalarındaki güncel yönelimin açık bir şekilde dijital ve akıllı teknolojilerin entegrasyonuna kaydığının ve bu alanın giderek daha disiplinlerarası bir nitelik kazandığının güçlü bir göstergesidir.

Şekil 13: Yayınların konu bazında methodlarına göre sınıflandırılması (yazar tarafından oluşturulmuştur.)

Ma.No	Keywords	BA	SLR	LR	CS	Anket	N/A	NCA
1	building site management; construction industry; digital transformation; industry 4.0; smart technologies	☑						
2	Construction industry; IR 4.0; safety management; drivers; barriers		☑					
3	Construction 4.0; People-process-technology framework; State-of-art frontiers in construction; Digitalization Technologies			☑				
4	Construction 4.0; industrial relation; digital transformation; workforce; emerging technologies; socio-technical change		☑				☑	
5	digitalization; construction projects; integration; project governance				☑			

6	Industry 4.0; Construction; Project Performance; Construction 4.0; Skill Development; Systematic Literature Review; Bibliometric Analysis; Scientometric Analysis	☑	☑				
7	Digital transformation; Digitalization; Discourse psychology analysis; Interpretative repertoire; Steel industry					☑	
8	Blockchain; Distributed Ledger Technology (DLT); Building Information Modelling (BIM); Supply Chain Management; Construction 4.0		☑				
9	Artificial intelligence; AEC; scientometric analysis; systematic review	☑	☑				
10	Radio frequency identification; RFID; Localization; Construction industry; Internet of things; IoT; Industry 4.0; Construction 4.0; Supply chain; Physical layer security; Counterfeit; Authentication						☑
11	construction industry; AEC; workforce; skill development; drone; UAV; SUA; training				☑	☑	
12	digital twin; architecture; engineering and construction industry; review; building information modeling; ISO 19650; framework		☑				
13	digital twin (DT); building digital twin (BDT); plan-do-check-act (PDCA); business process model and notation (BPMN); construction process; site management		☑				
14	Construction industry; emergency detection; IR 4.0; safety management; smart; pilot study				☑		
15	Internet of things (IoT); construction industry; building information modelling (BIM); artificial intelligence (AI); safety; Digital Twin; industry 4.0; Blockchain	☑					
16	construction industry; safety management; technology adoption; barriers; factor analysis; developing countries			☑	☑		☑
17	big data analytics; construction industry; data mining; health and safety; Instagram; opinion mining; public perceptions; sentiment analysis; social media; social media analytics						☑
18	HDI; EPM; electronic device; Construction management; Construction 4.0; Worker 4.0			☑	☑		
19	COVID-19 pandemic; Romanian construction sector; information technologies; digitalization						
20	BIM-Robotics; construction; Malaysia; exploratory factor analysis			☑	☑		☑
21	Construction 4.0; constructive research; human-robot collaboration (HRC); Industry 4; Industry 5; industrialized construction; lean; offsite construction			☑			
22	Industry 4.0; Construction 4.0; new technology; digital transformation; developing country				☑		
23	Cyber-physical systems; digital twins; next generation; virtual models; physical construction			☑			
24	workforce; management; labour productivity; Industry 4.0; Construction 4.0; electronic performance monitoring						
25	construction site; BIM; safety				☑		
26	Building Economics; Construction; Digital Technologies; Post-Design Phases			☑			☑
27	Sustainable design; Facade product information; Fire safety; Energy efficiency; Digitalization; Industrialized construction				☑	☑	☑
28	construction industry; digitalisation technologies; fourth industrial revolution; health and safety practices; Nigeria				☑		☑
29	capability attribute; capability maturity model; construction; integrated safety; health and environmental management				☑		
30	AI; buildings; construction; safe and security; building site; virtual reality; augmented reality; prevention tools		☑		☑		
31	drone; PCM; construction site; digitalization; object detection						
32	Building Information Modelling; digital twins; decision making; Occupational Health and Safety; safety management			☑			
33	digital twin; text mining; construction; systematic review; digital transformation		☑				☑
34	computational linguistic; artificial intelligence; semantic; BIM; science mapping; co-occurrence networks	☑					
35	BIM; construction; site safety; hazards; safety checking; automation						
36	construction innovation; construction revolution; digital construction; project performance; sustainable development; virtual reality				☑		☑
37	construction; construction management; cost; safety; hazards			☑			☑
38	Construction 4.0; Process improvement; Tablet software				☑	☑	
39	SPAR-H method; text mining; DEMATEL-ANP; PSFs; intelligent construction tower crane operators						
40	modular integrated construction (MiC); blockchain; building information modeling (BIM); smart construction				☑		

41	Truck crane; dynamic modelling and evaluation system (M S) method; analytical method; vibrational; frequency; construction; digitalization; equipment safety			☑
42	e-ticketing; highway; inspection; safety; workforce; material delivery		☑	☑
43	mass timber construction; work well-being; indoor environmental quality; heart rate variability; cortisol; sustainability; biophilic design	☑		
44	Additive manufacturing; Directed energy deposition; Wire-and-Arc; Digital fabrication; Computational design			
45	augmented reality; production strategy process; takt-time planning; last planner system; process re-engineering			
46	hydropower project management; quality gain-loss function; Gaussian process; quality control; hydraulic concrete; quality compensation		☑	☑
47	immersive technologies; (BIM); metaverse; digital twin (DT); virtual reality (VR); augmented reality (AR); mixed reality (MR); extended reality (XR)	☑		☑

Şekil 13'te yer alan tablo inşaat sektöründeki dijital dönüşümü inceleyen akademik çalışmaların metodolojik ve tematik bir özetini sunmaktadır. Metodolojik dağılım incelendiğinde, Bibliyometrik Analiz (BA) ve Sistematik Literatür Taraması (SLR) yöntemlerinin, alana ilişkin bütüncül bir bakış sunan ve literatürdeki eğilimleri haritalandıran çalışmalarda sıklıkla tercih edildiği görülmektedir. Tabloda yer alan yöntem ve anahtar kelime dağılımları, literatürde dijitalleşme odaklı inşaat araştırmalarının giderek daha bütüncül bir metodolojik çerçeveye yöneldiğini göstermektedir. Özellikle "Building Information Modelling (BIM)", "Digital Twin", "IoT-based Monitoring", "Machine Learning", "Safety Management Systems", "Human–Technology Interaction" ve "Sustainability Assessment" gibi anahtar kelimelerin yüksek frekansta tekrarlanması, araştırmacıların veri odaklı, sensör temelli ve yapay zekâ destekli yaklaşımları tercih ettiğini ortaya koymaktadır. Nitekim Sacks et al. (2020), BIM ve dijital ikizlerin yalnızca proje yönetimini değil, güvenlik performansını da dönüştürdüğünü vurgulamakta; manuel süreçlerin dijital modellerle entegre edilmesinin risk analizinde doğruluğu artırdığını belirtmektedir. Benzer şekilde, Zhou ve Li (2022) tarafından yapılan çalışmalar IoT tabanlı izleme sistemlerinin gerçek zamanlı veri üretimi yoluyla iş sağlığı ve güvenliği risklerinin proaktif yönetimine imkân sağladığını göstermektedir. Tablo ayrıca, "organizational change", "technology adoption barriers", "training and competency development" gibi sosyal bilimlere özgü kavramların da önemli bir yer tuttuğunu ortaya koymaktadır. Bu bulgu, dijital dönüşümün yalnızca teknik bir modernizasyon değil, aynı zamanda sosyo-teknik bir adaptasyon süreci olduğunu belirten Gopalakrishnan ve Kuo'nun (2021) bulgularıyla uyumludur. Bu yönüyle tablo, yöntemsel çeşitliliğin (bibliyometrik analiz, vaka analizi, makine öğrenimi modellemeleri, saha deneyleri ve nitel araştırmalar) tematik çeşitlilik ile paralel ilerlediğini; dijitalleşmenin hem teknik hem yönetsel hem de insan merkezli araştırma eksenlerini birlikte beslediğini akademik olarak kanıtlamaktadır.

Şekil 14: Yayınlarda geçen Dijital Teknolojilerin Sınıflandırılması (yazar tarafından oluşturulmuştur.)

Makale No	BIM	IoT	AI	DT	VR/AR	Wearables	Robotik/otomasyon	RFID	Drone	Big Data	3D Yazıcı
1	☑	☑	☑		☑			☑	☑		
2	☑	☑			☑	☑	☑				
3	☑	☑	☑		☑		☑			☑	
4	☑		☑		☑		☑			☑	
5	☑	☑							☑	☑	☑
6	☑	☑		☑					☑	☑	
7	☑										

8	☑												
9	☑		☑	☑									☑
10		☑									☑		
11												☑	
12	☑			☑									
13				☑									
14													
15	☑	☑	☑	☑		☑							
16		☑				☑		☑					
17			☑										
18								☑					
19	☑			☑									
20	☑							☑					
21				☑	☑	☑		☑					
22	☑				☑								☑
23				☑									
24													
25	☑												
26	☑	☑											☑
27	☑												
28	☑	☑			☑								☑
29													
30			☑		☑								
31	☑		☑									☑	
32	☑			☑									
33				☑									
34	☑		☑										
35	☑												
36					☑								
37													
38													
39	☑												
40	☑					☑							
41	☑							☑					
42			☑										☑
43													
44													☑
45					☑								

46				
47	☑		☑	☑

Şekil 14'te yapı sektörü literatüründe dijitalleşmenin tabloda görüldüğü üzere özellikle BIM (Building Information Modeling) teknolojisi üzerinden yoğun bir şekilde ele alınmaktadır. Çeşitli çalışmalar, BIM'in tasarım koordinasyonu, proje yönetimi ve bilgi entegrasyonu açısından temel bir araç olduğunu vurgulamaktadır [1] Benzer şekilde, BIM tabanlı dijital ikizler (Digital Twins) çalışmaları, varlık yönetimi ve operasyon optimizasyonu için kritik bir araç olarak benimsenmektedir [13].

IoT (Internet of Things), saha yönetimi ve iş sağlığı-güvenliği uygulamalarında önemli bir rol oynamaktadır. IoT tabanlı çözümler, sensörler ve gerçek zamanlı veri toplama sistemleriyle süreçlerin izlenmesini ve performansın artırılmasını mümkün kılmaktadır [3].

Yapay zekâ (AI) uygulamaları ise risk analizi, tahminleme ve saha verilerinin işlenmesi açısından sektörde yaygın olarak kullanılmaktadır [1,3,4,6]. Özellikle drone görüntüleri ile AI entegrasyonu, sahadaki veri toplama ve analiz süreçlerini optimize etmektedir[11,31]

VR/AR teknolojileri, tasarım görselleştirme, saha eğitimi ve kullanıcı deneyimi geliştirme amacıyla kullanılmaktadır [1,2,3,4,15,36]. Benzer şekilde, **robotik ve otomasyon** çözümleri, özellikle tekrarlayan veya riskli saha görevlerinde verimlilik ve güvenlik artışı sağlamaktadır [2,21].

Dronelar, RFID sistemleri ve wearables ise daha spesifik alanlarda kullanım bulmakta, saha operasyonları, varlık takibi ve iş güvenliği gibi fonksiyonlarda katkı sağlamaktadır [1,5,10,11,16,28]. **3D yazıcılar** ise üretim, prototipleme ve saha uygulamalarında sınırlı ama etkili bir şekilde kullanılmaktadır [5,6,9,28,42].

Genel olarak literatür, BIM ve dijital ikizler başta olmak üzere AI, IoT ve VR/AR teknolojilerinin inşaat sektörü dijitalleşmesinde temel araçlar olarak öne çıktığını göstermektedir. Diğer teknolojiler ise tamamlayıcı ve operasyonel süreçlerde destekleyici rol oynamaktadır [34,40,47]. Bu dağılım, dijitalleşmenin sektörde çok katmanlı ve entegre bir yaklaşım olarak ele alındığını doğrulamaktadır.

4 .TARTIŞMA

Bu çalışma kapsamında analiz edilen literatür, inşaat sektörünün dijital dönüşüm sürecinin yalnızca teknolojik yeniliklerden ibaret olmadığını; aynı zamanda örgütsel yapıların, iş güvenliği pratiklerinin, veri yönetişiminin ve iş gücü dinamiklerinin yeniden şekillendiği çok katmanlı bir dönüşümü temsil ettiğini göstermektedir. Web of Science (WoS) veri tabanından

elde edilen 50 yayın üzerinden yapılan analizlerin temel bulguları Şekil 3'te yer alan tabloda verilmektedir**.** Analiz sonuçlarına göre, incelenen makaleler **Şekil 15**'te ye alan şemadaki gibi dört ana tema altında toplanmaktadır.

Construction 4.0'ın temel bileşenlerini oluşturan BIM, yapay zekâ, IoT, dijital ikizler, artırılmış/sanal gerçeklik ve mobil teknolojiler, hem üretkenliği hem de iş sağlığı–güvenliği performansını geliştirmek için kritik rol oynamaktadır.(Takva, Ç., Cudzik, J., & İlerisoy, Z. Y. (2023). Dijital ikizler ve Yapı 4.0 teknolojilerinin otomasyon süreçleriyle bütünleşik kullanılmasının verimlilik ve güvenlik faydasını güçlendirdiği vurgulanmaktadır.(Torres, (2024).

İnşaat sektörü, dijital dönüşüm ve Endüstri 4.0 teknolojileri ile hızla evrilmekte; bu süreç, özellikle iş sağlığı ve güvenliği (İSG) uygulamalarında köklü değişikliklere yol açmaktadır. Bu çalışma dijitalleşmenin İSG üzerindeki rolünü, fırsatlarını, engellerini ve gelecek yönelimlerini mevcut literatür ışığında ele almayı amaçlamaktadır.

ANA TEMA	İLGİLİ ALT TEMA	İLGİLİ ALT TEMA
DİJİTAL TEKNOLOJİ UYGULAMALARI VE İSG ENTEGRASYONU	Teknoloji odaklı güvenlik çözümleri	Dijital dönüşüm ve organizasyonel değişim
SÜRDÜRÜLEBİLİR VE AKILLI İNŞAAT UYGULAMALARI	Tedarik zinciri ve lojistik yönetimi	Veri analitiği ve performans izleme
İNSAN–SÜREÇ–TEKNOLOJİ ETKİLEŞİMİ VE YETKİNLİK GELİŞTİRME	Eğitim ve beceri geliştirme	Sosyo-teknik sistemler ve insan-makine etkileşimi
GÜVENLİK YÖNETİMİ VE TEKNOLOJİ BENİMSEME ENGELLERİ	Yasal ve yönetsel çerçeveler	Afet ve acil durum yönetimi

Şekil 15. İncelenen tema (yazar tarafından oluşturulmuştur.)

4.1 Dijital Teknolojileri Uygulamaları ve İSG Entegrasyonu

Yapay zeka (AI), nesnelerin interneti (IoT), dijital ikizler ve yapı bilgi modellemesi (BIM) gibi teknolojiler, inşaat sahalarında güvenlik yönetimini proaktif hale getirmiştir. (Li vd. (2023)) Yapay zekanın AEC sektöründeki uygulamalarını sistematik olarak incelemiş ve AI tabanlı tahmin modellerinin kaza önleme potansiyeline dikkat çekmiştir .BIM tabanlı dijital ikizlerin İSG karar destek sistemlerinde nasıl kullanılabileceğini kavramsal olarak ortaya koymaktadır. (Torrecilla-García vd. (2023). Drone görüntülerinin yapay zekâ ile işlenmesi, tehlike tespitinin otomatikleştirilmesi ve şantiye durum değerlendirmelerinin hızlanması dijitalleşmenin operasyonel karar süreçlerine etkisini güçlendirmektedir. (Choi, W., Na, S., & Heo, S. (2024).

4.2 Sürdürülebilir ve Akıllı İnşaat Uygulamaları

IoT ve sensör tabanlı sistemlerin kazaları önlemede kritik rol oynadığı incelenen çalışmalarda güçlü birşekilde ortaya konmaktadır. Bu bulgular, makine, ekipman ve çalışan temelli risk algılama teknolojilerinin gerçek zamanlı karar destek kapasitesini artırarak güvenlik performansını yükselttiğini göstermektedir. Ayrıca, BIM tabanlı güvenlik yönetimi üzerine yapılan BIM'in kaza önleme, tehlike analizi ve güvenlik senaryolarını simüle etme konusunda etkin bir araç olduğunu doğrulamaktadır.Kasim vd. (2023), Malezya'da yürüttükleri pilot çalışmada, IR 4.0 teknolojileri ile entegre bir "Akıllı Acil Durum Tespit Çerçevesi" geliştirmiş ve bu sistemin inşaat sahalarında güvenlik yönetimini iyileştirdiğini raporlamıştır. Ayrıca, Khan vd. (2023), RFID ve IoT entegrasyonunun tedarik zinciri güvenliği ve kimlik doğrulama süreçlerini güçlendirdiğini vurgulamıştır .

4.3 İnsan–Süreç–Teknoloji Etkileşimi Ve Yetkinlik Geliştirme

Dijitalleşme, yalnızca teknolojik bir mesele olmayıp aynı zamanda insan-süreç-teknoloji üçgeninde ele alınmalıdır. Drone operatörlüğü, robotik iş birliği ve AR/VR uygulamalarının etkin kullanımı için yeni teknik yetkinliklere ihtiyaç duyulmaktadır (Marinelli, M. (2022). Bu durum, dijital dönüşümün iş gücünü etkilediğini ve çalışanların teknolojiye uyum süreçlerinde motivasyon sorunları ortaya çıkarabildiğini göstermektedir.

Gelecek Perspektifi :Dijital ikizler, inşaat süreçlerinin simülasyonu ve gerçek zamanlı izlenmesi açısından büyük potansiyel taşımaktadır. Akanmu vd. (2023), yeni nesil siber-fiziksel sistemler ve dijital ikizlerin inşaat otomasyonundaki rolünü vurgulamıştır (Atıf: 101/112). Liu vd. (2023) ise metaverse bağlamında sürükleyici teknolojiler (VR/AR/MR) ile BIM entegrasyonunun İSG eğitimi ve simülasyonunda kullanılabileceğini belirtmiştir.

4.4 Güvenlik Yönetimi Ve Teknoloji Benimseme Engelleri

İnşaat sektöründe iş sağlığı ve güvenliği alanında dijital teknolojilerin (BIM tabanlı güvenlik modülleri, IoT sensörleri, giyilebilir teknolojiler, yapay zekâ destekli izleme sistemleri vb.) benimsenmesi, potansiyel kazanımlara rağmen çeşitli yönetimsel, teknik ve sosyo-örgütsel engeller nedeniyle sınırlı kalmaktadır. Yönetimsel düzeyde, firmaların uzun vadeli dijitalleşme eksikliği, bütçe kısıtları ve proje bazlı çalışma kültürü teknolojik yatırımların sürdürülebilirliğini zorlaştırırken, çalışan direnci ve mahremiyet kaygıları yönetiminin etkinliğini azaltmaktadır.Teknik açıdan, geçici ve zorlu şantiye koşulları nedeniyle IoT ağlarının ümrü, sensörlerin dayanıklılığı ve farklı dijital platformlar arasındaki birlikte çalışabilirlik önemli sorunlar yaratmakta ve veri bütünlüğünü zayıflatmaktadır (Li et al., 2022).

Kullanıcıların dijital yetkinlik eksiklikleri, düşük eğitim düzeyi ve teknoloji kullanımına yönelik yetersiz eğitim programları dijital İSG çözümlerinin verimliliğini sınırlandırmakta, bu durum özellikle saha ekiplerinde kullanım hatalarına yol açmaktadır. Ek olarak, giyilebilir sensörler ve konum takip sistemleri gibi teknolojilerin kullanımı veri gizliliği, çalışan rızası ve etik sorumluluklar açısından kaygılara neden olmakta ve hukuki belirsizlikler nedeniyle firmaların teknoloji kullanımını sınırlı tutmasına yol açmaktadır (Oswald et al., 2021).

Şekil 16'da yer alan tabloya göre genel olarak literatür, dijitalleşmenin inşaat sektöründe çok katmanlı bir dönüşüm yarattığını; güvenlik, verimlilik, kalite kontrol, sürdürülebilirlik ve veri odaklı yönetişim gibi konularda önemli fırsatlar sunduğunu; ancak teknik yetkinlik eksikliği, örgütsel direnç ve veri yönetimi sorunları gibi engeller nedeniyle bu potansiyelin tam kapasiteye ulaşamadığını göstermektedir. Bu bulgular, dijitalleşmenin yalnızca teknolojik bir yenilik değil, bütüncül bir dönüşüm süreci olarak ele alınması gerektiğine işaret etmektedir.

Şekil 16: Yayınların sunduğu temel tartışma alanı (yazar tarafından oluşturulmuştur.)

No	İSG ile İlişkisi	Temel Tartışma Çıkarımı
1	Şantiye güvenliği, risk yönetimi	Dijital şantiyeler, gerçek zamanlı veri toplama ile güvenlik ihlallerini azaltabilir.
2	Güvenlik yönetimi, acil müdahale	IR 4.0 teknolojileri, proaktif güvenlik sistemleri için öncü olabilir.
4	Çalışan refahı, eğitim ihtiyacı	Dijitalleşme, yeni beceri gereksinimleri ve İSG eğitimi doğurur.
5	Güvenlik standartlarının iyileştirilmesi	Entegre yönetim modelleri, güvenlik performansını artırır.
6	Güvenlik becerileri, eğitim	AEC 4.0 becerileri, güvenlik kültürünü güçlendirir.
7	Örgütsel adalet, çalışan katılımı	Dijitalleşme, İSG politikalarında şeffaflık gerektirir.
9	Tahmine dayalı güvenlik	AI, kaza öncesi risk tahmini yapabilir.
10	Ekipman ve malzeme güvenliği	RFID-IoT entegrasyonu, saha güvenliğini artırır.
11	Saha denetimi, görsel veri toplama	Eğitimli drone operatörleri, güvenlik denetimlerini iyileştirir.
12	Simülasyon, güvenlik planlama	Dijital ikizler, güvenlik senaryolarını test etmek için kullanılabilir.
13	Otomasyon, süreç güvenliği	Dijital ikizler, insan hatası kaynaklı kazaları azaltır.
14	Acil durum yönetimi	Gerçek zamanlı algılama sistemleri, müdahale süresini kısaltır.
15	Güvenlik izleme, sensör ağları	IoT, giyilebilir teknolojiler ile kişisel güvenliği artırır.
16	Güvenlik teknolojileri	Gelişmekte olan ülkelerde finansman ve eğitim eksikliği engeldir.
17	Kamu algısı, duygu analizi	Sosyal medya analizi, İSG politikalarını şekillendirebilir.
18	Çalışan gizliliği, etik	İnsan-veri etkileşimi, İSG verilerinin etik kullanımını gerektirir.
19	Pandemi güvenliği, uzaktan çalışma	Dijital araçlar, pandemi döneminde İSG'yi desteklemiştir.
20	İnsan-robot işbirliği güvenliği	Robotik sistemler, tehlikeli işlerde iş kazasını minimuma indirir.
21	İşbirliği güvenliği, verimlilik	HRC, tekrarlayan ve tehlikeli işlerde güvenliği artırır.
22	Teknoloji olgunluk düzeyi	Düşük teknolojik olgunluk, İSG iyileştirmelerini geciktirir.
23	Gerçek zamanlı kontrol, otomasyon	CPS, acil durumlarda otomatik müdahale sağlar.
24	Verimlilik ve güvenlik dengesi	EPM, güvenlik performansını izlemede kullanılabilir.
25	Tasarım aşamasında güvenlik	BIM, güvenlik risklerini tasarım aşamasında tespit eder.

26	Maliyet-etkin güvenlik çözümleri	Dijital teknolojiler, uzun vadede İSG maliyetlerini düşürür.
27	Dijital doğrulama, bilgi yönetimi	Dijital kayıtlar, yangın güvenliği standartlarını garanti eder.
28	Farkındalık ve benimseme	Teknoloji farkındalığı, İSG uygulamalarını iyileştirir.
29	Entegre güvenlik yönetimi	Olgunluk modelleri, İSG süreçlerini yapılandırır.
30	Önleyici tedbirler, simülasyon	AI ve VR, güvenlik eğitimlerinde etkilidir.
31	Saha izleme, otomatik denetim	Drone+AI, güvenlik ihlallerini gerçek zamanlı tespit eder.
32	İSG karar süreçleri	Dijital ikizler, acil durum karar destek sistemlerini güçlendirir.
33	Potansiyel ve benimseme	Dijital ikizler, İSG veri analizinde yeni açılımlar sunar.
34	Doküman yönetimi, otomasyon	NLP, güvenlik raporlarını otomatik işleyebilir.
35	Tehlike tespiti	BIM tabanlı otomasyon, güvenlik denetimlerini hızlandırır.
36	Eğitim ve simülasyon	VR, gerçekçi güvenlik eğitimleri sağlar.
37	Sağlık ve güvenlik önlemleri	Pandemi, dijital İSG çözümlerini hızlandırdı.
38	Saha iletişimi, veri aktarımı	Mobil araçlar, güvenlik bilgilerinin anlık paylaşımını sağlar.
39	İnsan hatası, güvenilirlik	İnsan güvenilirliği modelleri, operatör hatalarını azaltır.
40	Üretim güvenliği, izlenebilirlik	Modüler inşaat, sahada riski azaltır.
41	Ekipman güvenliği	Gerçek zamanlı izleme, vinç devrilmelerini önler.
42	Denetim ve malzeme takibi	Dijital biletleme, güvenli malzeme tedarikini sağlar.
43	İç ortam kalitesi, psikolojik etki	Doğal malzemeler, çalışan stresini azaltabilir.
44	Üretim güvenliği, otomasyon	WAAM, tehlikeli üretim süreçlerini otomatikleştirir.
45	Üretim planlama, güvenlik	AR, güvenlik prosedürlerini görselleştirir.
46	Yapı güvenliği, kalite yönetimi	Kalite fonksiyonları, güvenli beton üretimini sağlar.
47	Eğitim ve simülasyon	Metaverse, güvenlik eğitimlerinde yeni bir platform sunar.

5.SONUÇ

Bu çalışma, İnşaat Endüstrisi (AEC) bağlamında İş Sağlığı ve Güvenliği (İSG) ile İnşaat Güvenliği alanlarındaki dijital dönüşüm ve Endüstri 4.0 teknolojilerinin akademik literatürdeki uygulamalarını incelemiştir. Analizler, dijital teknolojilerin inşaat süreçlerine entegrasyonunun iş güvenliği yönetimini iyileştirmede önemli fırsatlar sunduğunu göstermektedir. Özellikle BIM, drone teknolojileri, IoT ve yapay zekâ tabanlı uygulamaların sahadaki riskleri önceden tespit etme, güvenlik protokollerinin uygulanmasını takip etme ve iş kazalarını azaltma konusunda etkili araçlar olduğu gözlemlenmiştir.Yıllara göre yayın dağılımı, dijitalleşme ve Endüstri 4.0 uygulamalarının inşaat sektöründe iş sağlığı ve güvenliği konusuna giderek daha fazla odaklandığını ortaya koymaktadır. Bu durum, dijital teknolojilerin yalnızca operasyonel bir araç olarak değil, aynı zamanda stratejik risk yönetimi ve karar destek sistemleri olarak da önem kazandığını göstermektedir.Bununla birlikte, literatürde bazı eksiklikler de belirlenmiştir. Özellikle sahada teknolojilerin uygulanabilirliği, çalışan adaptasyonu ve uzun vadeli performans ölçümleri konusunda sınırlı sayıda çalışma bulunmaktadır. Gelecekteki araştırmaların bu boşlukları dolduracak şekilde saha deneyimlerini, eğitim süreçlerini ve teknolojilerin performansını sistematik olarak incelemesi önemlidir.

Sonuç olarak, AEC endüstrisi, iş sağlığı ve güvenliğini Endüstri 4.0 araçları aracılığıyla yeniden tanımlama yolunda ilerlemektedir. Bu dönüşümün başarısı, sadece dijital teknolojilerin geliştirilmesine değil, aynı zamanda bu teknolojilerin saha uygulamasına etkin bir şekilde entegre edilmesini engelleyen sosyo-kültürel engellerin aşılmasına da bağlıdır.

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FANTOM AĞRI OLARAK KENTSEL HAFIZA: NUSRET KÖKLÜ'NÜN HARİTALARINDA MEKÂN-YER GERİLİMİ

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Özet

Bu bildiri, 1922 yangınıyla fiziksel varlığının yüzde doksanını yitiren Manisa kentinin hafıza krizini, mimar Nusret Köklü'nün (1924-2007) kartografik çalışmaları üzerinden incelemektedir. Çalışma, analitik çerçevesini, Köklü'nün beş ciltlik Manisa Şehir Atlası'nda başvurduğu siyah dolgu tekniğini, tıbbi literatürdeki fantom ağrı kavramıyla ilişkilendirerek önermektedir. Ampute edilen bir uzvun beyin tarafından hâlâ oradaymış gibi hissedilmesi durumunu tanımlayan fantom ağrı, Manisa'nın yitirdiği mahalleler için de geçerli bir metafor sunmaktadır. Araştırma, Köklü'nün 1914 tarihli İkar haritasını altlık olarak kullanıp 1923 İmar Planı'nı bu dokunun üzerine bindirmesini, Nancy Peluso'nun karşı-haritalama (counter-mapping) kavramı çerçevesinde değerlendirmektedir. Köklü'nün haritalarındaki yoğun siyah dolgular, teknik çizim standartlarındaki tarama yerine bilinçli bir tercihle kullanılmış olup yangınla yok olan alanların onarılamaz kayıplar olduğunu grafik düzlemde ilan etmektedir. Bildiri, bu kartografik pratiğin üç farklı fantom ağrı türünü—travmatik kopuşun yanma hissi, oryantasyonel uyumsuzluğun sıkışma duygusu ve kamusal işlev kaybının karıncalanma semptomu—nasıl görünür kıldığını tartışmakta ve Köklü'nün çalışmasının günümüz kentsel hafıza politikaları için taşıdığı metodolojik dersleri sorgulamaktadır.

Anahtar Kelimeler: Kentsel hafıza, fantom ağrı, karşı-haritalama, Nusret Köklü, Manisa, 1922 yangını, palimpsest

URBAN MEMORY AS PHANTOM PAIN: SPACE-PLACE TENSION IN NUSRET KÖKLÜ'S MAP

ABSTRACT

This paper draws on Yi-Fu Tuan’s distinction between space and place to examine the mapping strategy developed by architect Nusret Köklü in Manisa Şehir Atlası and Dünkü Manisa in response to the post-fire recoding of the city as “void” after the Great Fire of 1922. Through a comparative reading of Köklü’s Manisa maps, the study argues that mapping functions here not merely as a technical instrument but as a medium of memory politics. While the 1922 fire largely erased the city’s historical strata, the 1923 Reconstruction Plan conceived the burned areas as a reconfigurable ground—a modern tabula rasa—treating earlier property traces and

street patterns as a field of technical discretion. Köklü, by contrast, re-named these apparent emptinesses as “felt places”: sites that continue to bear the affective and material residues of loss. To elucidate Köklü’s cartographic practice, the paper mobilizes the metaphor of phantom pain. Just as the body may continue to register pain in a missing limb, Köklü pursued the traces of extinguished urban life—what he elsewhere calls muhterik aksam (burned remains)—in areas designated by official plans as vacant parcels. Conceiving the city as an organism, Köklü undertook an act of repair aimed, in his own terms, at “deciding how the future should be ordered.” Using Engineer İkar’s 1914 map as a base layer, he sought to bring submerged strata to the surface by marking the fire zones as black stains and meticulously plotting lost buildings one by one. In this sense, his maps function as a form of restitution—not in the narrow legal sense, but as a cartographic reconstruction of an absent urban world. Köklü’s endeavor is best read as a sustained tension with the rationalist planning ethos of his time. He sought to re-signify the functional voids of modern planning with a sensibility close to Tuan’s notion of “fields of care.” By inscribing burned churches, hans, and neighborhood boundaries, he insisted that physical gaps remain, in collective memory, “phantom places”—places still experienced despite material disappearance. At the same time, these maps invite critical scrutiny: at moments, they may smooth over the past’s plurality and conflict in favor of an aesthetic coherence aligned with a “golden age” imaginary. Even so, Köklü’s cartographies exceed the status of technical documents. They operate as instruments of topophilic remembrance—a defense of place-memory against the “spatial freedom” promised by official reconstruction, that is, against a modernist regime of forgetting. Read this way, the maps perform a practice of mourning in the wake of the fire and a therapeutic intervention aimed at repairing the city’s damaged memory.

Keywords: *Urban memory, phantom pain, counter-mapping, Nusret Köklü, Manisa, 1922 fire, palimpsest*

Giriş

Kent, geometrik bir yapı yığınının ötesinde, toplumsal yaşanmışlıkların ve tarihsel katmanların iç içe geçtiği canlı bir organizma olarak kavranmalıdır. Yi-Fu Tuan'ın (1977) mekân ile yer arasında öngördüğü temel ayrım—mekânın soyut ve özgür, yerin ise yaşanmışlıklarla dolu ve güvenli olması—bu kavrayışın kuramsal zeminini oluşturur. Kimi kentler için mekânsal kayıp zamana yayılan bir aşınmadan ziyade ani ve şiddetli bir "amputasyon" biçiminde tezahür eder.

1922 Eylül'ünde vuku bulan “harîk-i kebîr” ile Manisa, fiziksel varlığının yüzde doksanını yitirerek (Bilgi, 2022) böylesi bir ontolojik yarılmanın merkezine konumlanmıştır.

Erken Cumhuriyet dönemi planlama anlayışı bu travmatik boşluğu modern bir ulus-devlet kenti inşa etmek için "tabula rasa" fırsatı olarak değerlendirmiştir. 1923 İmar Planı'nın ortaya koyduğu rasyonalist doku, kentin yüzyıllardır biriktirdiği aidiyet duygusunu—Tuan'ın (1974) "ihtimam alanları" (fields of care) olarak kavramsallaştırdığı samimi ortamları—geri plana itmiştir. İşte bu noktada mimar Nusret Köklü'nün (1924-2007) kartografik çalışmaları, resmî planlamanın dayattığı "modernist unutuşa" karşı sessiz bir itiraz olarak nitelik kazanır.

Köklü'nün Manisa Şehir Atlası'nda yangın alanlarını yoğun siyah dolgularla işaretlemesi, tıpta ampute edilen bir uzvun hâlâ oradaymış gibi hissedilmesi durumunu tanımlayan "fantom ağrı" metaforuyla açıklanabilir. Bu bildiri, Köklü'nün haritacılık pratiğini salt teknik bir belgeleme süreci olarak değil, kentsel hafızanın onarımına yönelik terapötik bir müdahale ve "mekânsal restitüyon" denemesi olarak çerçevelemektedir.

8 Eylül 1922'de sona eren Yunan işgali sırasında çekilen ordunun çıkardığı yangın, üç gün sürerek Manisa'nın 10.700 hanesinden 10.000'e yakınını yok etmiştir (Bilgi, 2022, s. 242; Köklü, 1976, s. 86). Bu felaket, binlerce ihtimam alanını bir anda kül ederek kenti anlamdan yoksun bir boşluğa indirgemiştir. Cumhuriyet modernizmi bu boşluğu paradoksal bir fırsat olarak değerlendirmiş; 21 Temmuz 1923'te onaylanan İmar Planı, Mühendis Selahattin ve ekibi tarafından rasyonel bir ızgara sistemi olarak tasarlanmıştır (Aydın, 2019, s. 111).

Bu radikal dönüşümü yalnızca ideolojik bir hafıza silme girişimi olarak okumak eksik kalacaktır. Plan, yangın riski taşıyan sıkışık ahşap dokuyu ve salgın hastalıklara zemin hazırlayan altyapı yetersizliklerini gidererek dönemin sağlıklı kent (sanitary city) paradigmasının da bir ürünüdür. Ancak plandaki rasyonel geometri, organik sokak dokusunu ve "yer" duygusunu ortadan kaldırırken 1915 Tehcir Kanunu ve Emval-i Metruke düzenlemeleri çerçevesinde Hazine mülkiyetine geçen Gayrimüslim taşınmazları anonim "boşluklar" olarak ele almıştır (Aydın, 2019, s. 143). Köklü'nün haritalarının önemi tam da bu bağlamda ortaya çıkar: Bu müdahaleler, "Burada yaşam vardı." şerhi olarak okunabilir.

2. Karşı-haritalama: Köklü'nün kartografik itirazı

İstanbul Güzel Sanatlar Akademisi mezunu Yüksek Mimar Nusret Köklü (1924-2007), Cumhuriyet'in modernleşme idealine sahip çıkan bir aydın ve siyasetçi olmasına karşın kentin hafızasının silinmesi karşısında sessiz bir itirazı başlatmıştır. (Güneş, Uğurlu & Yüksek, 2025, s. 68). Köklü'nün haritalama pratiği, kartografya literatüründe Nancy Peluso'nun (1995)

kavramsallaştırdığı karşı-haritalama (counter-mapping) eylemiyle tanımlanması gereken bir müdahaledir. Karşı-haritalama, resmi haritalarının otoritesine meydan okuyarak yerel halkın görünmez kılınan mekânsal varlıklarını yeniden haritaya dahil etme stratejisidir (Peluso, 1995, s. 384).

Köklü'nün beş ciltlik Manisa Şehir Atlası, resmî haritacılığın "boş arsa" olarak tanımladığı alanların zengin bir geçmişe sahip olduğunu kanıtlama çabasıdır. Resmî kadastro yangın alanlarını "boşalmış parseller" olarak işaretlerken Köklü ise bu boşluğa 1914 verileriyle müdahale etmiş; sinagog, kiliseler gibi temsili mekânlarla birlikte haritaya yeniden işleyerek haritayı bir itiraz belgesine dönüştürmüştür.

Köklü, referans noktası olarak felaketten hemen önceki tamlık hâlini temsil eden 1914 yılını tercih etmiştir. Mühendis İkar tarafından 1/2000 ölçeğinde hazırlanan bu harita, yangın öncesi döneme ait bilinen tek kapsamlı kartografik belgedir (Aydın, 2019, s. 99). Köklü'nün metodolojisi kartografik bir palimpsest yaratma eylemidir: 1914 haritasını altlık olarak kullanmış, 1923 planının rasyonel ızgarasını bu dokunun üzerine bindirmiştir.

Bu süperpozisyon, kâğıt üzerinde belirgin bir grafik gerilim üretir: Bir yanda topoğrafyayla uzlaşan, yumuşak eğrili Osmanlı çizgisi; diğer yanda bu dokuyu keskin biçimde ayıran, dik açılı Cumhuriyet çizgisi. Köklü, 1914'ün organik dokusunu siyah hatlarla, 1923 planının geometrik bulvarlarını orijinal haritada kırmızı ile gösterilen hatlarla işlemiştir. Bu grafik tercih, olan ile olması istenen arasındaki gerilimi açığa çıkaran bir kentsel arkeoloji niteliği taşır.

Köklü, Manisa Şehir Atlası'nın ikinci cildinde yangından etkilenen alanları yoğun siyah dolgularla işaretlemiştir (Köklü, 1993, s. 3). Teknik çizim standartlarında hasarlı alanlar genellikle tarama (hatching) ile gösterilir; bu yöntem alanın kısmen var ve onarılabilir olduğunu işaret eder. Köklü ise bilinçli bir semiyotik tercihle tam dolgu (solid fill) kullanmıştır. Bu yoğun siyah bloklar, alanın tamamen yok olmuş olduğuna ve geri getirilemeyecek bir kayba gönderimde bulunur. Dolgu, grafik dilde bir yokluk işareti olarak işlev görür.

Tıbbi literatürde fantom ağrı homojen bir sızıdan ibaret değildir; yanma, sıkışma, karıncalanma gibi farklı somatik tezahürleri vardır. Merleau-Ponty'nin (2012) vurguladığı üzere fantom uzuv ampute edilen parçanın belirsiz varlığıdır. Köklü'nün haritalarındaki siyah dolgular da farklı mekânsal deneyimlere karşılık gelen katmanlı bir ağrı yapısı sunar.

Öncelikli olarak yanma hissi biçiminde tanımlanabilecek travmatik kopuş ağrısı dikkat çeker. Köklü'nün yoğun siyah dolgularla işaretlediği alanlar, 1922 yangınının fiziksel şiddetinin

bellekteki kalıntısıdır. Köklü bu dolguların içini boş bırakmaz; 1914 haritasından aktardığı verilerle yanan kiliseleri, hanları ve konutları tek tek işler.

Bu bağlamı derinleştiren bir diğer unsur, sıkışma ve yön kaybı olarak adlandırılabilecek oryantasyonel ağrıdır. 1923 planının ızgara sistemi, organik sokak dokusuna alışkın bedenin hareket şemasını bozmuştur. Seamon'un (1979) beden balesi dediği ritmik rutinler kesintiye uğradığında, birey kendi kentinde yönünü bulamamanın yarattığı bir mekânsal vertigo yaşar. Köklü'nün 1914'ün kıvrımlı çıkmaz sokaklarını 1923'ün düz caddeleri üzerine çakıştırması, tam da bu sıkışma hissini gözler önüne serer.

Buna koşut olarak karıncalanma biçiminde nitelendirilebilecek hayalet işlevsellik ağrısı üzerinde durulmalıdır. Köklü, yalnızca konutları değil "Ulu Mezarlık" veya "Kışla Meydanı" gibi kamusal boşlukları da haritalarına işlemiştir (Aydın, 2019, s. 148). Bir meydanın kaybı, toplumsal ritüellerin gerçekleştiği uzvun kaybı gibidir. Bu alanların haritada eski işlevleriyle etiketlenerek yer alması, toplumsal hafızada hâlâ bir işlev talep edildiğini açığa çıkarır.

Köklü'nün haritaları, yukarıda betimlenen fantom ağrının kartografik karşılığıdır. Resmî kadastro mülkiyeti hak ve sınır olarak tanımlarken Köklü'nün haritaları mülkiyeti yaşanmışlık ve kimlik olarak ele alır. Özellikle emval-i metruke kapsamında Hazine adına tescil edilen Gayrimüslim mülklerinin asli kimliğini belgeleyen bu çalışma bir hafıza tapusu işlevi görmektedir. Tıpkı fantom ağrı çeken bir hastanın olmayan uzvuna aynayla bakarak beynini rahatlatması gibi (ayna terapisi), Köklü'nün haritaları da Manisa halkına yitirdikleri kenti geri yansıtarak yaslarını tamamlama imkânı sunmuştur.

Köklü'nün haritalarında çizdiği Manisa portresi, topofilyanın yoğun hâliyle yüklüdür. Geçmişi altın çağ olarak kurgulayan bu idealizasyon, riskli bir cazibe barındırır. Svetlana Boym'un (2002) onarıcı nostalji dediği türe yaklaşan bu tavır, geçmişi yeniden inşa edilmesi gereken tam ve bozulmamış bir bütün olarak tasarlar. Ancak geçmişi kutsama eğilimi de salt bir romantizm olarak eleştirilmemelidir. Köklü, modernist "mekân"ın geçmişin "yer"ini tamamen silerek değil, onu kapsayarak ve onunla diyaloğa girerek anlamlı bir "yere" dönüşebileceğini savunur. Yarattığı altın çağ imgesi, kentsel kimliğin tamamen silinmesini engellemiştir; nitekim Köklü'nün Çarşı bölgesindeki Bedesten ve Kurşunlu Han'ı haritalarında ısrarla işlemesi, bu yapıların günümüze ulaşmasında zihinsel bir altyapı oluşturmuştur (Aydın, 2019, s. 185).

3. Hafıza, planlama ve bugüne dair sorular

Nusret Köklü'nün çalışmaları, Manisa kent tarihi için salt bir veri deposu değil, metodolojik bir derstir. Karşı-haritalama (counter-mapping) pratiğinin erken ve özgün bir örneğini sunan bu

çalışma, resmî kartografyanın görünmez kıldığı toplulukları ve mekânları yeniden görünür kılmıştır. Köklü'nün siyah dolguları, bir yas ilanı olduğu kadar geleceğin planlamacılarına bir uyarıdır: Mekân asla boş değildir; her boş parselin altında, hatırlanmayı bekleyen bir yer yatmaktadır.

Teknik çizim dilinde tarama yerine tam dolgu tercih etmesi, bu alanların onarılabilir hasarlar değil geri dönüşü olmayan kayıplar olduğunu grafik düzlemde ilan etmektedir. Bununla birlikte, nesnel bir okuma bu kaydın inşa edilmiş bir temsil olduğunu göz ardı etmemelidir.

Modernist ızgara planın da zamanla kendi "yerlerini" yaratma potansiyeli vardır; ancak Manisa'daki travmatik kopuş bu potansiyelin tam olarak gerçekleşmesini engellemiştir. Sorun geometrinin kendisinde değil, sürekliliğin koparılmasındadır.

Son tahlilde kentlerin tarihini anlamak ve bugüne tercüme etmek üzere, Köklü'nün bıraktığı mirası eleştirel bir ipucu olarak okumaktır. Onun bıraktığı miras, mimarlığın ve şehirciliğin sadece inşa etmekle değil, bununla beraber geçmişin hafızasını onarmakla da yükümlü olduğunu hatırlatmakta ve daha önemlisi, her yeni planlama müdahalesinin hangi fantom ağrıları üreteceğini sorgulamamız gerektiği konusuna dikkat çekmektedir.

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PASİF EV KRİTERLERİ VE GELENEKSEL KONUT PLAN MORFOLOJİSİ: FORM FAKTÖRÜ ODAKLI BİR DEĞERLENDİRME

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ÖZET

Dünya genelinde küresel enerji tüketimi ve karbon emisyonlarının önemli bir yüzdesi, binalar ve inşaat sektörü birlikte ele alındığında, yapılaşma faaliyetleri kaynaklıdır. İnşaat sektöründe enerji kullanımının önemli bir kısmı ise konut yapılarıyla ilişkilidir. Enerji etkin yapı tasarımı kriterlerine uygun uluslararası kabul görmüş Pasif Ev standardı, ısıtma ve soğutma enerjisi kullanımını düşürmeyi hedefleyen bir yaklaşımdır. Genellikle yüksek performanslı yalıtım, sızdırmazlık ve mekanik sistemlerle ilişkilendirilen bu yaklaşımın, yüzyıllar boyunca yerel iklim koşullarına uyum sağlayarak gelişmiş geleneksel konut mimarisiyle özellikle yapı formu ve plan kurgusu düzeyinde örtüşen yönlerinin değerlendirilmesi, sürdürülebilir mimarlık açısından önemli bir araştırma alanı oluşturmaktadır. Bu çalışmada, Pasif Ev kriterleri ile geleneksel konutların yapı formu ve mekânsal organizasyonu arasındaki ilişkileri ele alan araştırmalar incelenmiştir. Literatürde yer alan bulgular doğrultusunda yüzey/hacim (A/V) oranı, mekânsal zonlama ve pasif iklimlendirme stratejileri karşılaştırmalı olarak değerlendirilmiştir. İncelenen literatür, yapı kütlesinin kompaktlığı ve yüzey/hacim oranının enerji performansını etkileyen tasarım değişkenleri olduğunu göstermektedir. Çalışma kapsamında değerlendirme mevcut literatür bulguları üzerinden yürütülmüştür. Geleneksel Türk evlerindeki özellikle kapalı sofa düzenlerinin, mekânsal zonlama ve ara mekân oluşturma özellikleri bakımından Pasif Ev yaklaşımındaki bazı tasarım stratejileriyle kavramsal benzerlikler taşıdığı değerlendirilmiştir. Çalışma, geleneksel konut plan morfolojisinin Pasif Ev tasarımında kullanılan bazı yaklaşımlarla kavramsal benzerlikler taşıdığını ve bu yaklaşımların çağdaş yapı kabuğu ve hava sızdırmazlığı çözümleriyle birlikte değerlendirilebileceğini ortaya koymaktadır.

Anahtar Kelimeler: Pasif Ev kriterleri, sürdürülebilir mimarlık, geleneksel konut planı, tasarım analizi, konut morfolojisi, form faktörü

PASSIVE HOUSE CRITERIA AND TRADITIONAL RESIDENTIAL PLAN MORPHOLOGY: AN EVALUATION FOCUSED ON THE FORM FACTOR

ABSTRACT

A significant proportion of global energy consumption and carbon emissions is attributable to building and construction activities when buildings and the construction sector are considered

together. A substantial share of energy use in the construction sector is associated with residential buildings. The internationally recognized Passive House standard, which is based on energy-efficient building design criteria, aims to reduce heating and cooling energy consumption. Although this approach is generally associated with high-performance insulation, airtightness, and mechanical systems, examining its similarities with traditional residential architecture, which has evolved over centuries in response to local climatic conditions, particularly in terms of building form and spatial layout, represents an important area of research in sustainable architecture. This study reviews research examining the relationships between Passive House criteria and the building form and spatial organization of traditional housing.Based on findings reported in the literature, the surface-to-volume (A/V) ratio, spatial zoning, and passive climate control strategies are comparatively evaluated. The reviewed literature indicates that building compactness and the surface-to-volume ratio are design variables that influence energy performance. The assessment was conducted based on existing findings in the literature. In particular, enclosed sofa arrangements in traditional Turkish houses are considered to share conceptual similarities with certain design strategies employed in the Passive House approach in terms of spatial zoning and the creation of transitional spaces. The study indicates that traditional residential plan morphology shares conceptual similarities with certain approaches used in Passive House design and that these approaches can be considered alongside contemporary building envelope and airtightness solutions.

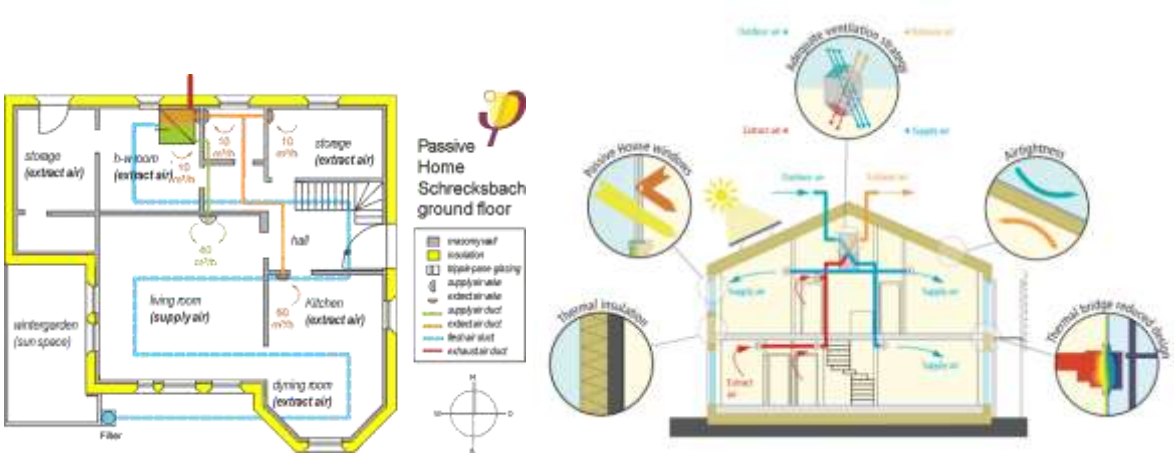
Keywords: Passive house criteria; sustainable architecture; traditional residential plan; design analysis; residential morphology; form factor.

1. GİRİŞ

Bina ve inşaat sektörü, küresel enerji tüketimi ve karbon emisyonlarında önemli bir paya sahiptir. Bu nedenle enerji etkin yapı tasarımı, iklim değişikliğiyle mücadelede önemli bir araştırma ve uygulama alanı olarak öne çıkmaktadır (UNEP, 2026). 1970'li yıllardaki enerji krizlerinin ardından, binaların enerji gereksinimini azaltmaya yönelik çalışmalar hız kazanmıştır. Bu süreçte ısı yalıtımı ve ısı geri kazanımlı havalandırma gibi çözümler düşük enerjili bina tasarımında öne çıkmıştır (Steinmüller, t.y.).

İlk Pasif Ev, 1990–1991 döneminde Almanya'nın Darmstadt-Kranichstein semtinde hayata geçirilmiş ve 1991 yılında kullanıma alınmıştır (Schnieders vd., 2015). Schnieders vd. (2015) tarafından açıklanan işlevsel tanıma göre Pasif Ev, ısıtma, soğutma ve nem alma gereksinimlerinin, iç hava kalitesi için gerekli olan taze besleme havasının koşullandırılmasıyla

karşılanabildiği binadır. Farklı iklim bölgeleri için geliştirilen Pasif Ev modellerinin yıllık iklimlendirme enerjisi gereksiniminin, aynı geometriye sahip geleneksel yalıtımlı binalara kıyasla %75–95 oranında daha düşük olduğunu belirlemiştir. Ayrıca Almanya ve benzer iklimlerdeki Pasif Ev uygulamalarında, geleneksel yeni binalara göre ısıtma enerjisinde %80–90 oranında tasarruf sağlandığını belirtmiştir. Pasif Ev standardında yıllık mekân ısıtma enerjisi talebi 15 kWh/(m²·yıl) ile sınırlandırılmıştır. Yüksek ısıl performanslı dış duvarlar, çatı ve pencerelerden oluşan bina kabuğu, dış ortamla gerçekleşen ısı geçişini sınırlandırarak enerji gereksiniminin azaltılmasına katkı sağlamaktadır. İnsanlardan kaynaklanan iç ısı kazançları ve güneş ışınımından elde edilen pasif ısı kazanımları, uygun koşullarda ısıtma gereksinimini azaltabilmektedir. Isı geri kazanımlı mekanik havalandırma sistemi ise gerekli taze hava miktarını sağlayarak iç hava kalitesinin korunmasına katkıda bulunmaktadır (Schnieders vd., 2015), (Şekil 1).



Şekil 1. Pasif Ev yaklaşımında ısı yalıtımı, hava sızdırmazlığı ve kontrollü havalandırma sistemlerinin mekânsal organizasyonla ilişkisi (URL-1 ve URL-2).

Almanya'da tasarlanan ilk yapı örneklerinde enerji kazanımı ve konforu sağlanmış olsa da ılıman iklim özelliklerine sahip bölgelerde bu pasif ev uygulamalarının soğutma enerjisi bakımından aynı düzeyde performans sergilemesi her zaman mümkün olmamaktadır. Bu bağlamda Antalya'da yapılan bir çalışmada soğutma yüklerinin Pasif Ev standartlarını karşılamada yetersiz kaldığı saptanmıştır (Demirel, 2013). Dirençli soğutma üzerine yürütülen çalışmalar, sıcak hava dalgalarına karşı yalnızca yapı kabuğunun ısıl performansını artırmaya odaklanmanın her durumda yeterli olmayabileceğini; pasif yapı kabuğu önlemlerinin düşük enerjili veya aktif soğutma stratejileriyle birlikte değerlendirilmesi gerektiğini ortaya koymaktadır (Attia vd., 2021; Zhang vd., 2021). Gece havalandırması ise bu stratejilerden biri

olmakla birlikte, etkinliği iklim koşullarına bağlıdır ve gerektiğinde ek soğutma önlemleriyle desteklenmelidir (Zhang vd., 2021).

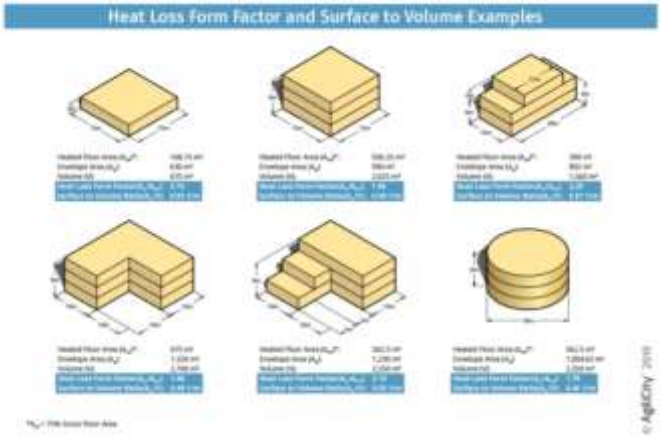
2. YÖNTEM

Bu çalışma, Pasif Ev kriterleri ile geleneksel konut mimarisinin plan morfolojisi ve mekânsal organizasyon ilkeleri arasındaki ilişkileri, mevcut literatür bulguları doğrultusunda karşılaştırmalı olarak değerlendirmektedir. Araştırma, çağdaş yapı fiziğinin enerji verimliliğine yönelik yaklaşımları ile geleneksel konut mimarisindeki yapı formu ve mekânsal organizasyon arasındaki ilişkiyi incelemeyi amaçlamaktadır. Çalışmanın yöntemsel kurgusu, ortaya koyduğu nicel performans hedefleri ile geleneksel mimarinin sunduğu nitel mekânsal organizasyon ilkelerini bir arada değerlendiren analitik bir çerçeve üzerine inşa edilmiştir. Literatür incelemesi üç aşamada yürütülmüştür. İlk aşamada, Pasif Ev kriterlerine uygunluğun değerlendirilmesi amacıyla uluslararası simülasyon çalışmaları ve literatürde yer alan derlemeler incelenmiştir. Bu kapsamda Schnieders vd. (2015) ile Rodríguez-Ubiñas vd. (2014) tarafından gerçekleştirilen çalışmalar temel referanslar olarak kullanılmıştır. İkinci aşamada, literatürde tanımlanan termal tampon bölge, mekânsal zonlama ve hizmet çekirdeği gibi planlama ilkeleri, geleneksel konut mimarisindeki sofa ve servis mekânlarıyla ilişkileri açısından kavramsal düzeyde değerlendirilmiştir. Bu değerlendirmede, ısıtılan ve ısıtılmayan hacimlerin ayrıştırılmasına ilişkin mevcut araştırmalarda sunulan yaklaşımlar ve plan şemaları esas alınmıştır (Schnieders vd., 2015). Üçüncü aşamada ise farklı iklim bölgelerinde gerçekleştirilen çalışmalarda ortaya konulan bulgular, yapı formu, mekânsal organizasyon ve pasif iklimlendirme stratejileri açısından karşılaştırmalı olarak değerlendirilmiştir. Bu çerçevede, Pasif Ev yaklaşımında öne çıkan termal tampon bölge oluşturma, mekânsal zonlama ve mekânsal hiyerarşi ilkeleri ile geleneksel konut mimarisindeki sofa ve kompakt plan düzenleri arasındaki benzerlikler ve farklılıklar, literatür bulguları doğrultusunda kavramsal olarak değerlendirilmiştir.

3. BULGULAR ve TARTIŞMA

Bir binanın tasarım sürecinde iklim koşullarına göre mimari formun belirlenmesi, kullanılacak mekanik sistemlere dayalı enerji yükünün azalmasında önemli rol oynamaktadır. Buna göre bir yapıdaki enerji kaybı, ısı geçişine maruz kalan yüzey alanı ile doğru orantıya sahiptir. Rodríguez-Ubiñas vd. (2014), Solar Decathlon Europe 2012 kapsamında izlenen konutlarda, yapı kabuğunun ısıl geçirgenliğinin yanı sıra yönlenme ve geometrik oranların da ısıl konfor ve

enerji performansı üzerinde belirleyici olduğunu ortaya koymuştur. Bina geometrisindeki girinti ve çıkıntıların artması, dış ortamla temas eden yapı kabuğu yüzeyini genişleterek yüzey/hacim oranının yükselmesine neden olabilmektedir (Rodríguez-Ubiñas vd., 2014). Buna karşılık, kompakt kütlesel formlar birim hacim başına düşen dış yüzey alanını azaltarak özellikle ısıtma enerjisi gereksiniminin sınırlandırılmasına katkı sağlayabilmektedir (Schnieders vd., 2015). Bununla birlikte, yapı formunun toplam enerji performansı üzerindeki etkisi iklim koşulları, güneş kazanımları ve doğal havalandırma gibi diğer pasif tasarım stratejileriyle birlikte değerlendirilmelidir (Rodríguez-Ubiñas vd., 2014; Manioğlu ve Koçlar Oral, 2015). Bu çalışmada bina kütlesinin kompaktlığı, ısıl kabuk alanının (A) koşullandırılmış bina hacmine (V) oranını ifade eden yüzey/hacim (A/V) göstergesi üzerinden kavramsal olarak değerlendirilmektedir. Bu gösterge, plan şeması, kat sayısı ve kütle geometrisinin dış kabuk alanıyla ilişkisini değerlendirmeye olanak sağlamaktadır (Şekil 2), (Rodríguez-Ubiñas vd., 2014).



Şekil 2. Farklı bina geometrilerinde yüzey/hacim oranı ve ısı kaybı form faktörünün karşılaştırılması (Vidmar, 2019; URL-4).

Yüzey/hacim (A/V) oranının azalması, diğer koşullar sabitken dış ortamla ısı alışverişinde bulunan yapı kabuğu alanını azaltarak özellikle ısıtma enerjisi gereksiniminin sınırlandırılmasına katkı sağlayabilmektedir (Rodríguez-Ubiñas vd., 2014; Schnieders vd., 2015). Rodríguez-Ubiñas vd. (2014), Solar Decathlon Europe 2012 kapsamında incelenen konutların yapı formu ile ısıl performansları arasındaki ilişkiyi değerlendirmiştir. Çalışmada, en düşük yüzey/hacim oranına sahip üç konutun değerleri 0,80–0,93 m^{-1} arasında değişirken, incelenen yedi konutun ortalaması 1,15 m^{-1} olarak belirlenmiştir. Bu bulgular, yüzey/hacim

oranının yapı formu ve enerji performansının değerlendirilmesinde önemli bir gösterge olduğunu ortaya koymaktadır.

Kütle bütünlüğünün bozulmasının doğrudan yalıtım gereksinimine yansıdığı, Schnieders vd. (2015)'in Tokyo için geliştirdiği Pasif Ev tasarımında da görülmektedir: zemin katta otopark için oluşturulan girinti ve çatı terası, önemli tasarım öğeleri olmakla birlikte yapının kompaktlığını azaltmakta ve buna bağlı olarak yalıtım gereksinimini artırmaktadır. Bu bulgular, yüzey/hacim oranının yalnızca teknik bir hesaplama parametresi değil, doğrudan plan morfolojisiyle ilişkili temel bir tasarım göstergesi olduğunu ortaya koymaktadır (Schnieders vd., 2015; Rodríguez-Ubiñas vd., 2014). Geleneksel Türk konut mimarisinde iklim koşulları ve yerel gereksinimler doğrultusunda farklı kütle biçimlenişleri görülmektedir. Bazı konut örneklerinde kompakt plan düzenleri ve bitişik yapılaşma, dış ortamla temas eden yüzeylerin sınırlandırılması açısından önem taşımaktadır.

Gezer (2013), geleneksel Safranbolu evlerinde bu biçimlenişin iklim koşullarına ve arazi yapısına uyum yoluyla geliştiğini; yüksek tutulan bahçe duvarlarının soğuk hava ve rüzgârın önünü kestiğini, gündelik yaşamın geçtiği orta katın ise soğuk kış günlerinde kolay ısıtılabilmesi için üst kata göre daha alçak (2,3–3 m) tavan yüksekliğinde tutulduğunu belirtmektedir. Örneğin İskilip evlerinde yapıların yan yana, bitişik düzende konumlandırılmasının soğuk rüzgârlara karşı alınmış bilinçli bir önlem olduğu ve evlerin kışın fazla ısı kaybetmemek için kareye yakın bir formda kurgulandığı belirtilmektedir (Koşan, 2021).

Özdemir ve Bektaş Ekici (2020) tarafından Harput Şefik Gül Evi üzerinde gerçekleştirilen simülasyon çalışmasında, yüzey alanının büyük bir bölümü toprak altında bulunan tandır evinin yapı içerisindeki en düşük soğutma yüküne sahip mekân olduğu belirlenmiştir. Yapının ısıtma, soğutma ve aydınlatma gereksinimlerinin toplamı ise yıllık 125,21 kWh/m² olarak hesaplanmıştır. Bulgular, geleneksel konutlarda yapı elemanlarının toprakla temasının ve mekânsal özelliklerin soğutma performansı üzerindeki etkilerinin değerlendirilmesi açısından önem taşımaktadır.

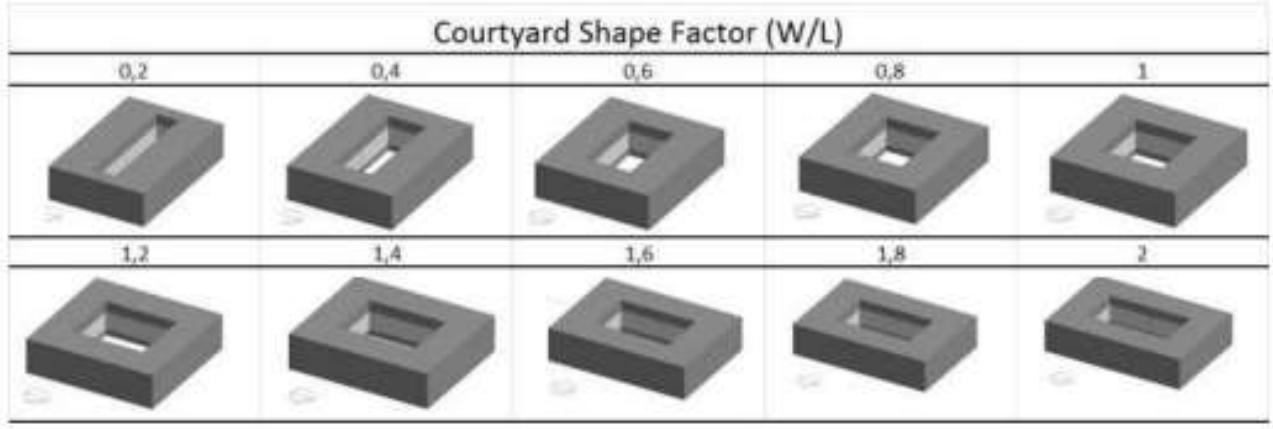
Demirel (2013), Türkiye'nin farklı iklim bölgelerinde Pasif Ev kriterlerinin uygulanabilirliğini incelemiştir. Antalya iklim koşullarında değerlendirdiği dört bina kabuğu alternatifinde yıllık soğutma enerjisi gereksiniminin 31–43 kWh/m² arasında değiştiğini belirlemiştir. Bu sonuç, sıcak iklim bölgelerinde ısıtma enerjisinin yanı sıra soğutma gereksiniminin de tasarım sürecinde dikkate alınması gerektiğini göstermektedir. Schnieders vd. (2015), farklı iklim

bölgelerinde geliştirilen Pasif Ev modellerinin enerji performanslarını incelemiştir. Çalışmada, sıcak iklim koşullarında ısıtma enerjisi gereksiniminin ortadan kalkabildiği, buna karşılık özellikle sıcak ve nemli iklimlerde soğutma ve nem alma enerjisi ihtiyacının önem kazandığı ortaya konmuştur. Bu nedenle sıcak iklimlerde güneş kontrol camları, geniş saçaklar ve açık renkli dış yüzeyler gibi pasif tasarım çözümlerinin soğutma yüklerinin azaltılmasında önemli rol oynadığı belirtilmiştir.

Bu noktada geleneksel konut mimarisinde kullanılan yapı malzemeleri ve mekânsal çözümler dikkat çekmektedir. Koşan (2021), geleneksel İskilip evlerinde kullanılan kerpiç ve alçı gibi yapı malzemelerinin gündüz güneş ısısını depolayarak gece boyunca iç mekânın sıcak kalmasına katkı sağladığını belirtmiştir. Algburi (2018), geleneksel konut mimarisinden yararlanılarak geliştirilen pasif soğutma stratejilerinin birlikte uygulandığı bir simülasyon senaryosunda, temmuz ayındaki toplam soğutma yükünün 6.997 kWh'ten 4.461 kWh'e düştüğünü göstermiştir.

Mushtaha vd. (2021), ılıman iklim koşullarında gerçekleştirdikleri simülasyon çalışmasında, gölgeleme, doğal havalandırma, ısı yalıtımı ve pencere/duvar oranının azaltılmasını içeren birleşik pasif tasarım senaryosunun, başlangıç modeline kıyasla toplam dış soğutma yükünü %59 oranında azalttığını göstermiştir. Avlulu yapı tipolojilerinde enerji performansı, yalnızca yüzey/hacim oranına bağlı olmayıp avlunun geometrisi ve oluşturduğu gölgelenme koşullarıyla birlikte değerlendirilmelidir.

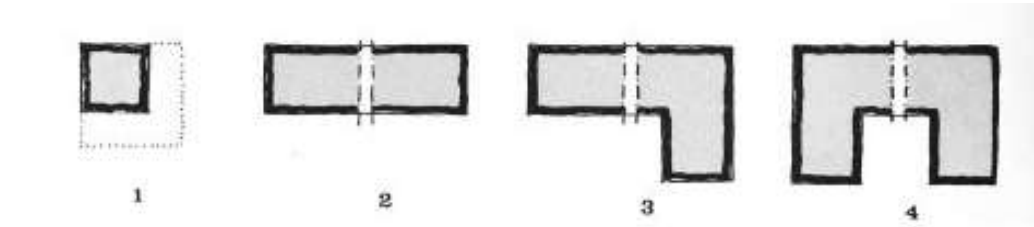
Manioğlu ve Koçlar Oral (2015), sıcak-kurak iklim koşullarında avlulu yapı formlarının enerji performansını incelemiştir. Çalışmada, bina formunu tanımlayan yüzey/hacim (A/V) oranı 1 değerinde sabit tutulurken, avlu genişliğinin uzunluğuna oranı (W/L) değiştirilerek farklı avlu geometrileri oluşturulmuştur. Simülasyon sonuçları, avlu şekil faktörünün güneş kazanımları ile ısıtma ve soğutma yüklerini etkilediğini; en uygun oranın bina büyüklüğüne ve değerlendirmeye alınan enerji yüküne göre değişebildiğini göstermiştir (Şekil 3).



Şekil 3. Avlu şekil faktörüne (W/L) göre farklılaşan bina geometrileri (Manioğlu ve Koçlar Oral, 2015)

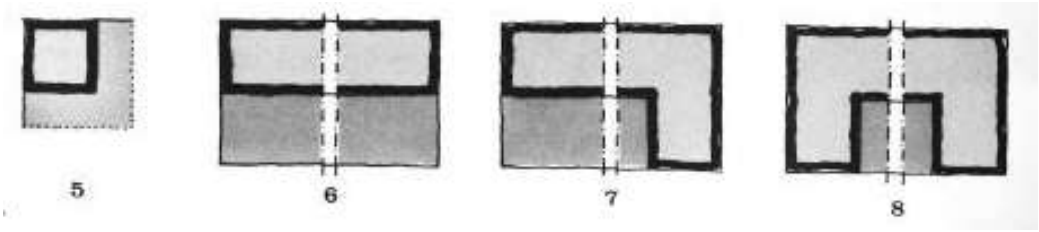
Mekânsal zonlama stratejileri de binaların enerji performansını etkileyebilmektedir. Özellikle soğuk iklimlerde merdiven, koridor ve servis hacimlerinin yaşam alanları ile dış çevre arasında termal tampon bölge oluşturacak biçimde düzenlenmesi, ısı kayıplarını sınırlandırmaya yönelik bir tasarım yaklaşımı olarak değerlendirilmektedir. Schnieders vd. (2015), Yekaterinburg için geliştirilen Pasif Ev tasarımında merdiven ve asansörün ayrı ve ısıtılmayan bir hacim içine alındığını; bu çözümün termal kabuk içindeki kullanılabilir alanı azamiye çıkarırken hava sızdırmazlığının sağlanmasını ve ısıtılmayan bodruma doğru oluşan ısı köprülerinin azaltılmasını kolaylaştırdığını aktarmaktadır. Bu örnek, dolaşım ve servis hacimlerinin konumlandırılmasında iklim koşullarının ve ısıtılan mekânlarla kurulan ilişkinin dikkate alınmasının önemini göstermektedir.

Geleneksel Türk evlerinde sofalar, odalar arasında dolaşımı sağlayan ve plan tipine göre farklı biçimlerde düzenlenen ortak mekânlardır. Özellikle kapalı sofa düzenleri, odalar ile dış çevre arasında ara mekân oluşturabilmeleri bakımından termal tampon bölge yaklaşımıyla ilişkilendirilebilir. Koşan (2021), geleneksel İskilip evlerinde gusülhanelerin oda içinde yüklük ve ocaklıkla ilişkili biçimde düzenlendiğini ve ocaktan sağlanan ısının banyo mekânının ısıtılmasında kullanıldığını belirtmektedir. Geleneksel Türk evi planları, sofa kullanımına ve sofanın konumuna göre farklılaşmaktadır. Bu plan tipleri, mekânların dış çevreyle ilişkisi ve iklim koşullarına uyum açısından değerlendirilebilir (Küçükerman, *Türk Evi*; aktaran URL-3). Sofasız plan tiplerinde odalar arasındaki dolaşım, avlu veya açık alanlar üzerinden sağlanmaktadır. Bu plan düzenine özellikle sıcak iklim koşullarının görüldüğü güney bölgelerinde rastlanmaktadır (Küçükerman, *Türk Evi*; aktaran URL-3) (Şekil 4).



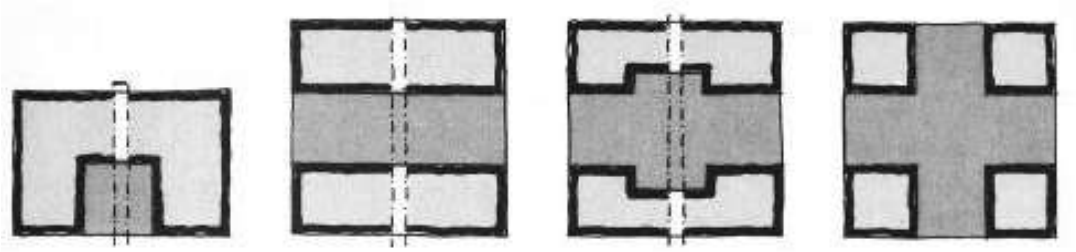
Şekil 4. Sofa Kullanılmayan Geleneksel Konut Tipolojileri (Küçükerman, *Türk Evi*; aktaran URL-3).

Dış sofalı plan tiplerinde odalar arasındaki dolaşım, dış mekâna açılan üstü örtülü bir sofa aracılığıyla sağlanmaktadır. Bu yarı açık mekân, dolaşım işlevinin yanı sıra güneş ve yağmur gibi çevresel etkilere karşı belirli ölçüde koruma sağlayan bir geçiş alanı olarak değerlendirilebilir (Şekil 5).



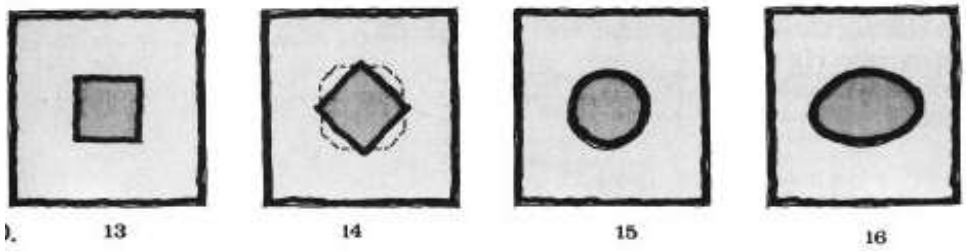
Şekil 5. Dış Sofalı Geleneksel Konut Tipolojileri (Küçükerman, *Türk Evi*; aktaran URL-3).

İç sofalı plan tiplerinde sofa, yapı kütlesinin içinde konumlanarak odalar arasındaki dolaşımı sağlamaktadır. Bu düzenleme, dış çevreye daha kapalı bir mekânsal organizasyon oluşturmakta ve iklim koşullarına karşı korunaklı bir geçiş alanı sunabilmektedir (Şekil 6).



Şekil 6. İç Sofalı Geleneksel Konut Tipolojileri (Küçükerman, *Türk Evi*; aktaran URL-3).

Orta sofalı plan tiplerinde sofa, yapı kütlesinin merkezinde konumlanmakta ve odalar bu ortak mekânın çevresinde düzenlenmektedir. Bu plan kurgusu, mekânların bir merkez etrafında toplanması bakımından kompakt yapı formuyla kavramsal olarak ilişkilendirilebilir (Şekil 7).



Şekil 7. Orta Sofalı Geleneksel Konut Tipolojileri (Küçükerman, *Türk Evi*; aktaran URL-3).

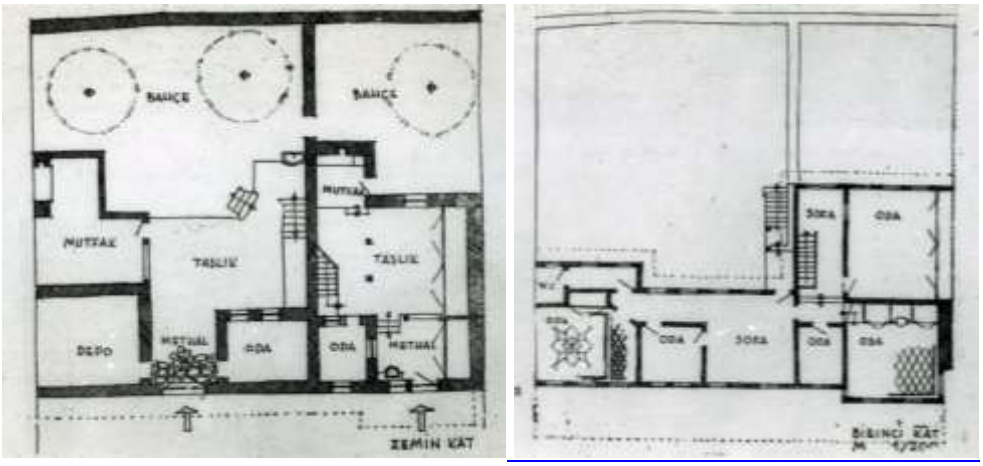
Geleneksel Türk evlerinde mekânsal organizasyon, yatay düzlemin yanı sıra katlar arasında da farklılaşmaktadır. Koşan (2021), İskilip evlerinde zemin katların ağırlıklı olarak depolama ve servis

işlevleri için kullanıldığını, yaşam alanlarının ise ara ve üst katlarda düzenlendiğini belirtmektedir. Bu işlevsel ayrım, Pasif Ev yaklaşımında ısıtılan ve ısıtılmayan hacimlerin mekânsal organizasyonu açısından kavramsal benzerlikler taşımaktadır (Şekil 8).

SONUÇ

İncelenen literatür, Pasif Ev tasarımında bina geometrisi ve yüzey/hacim oranının enerji performansını etkileyen önemli parametreler arasında yer aldığını göstermektedir. Kompakt yapı formları, dış ortamla ısı alışverişinde bulunan kabuk alanını sınırlandırarak özellikle ısıtma enerjisi gereksiniminin azaltılmasına katkı sağlayabilmektedir. Bununla birlikte, sıcak iklim bölgelerinde soğutma gereksiniminin de dikkate alınması ve yapı kabuğuna yönelik önlemlerin iklime uygun pasif soğutma stratejileriyle birlikte değerlendirilmesi önem taşımaktadır.

Geleneksel Türk evlerinde görülen kapalı sofa düzenleri, yaşam alanları ile geçiş mekânlarının organizasyonu bakımından Pasif Ev tasarımında kullanılabilen mekânsal zonlama yaklaşımlarıyla kavramsal benzerlikler göstermektedir. Benzer şekilde, geleneksel konutlarda kullanılan avlu düzenlemeleri, iklim koşullarına ve avlu geometrisine bağlı olarak gölgelenme sağlayabilmekte ve soğutma enerjisi gereksiniminin azaltılmasına katkıda bulunabilmektedir (Manioğlu ve Koçlar Oral, 2015).



Şekil 8. Geleneksel Türk Evi Yatay ve Dikey Zonlama Kurgusu (Salt Araştırma, Harika-Kemali Söylemezoğlu Arşivi)

Sonuç olarak, geleneksel konut mimarisinde görülen yapı formu, mekânsal zonlama ve avlu gibi tasarım yaklaşımlarının, Pasif Ev standartlarında öne çıkan ısı yalıtımı ve hava sızdırmazlığı ilkeleriyle birlikte ele alınması, iklime duyarlı ve enerji etkin konut tasarımı açısından potansiyel sunmaktadır. Bununla birlikte, söz konusu yaklaşımların enerji performansı üzerindeki etkilerinin nicel olarak ortaya konulabilmesi için farklı iklim koşullarında gerçekleştirilecek karşılaştırmalı enerji simülasyonlarına ihtiyaç bulunmaktadır.

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ISSUES OF DEVELOPING THE INFRASTRUCTURE OF THE REAL ESTATE MARKET IN UZBEKISTAN

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Abstract

This article analyzes the concept of real estate market infrastructure, its main components, and its impact on economic efficiency. The role of infrastructure elements such as the cadastral system, financial institutions, insurance organizations, real estate agencies, and information platforms within economic mechanisms is examined. The research findings indicate that a developed infrastructure improves the investment climate in the real estate market, increases transaction transparency, and accelerates economic growth.

Keywords: real estate market, infrastructure, economic efficiency, investment, cadastral system, mortgage, digital platforms.

Introduction. The real estate market is one of the key sectors of the economic system, and its infrastructure ensures the stable functioning of the entire system. Infrastructure represents an interconnected system of financial, legal, informational, and organizational institutions. It supports processes related to the construction, valuation, registration, financing, and execution of real estate transactions.

In recent years, the growth rate of the real estate market in Uzbekistan has increased significantly. This is explained, on the one hand, by the expansion of state mortgage lending programs and, on the other hand, by the intensification of urban development policy. From this perspective, assessing the economic efficiency of market infrastructure has become a highly relevant issue.

Research Methodology. The research was conducted using the following scientific approaches:

- **System analysis** – identifying the structural components of the real estate market infrastructure and assessing their interconnections.
- **Statistical analysis** – examining key indicators of infrastructure development based on data from the State Statistics Committee of Uzbekistan and the Central Bank.
- **Comparative analysis** – conducting a comparative study with the experiences of Russia, Kazakhstan, and Turkey.

- **Expert survey** – assessing the economic impact of infrastructure based on the opinions of economists and construction sector experts.
- **Indicator system** – developing indicators (RII – Real Estate Infrastructure Index) to measure infrastructure efficiency.

Statistical data from the period **2015–2025** were used in the study.

Results. The infrastructure of the real estate market in Uzbekistan consists of the following elements:

- **Legal system:** Land Code, Cadastral Agency, and Notary system.
- **Financial sector:** mortgage lending, bank guarantees, insurance system.
- **Information system:** "E-Cadastre," "Single Window" platforms, online agencies.
- **Construction infrastructure:** design, contracting, supervision, and expertise systems.

The coordination among these elements enhances economic efficiency.

During the study, the following indicators were analyzed to assess economic efficiency:

Indicator	2015	2020	2024	Growth (%)
Volume of mortgage loans (trillion UZS)	3.5	12.8	26.4	+654
Share of construction investments (%)	8.4	10.7	12.1	+44
New residential area (million m²)	10.3	18.5	24.7	+140
Digital registration of transactions (%)	12	48	76	+533

These data demonstrate that infrastructure development directly increases economic efficiency.

A developed infrastructure enhances the speed and reliability of transactions. As a result of the development of mortgage mechanisms, banks' loan portfolios have become more stable. In 2024, the repayment rate of mortgage loans reached **95%**, indicating a reduction in financial risks.

Infrastructure development also creates new jobs, increases housing provision, and improves living standards. Between **2015 and 2024**, the construction sector created more than **200,000 new jobs**.

Discussion. Although the infrastructure of the real estate market in Uzbekistan has not yet been fully formed, significant positive changes have been observed in recent years. However, the analysis reveals several problems:

- The unified database of information has not yet been fully integrated.

- The insurance system remains underdeveloped, and risk management mechanisms are weak.
- There are regional disparities in infrastructure development.
- Coordination between the construction and financial sectors is insufficient.

Recommendations:

- Complete the digitalization of the cadastral system by fully launching an online registry of property rights.
- Expand insurance infrastructure by introducing mandatory insurance for real estate transactions.
- Integrate information systems by unifying “E-Cadastre,” “State Notary,” and “Mortgage” databases into a single platform.
- Increase investment attractiveness by implementing infrastructure projects in cooperation with the private sector (PPP model).

Conclusion. According to the research findings, the level of development of real estate market infrastructure has a direct impact on national economic efficiency. An effective infrastructure:

- accelerates capital circulation;
- strengthens intersectoral linkages within the economy;
- attracts new investments;
- improves public welfare.

For Uzbekistan, the priority task is to fully digitalize real estate infrastructure, improve financial and legal mechanisms, and align the sector with international standards.

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TARİHİ YAPILARDA KİMLİĞİN KORUNMASI: AMSTERDAM RİJKSMUSEUM'IN İÇ MEKAN ORGANİZASYONU

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ÖZET

Bugün tarihi yapıların korunması için yapılan restorasyon, renovasyon ve rekonstrüksiyon çalışmaları süreklilik ve sürdürülebilirlik anlamında yeterli gelmemektedir. Yapının yeni bir kimlik kazanması ya da mevcut kimliğini yeniden ortaya koyabilmesi için hayatın içinde kendine bir yer edinmesi gerekmektedir. Bu çalışmanın amacı sergileme mekanı kimliği korunarak yenilenmiş olan, Hollanda'nın Amsterdam kentinde bulunan Rijksmuseum (Ulusal Müze) adlı müze yapısını kimlik kavramı ve iç mekân organizasyonu bakımından analiz etmektir. Araştırmada nitel yöntemlerden yararlanılmış, kaynak ve literatür çalışması gerçekleştirilmiş, yerinde inceleme ve saha araştırması ile yerinde gözlem yapılmış ve edinilen verilerin değerlendirilmesinde betimleyici analiz ve mekânsal analiz yöntemlerinden yararlanılmıştır. Bu bina Pierre Cuypers tarafından tasarlanmış ve yapımı 1885 yılında tamamlanmış neo gotik ve neo rönesans tarzlarının iç içe geçtiği eklektik bir sergileme yapısıdır.

Bina 2013 yılında yenilenerek çağdaş müzecilik anlayışına uygun biçimde dış kabuk korunarak güncellenmiştir. Bu süreç Oeke Hoogendijk tarafından bir belgesele dönüştürülmüştür (Hoogendik, 2016) Bu güncelleme ile mekân organizasyonu ziyaretçiyi yönlendiren bir sirkülasyon anlayışı kazanmış ve koleksiyonlar kronolojik yerleştirme yaklaşımı ile düzenlenmiştir. Bu esnada yapı kimliği korunmuş ve sunduğu niteliklerden yararlanılmıştır. Yapının doğal aydınlatması ve artistik iç mekân atmosferi gibi nitelikleri korunarak kimliğin baskılanmasından kaçınılmıştır. Kronolojik organizasyon ise ziyaretçiyinin daha tutarlı ve etkili bir deneyim elde etmesini sağlamıştır. Bu araştırma detaylı ve hassas değerlendirilen bir örneği odağına alarak analiz etmeye çalışmış bu sayede hem gelecek akademik çalışmalara hem de meslek profesyonellerine katkı sunmayı hedeflemiştir.

Anahtar Kelimeler: İç Mekân, Kimlik, Müze, Mekân Organizasyonu, Rijksmuseum

PRESERVING IDENTITY IN HISTORICAL BUILDINGS: THE INTERIOR DESIGN OF THE AMSTERDAM RIJKSMUSEUM

ABSTRACT

Today, restoration, renovation, and reconstruction efforts undertaken to preserve historical buildings are insufficient in terms of continuity and sustainability. For a building to acquire a new identity or to reassert its existing one, it needs to find a place for itself within the vitality of life. The aim of this study is to analyze the Rijksmuseum (National Museum) in Amsterdam, Netherlands, which has been renovated while preserving its exhibition space identity, in terms of the concept of identity and interior spatial organization. The research utilized qualitative methods, including a literature review, on-site inspection and field research, and descriptive and spatial analysis methods in evaluating the collected data. Designed by Pierre Cuypers and completed in 1885, this building is an eclectic exhibition structure blending Neo-Gothic and Neo-Renaissance styles. In 2013, the building was renovated to reflect contemporary museology, preserving the original exterior shell while updating it. This update resulted in a more circulatory approach to space, guiding visitors, and organizing the collections chronologically. During this process, the building's identity was preserved, and its inherent qualities were utilized. By maintaining the building's natural lighting and artistic interior atmosphere, the suppression of its identity was avoided. The chronological organization ensured a more coherent and effective experience for the visitor. This research aimed to analyze this example, which was evaluated in detail and with precision, thereby contributing to both future academic studies and the professional community.

Keywords: Interior, Identity, Museum, Spatial Organization, Rijksmuseum

1.GİRİŞ

Günümüzde tarihi yapıların korunması için uygulanan restorasyon, renovasyon ve rekonstrüksiyon müdahaleleri, yapıların süreklilik ve sürdürülebilirlik açısından yeterli sonuçlar üretememektedir. Bu durum, koruma yaklaşımlarının sadece fiziksel müdahale boyutunda kalması ve yapının toplumsal hayat içindeki konumunun yeterince güçlendirilememesinden kaynaklanmaktadır. Yapının devamlılığını sürdürebilmesi için kullanıcılarıyla etkileşimde bulunması gerekmektedir.

Tarihi yapıların yaşayan organizmalar olarak toplumsal belleğin bir parçası olmaya devam edebilmeleri, statik koruma anlayışının ötesinde dinamik bir yaklaşım gerektirmektedir. Bu bağlamda, yapıların sadece fiziksel varlıklarının değil, kimliklerinin de korunması ve güncellenmesi kritik önem taşımaktadır.

Tarihi bir yapının korunması için yeniden işlevlendirme ile yeni bir kimlik kazanması önem taşımaktadır (Biber&İslamoğlu, 2023; Yeşilbaş,2015). Mevcut kimliğini çağdaş bağlamda yeniden ortaya koyabilmesi için, yapının güncel yaşamın içinde anlamlı ve bir yer edinmesi gerekmektedir. Bu süreç, yapının toplumsal hafızadaki konumunu güçlendirirken, aynı zamanda güncel kullanıcı ihtiyaçlarına yanıt verebilme kapasitesini de artırmaktadır (Jokilehto, 1999; Smith, 2006; UNESCO, 2019).

Yapının hayatın içinde kendine yer bulması, sadece fiziksel kullanım değil, aynı zamanda kültürel, sosyal ve sembolik düzeylerde de anlamlı ilişkiler kurabilmesini içermektedir. Bu çok katmanlı entegrasyon süreci, yapının sürdürülebilir korunmasının temel koşulunu oluşturmaktadır.

Bu araştırma, sergileme mekânı kimliği korunarak yenilenmiş olan Rijksmuseum örneğini, kimlik kavramı ve iç mekân organizasyonu perspektifinden sistematik olarak analiz etmeyi amaçlamaktadır. Çalışma, tarihi yapıların korunması ve yeniden işlevlendirilmesi konusunda hem akademik literatüre hem de uygulama alanına katkı sunmayı hedeflemektedir.

2.YÖNTEM

Hollanda'nın Amsterdam kentinde bulunan Rijksmuseum (Ulusal Müze) adlı tarihi müze yapısının detaylı değerlendirmesi, yapının özgün kimliğinin korunma biçimleri, çağdaş müzecilik anlayışı ile entegrasyonunun incelenmesi yoluyla kimlik analizi yapılmaya çalışılmıştır.

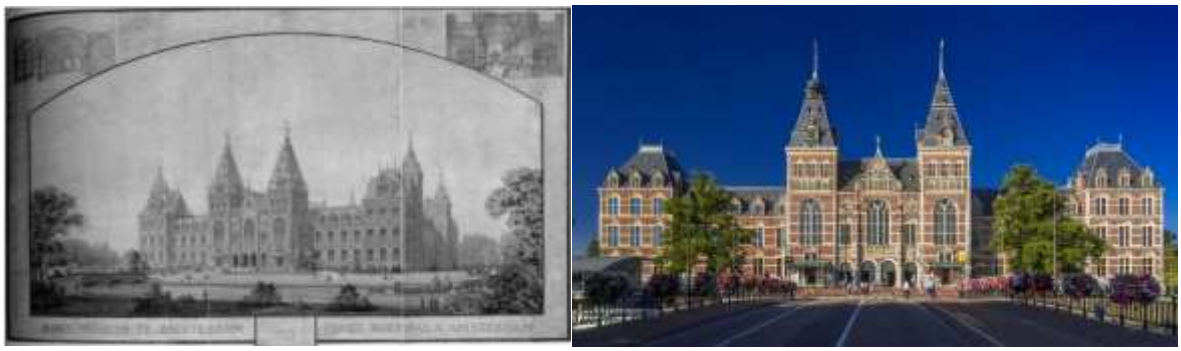
Araştırmada nitel araştırma yöntemleri temel alınmış, derinlemesine ve çok boyutlu bir inceleme gerçekleştirilmiştir. Konuya ilişkin ulusal ve uluslararası akademik kaynaklar, arşiv belgeleri ve teknik raporlar sistematik olarak incelenmiştir. Aynı zamanda müze gezilerek, görsel veriler toplanmış, saha araştırması ve gözlem yapılmıştır. Edinilen verilerin değerlendirilmesinde betimleyici analiz ve mekânsal analiz yöntemlerinden yararlanılmıştır

Araştırmanın metodolojisi, ulusal müze yapısının kimliği ve mekânsal organizasyon konularında çok katmanlı bir analiz gerçekleştirilmesine olanak tanımıştır. Yerinde gözlem ve literatür verilerinin birlikte değerlendirilmesi, yapının hem tarihsel bağlamını hem de güncel durumunu anlamada kapsamlı bir perspektif sunmuştur. Mekânsal analiz yaklaşımı iç mekân organizasyonu, sirkülasyon dinamikleri ve kullanıcı deneyiminin değerlendirilmesinde etkili bir araç olmuştur.

3. BULGULAR VE TARTIŞMA

3.1 İç Mekân Düzenlemesi, Sirkülasyon Sistemi ve Sergileme Stratejilerinin Değerlendirilmesi

Pierre Cuypers tarafından tasarlanan ve 1885 yılında yapımı tamamlanan Rijksmuseum (Ulusal Müze), 19. yüzyıl sonlarında Hollanda'nın ulusal kimlik arayışının mimari bir manifestosu olarak ortaya çıkmıştır. Yapı, gotik ve rönesans üsluplarının çağdaş anlayışlarını sentezleyerek, Hollanda'nın hem Orta Çağ hem de Rönesans dönemlerine olan tarihsel bağlarını vurgulamaktadır. Cuypers'in Rijksmuseum'un dekoratif programına ilişkin anlayışı, 1850'lerde Avrupa'ya yayılan kültürel milliyetçilik dalgasının bir örneğini teşkil etmektedir. Bu süreçte Georg Sturm'un duvar resimleri ön salon ve onur galerisi için tasarlanmıştır (Reynaerts, 2012).



Görsel 1-2 Rijksmuseum Orijinali ve Bugünü Url-1

Binanın eklektik stili, dönemin yaygın mimari anlayışını yansıtırken, ulusal koleksiyona ev sahipliği yapan bir yapı olması, müzenin sembolik önemini güçlendirmektedir. Tarihi yapıların, müze olarak yeniden işlevlendirilmesi yapı kimliği ile uyumlu bir fonksiyon içermesi sebebiyle sıklıkla rastlanılan bir yeniden işlevlendirme biçimidir. Hollanda Ulusal Müze'sini türdeşlerinden ayıran en önemli niteliği yapının ilk kullanım amacının da bir müze olmasıdır. 2013 yılındaki yenileme projesi ise bu tarihi kimliği koruyarak çağdaş müzecilik standartlarına uyarlama konusunda önemli bir başarı örneği sunmaktadır.

Yapının önemli mimari özelliklerinden biri neo gotik sivri kemerler ve dikey vurgular ile neo rönesans simetrik düzen ve proporsiyonların eklektik bir yaklaşımla bütünleşmesidir. Yapı tasarımında, 19. Yüzyıl Hollanda mimarisini yansıtmakta ve ulusal kimlik vurgusu taşıyan sembolik detaylar barındırmaktadır.

3.3.1 DIŞ KABUĞUN KORUNMASI

2013 yılında gerçekleştirilen kapsamlı yenileme çalışmasında, yapının tarihsel karakterini oluşturan dış cephe bütünüyle korunmuş, strüktürel güçlendirme ve restorasyon işlemleri özgün

malzeme ve yapım teknikleriyle uyumlu bir şekilde gerçekleştirilmiştir. Bu yaklaşım, yapının kentin kültürel kodlarını korumasını ve yapının kentin silüetindeki ikonik konumunu sürdürmesini sağlamıştır. Yenileme sürecinde yapının kimliğinin baskılanmasından kaçınılmış, bunun yerine özgün niteliklerin çağdaş işlevle uyumlu hale getirilmesi yoluyla özgün bir mekân estetiği yaratılmıştır. Bu yaklaşım, tarihi yapıların yeniden işlevlendirilmesinde kimlik koruması açısından örnek teşkil etmektedir (Norberg-Schulz, 1980; Choay, 2001).

3.3.2 Doğal Aydınlatma Sisteminin Korunması

Yapının özgün tasarımında Pierre Cuypers tarafından özenle planlanmış olan doğal aydınlatma sistemi, yenileme sürecinde titizlikle korunmuştur. Gün ışığının iç mekanlara kontrollü girişi hem enerji verimliliği hem de sergileme kalitesi açısından önemli bir nitelik olarak değerlendirilmiş ve yapay aydınlatmaya dair güncel teknik çözümlerle desteklenmiştir.

3.3.3 Artistik İç Mekân Atmosferi

19. yüzyılın karakteristik dekoratif öğeleri, özgün renk paleti ve mimari detayları içeren iç mekân atmosferi, yapının kimliğinin temel bileşeni olarak tanımlanmış ve restorasyonda bu niteliklerin korunmasına ve vurgulanmasına özen gösterilmiştir. Duvar resimleri, vitraylar ve dekoratif süslemeler titizlikle restore edilmiştir. Mekân atmosferi açısından, galerilerde sergilenen ürünlere altlık oluşturmada ve onlara sanatsal değer katmada etkin bir rol üstlenmiştir.

3.2 Mekânsal Organizasyon

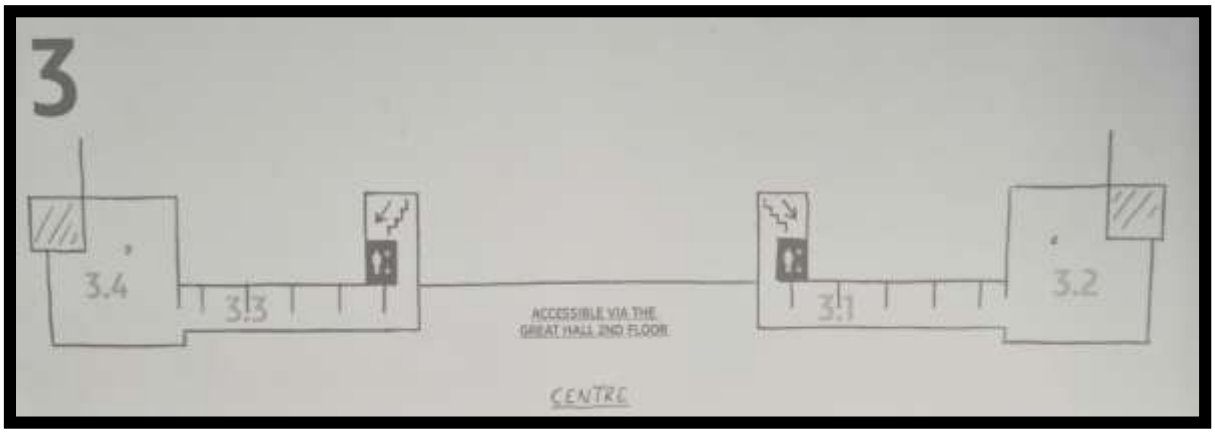
Müzenin mekânsal organizasyonunun genel değerlendirilmesi aşağıda yer alan tabloda özellikleri verilen dört temel bölümden oluşmaktadır.

Tablo 1: Rijksmuseum Mekân Organizasyonu

MEKAN	GİRİŞ VE KARŞILAMA	ANA DOLAŞIM AKSLARI	SERGİLEME SALONLARI	ÇIKIŞ VE DESTEK ALANLARI
ÖZELLİKLER	Ziyaretçi akışının kontrol edildiği ve yönlendirildiği merkezi giriş holü	Kronolojik akışı destekleyen ana koridorlar ve geçiş mekanları	Tematik ve kronolojik düzenlemeye göre organize edilmiş galeri mekanları	Müze mağazası ve kafeterya gibi destekleyici işlevlerle entegre çıkış bölgesi

Rijksmuseum oldukça geniş bir koleksiyona sahiptir. Dünya'nın en geniş Rembrandt koleksiyonuna da ev sahipliği yapmaktadır. Çevrimiçi olarak kamuya açık hale getirilmesi için dijital görüntüler ve meta veri açıklamalarından oluşan 110.000'den fazla nesneden oluşan bir set kullanılmıştır (Mensink&Gemert, 2014).

Mekân yerleşimi dört katlıdır. 1950 ve 2000 yılları arasındaki döneme ait sanat ve tasarım ürünlerine ayrılan üçüncü katta küresel düzeyde tanınırlığı olan moda tasarımcısı Yves Saint Laurent'in De Stijl Akımını vurgulayan altı elbiseden oluşan özel koleksiyonuna ait elbise tasarımından mimar ve endüstri ürünleri tasarımcısı Gerit Rietveld'in yine aynı akıma ait Red and Blue Chair adlı oturma elemanı tasarımına kadar çok çeşitli tasarım ürünlerine ait çağdaş örnekler yer almaktadır. Bu kata ikinci katta yer alan büyük salondan ulaşılabilmektedir. Sergilemenin tek bir doğrusal aks boyunca kurgulandığı, iki adet koridor tipinde galeri ve iki adet salon tipi galeri simetrik bir düzende yer almaktadır.



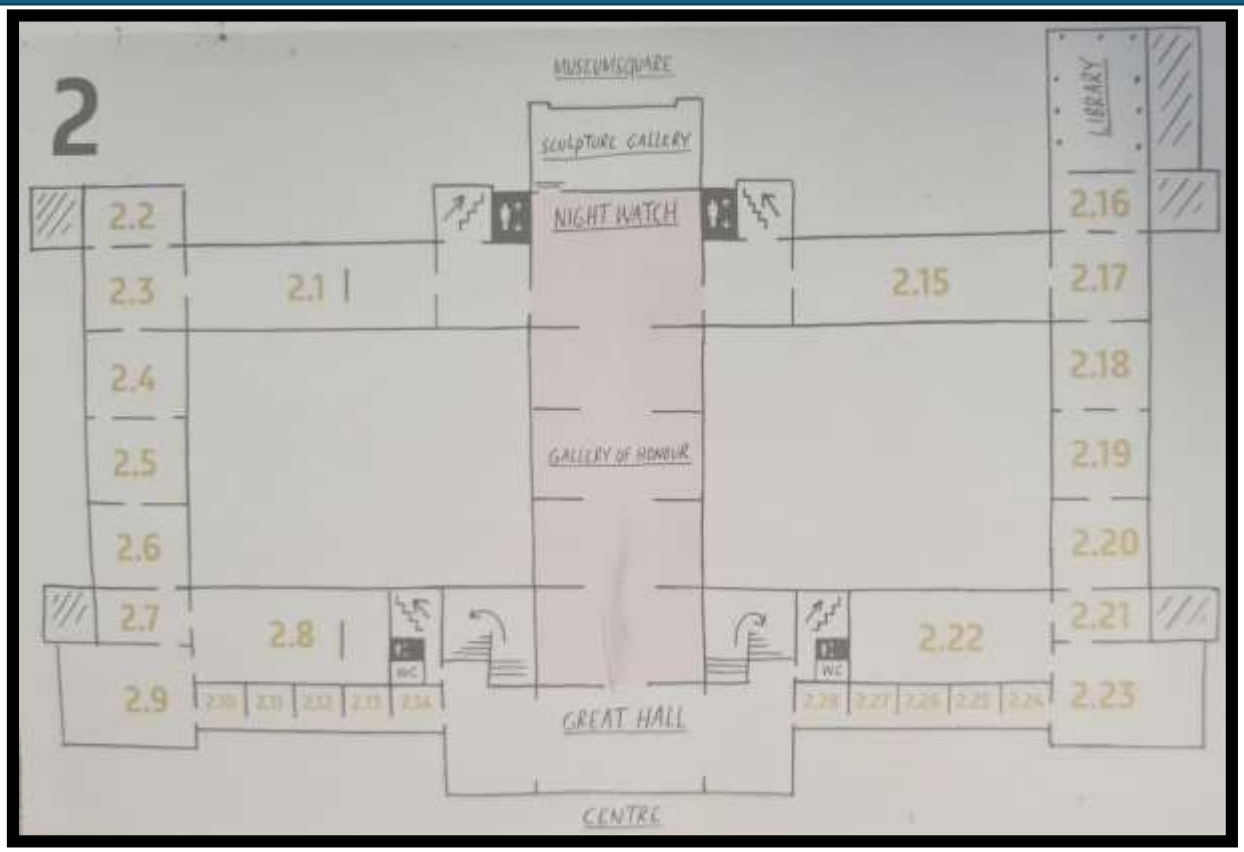
Görsel 3. 3. Kat Krokisi, Rijksmuseum Orijinal Rehberi

1600 ve 1650 yılları arasındaki döneme ait Hollanda Altın Çağı olarak da adlandırılan döneme ait sanat ve tasarım ürünlerine ayrılan ikinci katın merkez cephesinde bulunan büyük salondan üçüncü katta olduğu gibi yine simetrik iki farklı aksa dağılım söz konusudur. Düz devam edildiği taktirde önce ‘‘Gallery of Honour’’adı verilen dikdörtgen planlı merkezi galeriye sonrasında ise Rembrandt'ın ünlü tablosu ‘‘Night Watch’’un sergilendiği ana galeriye ulaşılabilmektedir. Bu iki aksın her birinde üçer adet dikdörtgen plana sahip salon tipinde galeri, biri büyük olmak üzere altışar adet kare plana sahip salon tipinde galeri ve beşer adet koridor tipinde galeri yer almaktadır. Portre, grup portresi, tür resmi, manzara ve denizcilik temalı tablolar bu galerilerin ana içeriğini oluşturur.



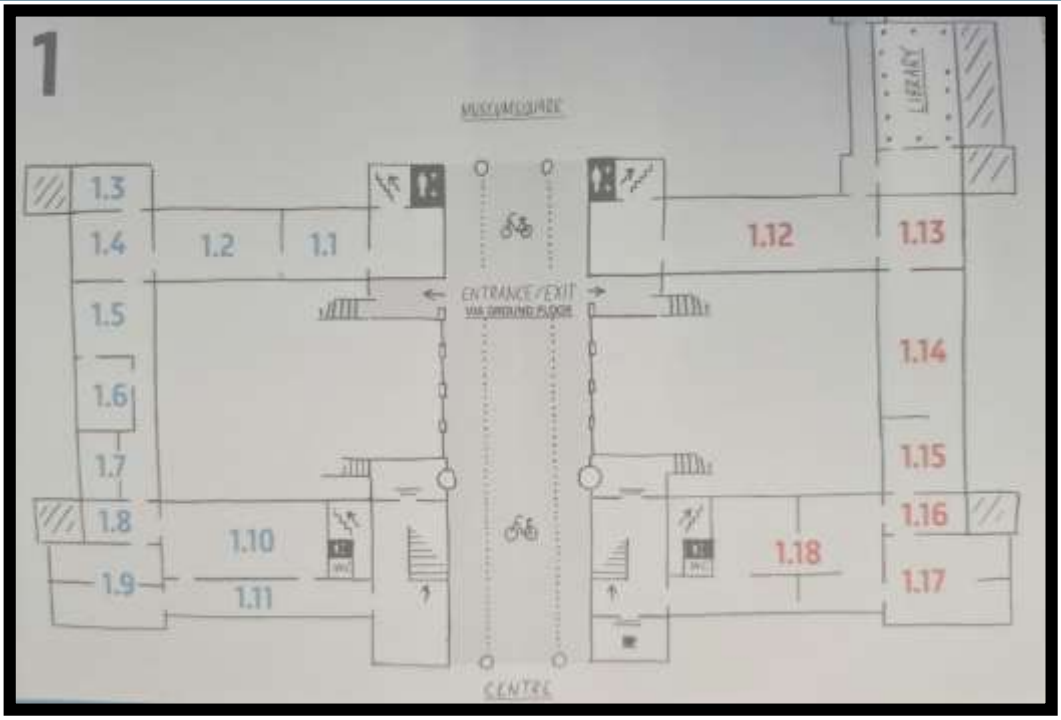
Görsel 4. Night Watch adlı eserin yer aldığı galeri, Rijksmuseum, Url-1

Merkez cephesinde yer alan büyük salondan sol aksta yer alan galerilerde ışık ve gölge kullanımıyla ön plana çıkan Rembrandt ve kış manzaraları ile tanınan Avercamp gibi ressamlarınn tabloları, uluslararası hukukun kurucularından biri olarak kabul edilen Hugo de Groot'a ait eşyalar gibi sanat ve tasarım ürünlerine yer verilmektedir. Sağ aksta yer alan galerilerde ise bebek evleri gibi oyuncak tasarımları, Hollanda'ya özgü kalay sırla kaplanmış seramik türü olan beyaz zemin üzerine mavi desenlere sahip delftware ürünler, Hollanda'nın denizci yanını ortaya koyan gemi maketleri gibi sanat ve tasarım ürünlerine yer verilmektedir. Her iki galerinin merkezinde ''Gallery of Honour' bulunmaktadır. Bu galeride Vermeer'in ''The Milkmaid'' ve Leyster'in ''De Serenade'' gibi tabloları bulunmaktadır. Bu galeri gezildikten sonra ''Night Watch'' adlı esere ve ona özel galeriye ulaşılabilmektedir. Sonrasında ise müze meydanı cephesine bakan ve heykel sanatına ayrılan bir galeri mevcuttur.



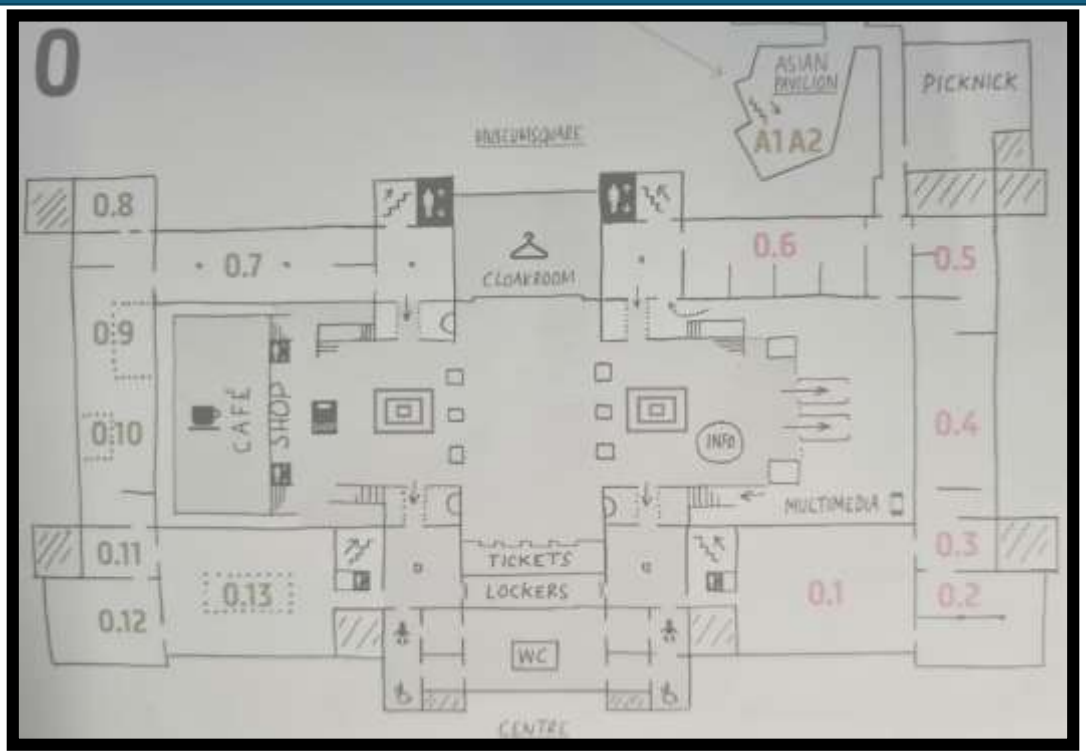
Görsel 3. 2. Kat Krokisi, Rijksmuseum Orijinal Rehberi

Birinci katta ise her iki aksta kare ve dikdörtgen plana sahip galeriler yer almaktadır. Bu kısım 1700 ve 1800 yılları arasındaki döneme ait sanat ve tasarım ürünlerine ayrılan kattır. Bu katta Van Gogh ve Goya'ya ait tablolar da dahil olmak üzere çok sayıda tablo gibi sanat ürünleri, seramik biblolar gibi dekoratif ögeler ve tasarım nesnelerinin sergilenmesine yer verilmiştir. Bu kat müzenin kalbi, Night Watch ise bir baş yapıt olarak müzenin ikonik eseridir. Hollandalı tasarımcılar ve sanatçıların Dünya sanat tarihinde etkin bir değer arz etmelerinin sosyo-kültürel ve sosyo-politik nedenleri arasında, Hollanda'nın denizcilik ve deniz ticareti nedeniyle dönemin Avrupa'sında maddi güce sahip olması yatmaktadır.



Görsel 4. 1. Kat Krokisi, Rijksmuseum Orijinal Rehberi

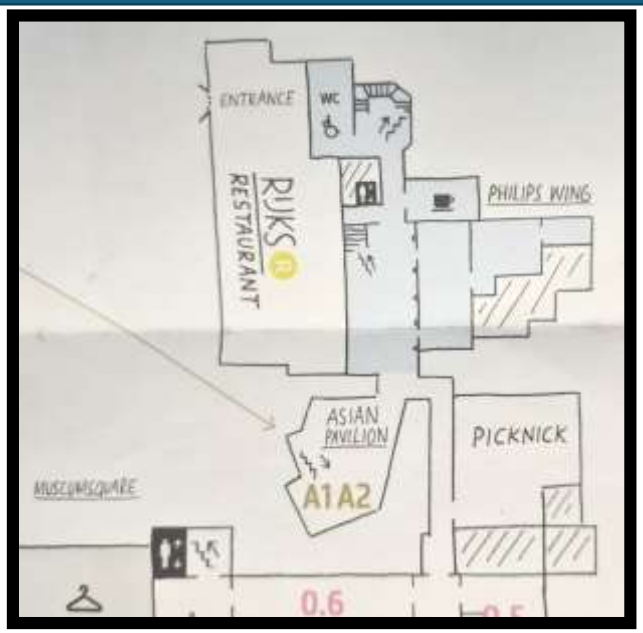
Giriş katında ise servis alanları ve galeriler yer almaktadır. Vestiyer bölümü ve ziyaretçilerin eşyalarını bırakabileceği kilitli dolaplar, müze mağazası, restoran, kafe ve danışma bu katta yer almaktadır. Dezavantajlı bireylerin ulaşımı için yerleştirilen dairesel asansörle erişilebilirlik sağlanmıştır. Bebek bakım bölümleri de anneler için tasarlanan diğer servis alanlarıdır. Galerilerde ise 1100-1800 yılları arasındaki döneme ait eserlere yer verilmiştir.



Görsel 5. Giriş Kat Krokisi, Rijksmuseum Orijinal Rehberi

Asya sanatına ait ürünlerin ise yine bu katta bulunan A1 ve A2 galerilerinde sergilenmektedir. Sergilenen nesnelerin çoğu, 1918'de kurulan Asya Sanatı Dostları Derneği tarafından toplanmış ve uzun vadeli olarak Rijksmuseum'a ödünç verilmiştir. Bu nedenle; diğer mekanlardan farklı olarak nesneler, menşe yerine dayalı bir sıralama ile ziyaretçinin Asya'nın çeşitli bölgeleriyle ilgili estetik ve stilistik unsurlar hakkında bir izlenim edinmesini sağlar. Endonezya, Hindistan, Japonya ve Çin sanatlarına ait sanat eserleri bu bölümde yer almaktadır (Fitski ve diğerleri, 2013)

Birinci ve ikinci katta sağ aksta kütüphane yer almaktadır. Ayrıca giriş ve birinci katlarda müzenin aynı aksında kurucusu Philips firmasına özel bir alanda konumlanmaktadır.



Görsel 6. Giriş Kat Krokisi, Asya Pavilyonu Rijks Rest. ve Philips Rijksmuseum Orijinal Rehberi

Eserler katlara kronolojik olarak yerleştirilmiş, bu sayede de belirli ortak özellikler etrafında birleşerek dönemlerin genel özelliklerini yansıtmışlardır. Bu da müze yapısının eğitici işlevini güçlendirmiştir.

Tablo 2: Rijksmuseum Katlar Arası Eserlerin Dağılımı

Kat	**Giriş Katı**	**1.Kat**	**2.Kat**	**3.Kat**
Eserlerin Dönemi Özellikleri	Ortaçağ Dönemi	18-19. Yüzyıllar	Altın Çağ (17. yy)	20. yüzyıl ve sonrası dünya sanatı eserleri
Eserlerin Özellikleri	Dini sanat ve el sanatları koleksiyonu	Neoklasik ve romantik dönem eserleri	Rembrandt ve çağdaşlarının başyapıtları	Modern ve Çağdaş

3.3 Mekânsal Organizasyon ve Sirkülasyon Sistemi

2013 yılındaki güncelleme ile mekân organizasyonu, ziyaretçiyi net bir şekilde yönlendiren bir sirkülasyon anlayışı kazanmıştır. Bu yeni düzenleme, ziyaretçi deneyimini optimize etmeyi ve koleksiyon ile etkileşimi güçlendirmeyi hedeflemiştir. ‘‘Ziyaretçi sanat eserlerini incelerken iç mekân tasarımından kaynaklanan bir zorluk yaşamamalıdır’’(Kaymakçı&Sever, 2022).

Yönlendirici sirkülasyon anlayışını sağlamak üzere açık ve anlaşılır dolaşım aksları kurgulanmış, hiyerarşik bir mekân anlayışı ortaya konmaya çalışılmıştır. Dinlenme ve toplanma noktalarına sahip mekân erişilebilirlik standartlarına da uyum sağlamıştır.

Sirkülasyon sisteminde kronolojik bir yerleştirme yaklaşımı tercih edilmiştir. Bu yaklaşım, sadece eserlerin tarih sırasına göre dizilmesi değil, aynı zamanda her dönemin sosyal, kültürel

ve sanatsal bağlamının da aktarılmasını içermektedir. Koleksiyonlar, bu sayede ziyaretçilerin Hollanda sanat tarihini sistematik ve tutarlı bir şekilde deneyimlemeleri sağlanmıştır. Dönemler arası geçişler, mekânsal deneyim ve sergileme teknikleri ile desteklenmiştir. Orta Çağ'dan bugüne uzanan geniş koleksiyon, tarihsel dönemlerin akışını yansıtacak şekilde sergilenmiştir. Ayrıca Dünya mirası evrensel tasarım ürünleri de müze koleksiyonları dahilinde yer almaktadır (Bennett, 1995; Bitgood, 2013; MacLeod, 2005).

3.4 Ziyaretçi Deneyiminin Geliştirilmesi

Kronolojik organizasyon, ziyaretçinin daha tutarlı ve etkili bir deneyim elde etmesini sağlamıştır. Bu düzenleme, sanat tarihsel gelişimin anlaşılmasını kolaylaştırırken, eserlerin bağlamsal değerinin de daha iyi kavranmasına olanak tanımıştır. Ziyaretçiler, Hollanda'nın kültürel ve sanatsal mirasını yönlendirici kronolojik sirkülasyon içerisinde takip ederek, dönemsel değişimleri ve süreklilikleri daha net algılayabilmektedir. Bu deneyim, ziyaretçi açısından müzeyi eğitici ve anlamlı bir yolculuğa dönüştürmektedir. Tarihi mekânın atmosferi ile çağdaş müzecilik anlayışının sunduğu olanaklar bir araya getirilerek, benzersiz bir ziyaretçi deneyimi yaratılmaya çalışılmıştır. ‘‘Geleneksel müzecilikten çağdaş müzecilik anlayışına geçiş sürecinde nesneden ziyaretçi ve hizmet odağına kayan tutum, müze içi mekân düzenlemelerine de sirayet etmiştir’’(Yıldırım&Aytıs, 2022)

SONUÇ

Bu araştırma, Hollanda Rijksmuseum (Ulusal Müze) örneğini detaylı ve hassas bir şekilde değerlendirerek, tarihi yapıların kimlik koruması ve çağdaş işlevlerle uyumlanması konusunda önemli çıktılar ortaya koymuştur. Rijksmuseum örneğinde, kimlik koruması ile işlevsel güncelleme arasında kurulan denge, yapının tarihsel değerlerinin baskılanması yerine, bu değerlerin çağdaş kullanım için bir kaynak olarak değerlendirilerek yeni işlevle entegre edilmesi, sürdürülebilir koruma anlayışının temel prensibi olarak ortaya çıkmaktadır. Koruma anlayışı yapının yaratıcı ve dinamik bir hale gelmesini sağlamıştır. Bu yaklaşım, restorasyon ve yenileme projelerinde uygulanabilecek bir model sunmaktadır.

Çalışma, başarılı bir restorasyon ve yenileme projesinin nasıl gerçekleştirilebileceğine dair somut ve uygulanabilir bilgiler sunmaktadır. Yapının doğal aydınlatma sistemi ve artistik iç mekân atmosferi gibi özgün nitelikleri, kimlik korumasının temel bileşenleri olarak değerlendirilmiş ve yenileme sürecinde titizlikle korunmuştur. Güncel sergileme teknolojileri, iklim kontrolü, güvenlik sistemleri ve erişilebilirlik standartları, yapının tarihsel kimliğine zarar vermeden entegre edilmiştir.

Kimlik koruması kavramının mekânsal organizasyon ve işlevsel güncelleme ile ilişkisi teorik düzeyde tartışılmıştır. Benzer projelerde uygulanabilecek stratejiler ve ilkeler, somut bir örnek üzerinden ortaya konulmaya çalışılmıştır. Rijksmuseum vakası, tarihi yapıların sadece fiziksel olarak değil, kimliksel olarak da korunmasının ve bu kimliğin çağdaş kullanım için bir değer kaynağı olarak görülmesinin önemini göstermektedir.

Araştırma, detaylı bir vaka incelemesi sunarak hem gelecek akademik çalışmalara hem de meslek profesyonellerine katkılar sunmayı hedeflemiştir. Kronolojik sergileme organizasyonunun ziyaretçi deneyimine olumlu etkileri, mekansal organizasyon stratejileri ve kimlik koruması yaklaşımları, benzer projelerde uygulanabilecek referans bilgiler sağlamaktadır. Bu çalışma, mimarlık, restorasyon ve müzecilik alanlarında çalışan profesyonellerin, tarihi yapıların yeniden işlevlendirilmesi projelerinde kimlik koruması ve çağdaş işlev arasında denge kurabilmeleri için bir öneri niteliği taşımaktadır.

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MÜZİKAL BELLEĞİN MEKÂNSAL SERGİLEMESİ: HARD ROCK KAFE'NİN MÜZE DENEYİMLİ İÇ MİMARİ KONSEPTİ

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ÖZET

Bu çalışma, çağdaş müzik kültürünün kolektif bellekteki temsillerinin mekânsal sergileme yoluyla nasıl deneyimlendiğini, Hard Rock Kafe konsepti üzerinden incelemektedir. Çalışma, Hard Rock Kafe'nin yalnızca tematik bir turistik kafe/restoran işlevinden değil; müze deneyimine yakın, anlatı temelli bir iç mimari kurgu sunduğu özgün konseptinden hareket etmektedir. Bu bağlamda mekân, yeme içme mekanı olmanın ötesine geçerek müzikal belleğin sergilendiği ve hatıraların mekânsal olarak yeniden üretildiği hibrit bir deneyim alanı olarak ele alınmaktadır. Araştırma kapsamında yerinde inceleme ve gözleme dayalı saha araştırması yapılmış, bu kapsamda Asya ve Avrupa'da yer alan Ho Chi Min, İstanbul, Kopenhag, Amsterdam, Atina gibi başkentlerde ve metropollerdeki örnekler ziyaret edilmiştir. Tüm örneklerde mekan tasarımında konsept dahilinde müzik enstrümanları, sahne kostümleri, sahne tasarımında kullanılan çeşitli objeler, arşiv niteliğindeki belgeler, antika değerine sahip albüm kapakları, imzalı albümler gibi dokümanlar bağlamsal bir anlatı içinde sergilendiği gözlemlenmiştir. Böylelikle konseptin ziyaretçilerin mekanı yalnız işlev doğrultusunda kullanmalarını değil marka kimliği ve müze-kafe konsepti doğrultusunda müzikal belleklerini besleyerek mekânsal bir deneyim yaşamaları hedeflediği saptanmıştır. Hard Rock Kafe iç mekânlarında kullanılan sergileme stratejileri; ziyaretçiyi pasif bir kullanıcı konumundan çıkarak deneyimin aktif bir parçası hâline getirmektedir. Bu yaklaşım Hard Rock Kafe popüler kültür, tüketim ve sergileme pratiklerini bir araya getiren, müzikal belleğin mekânsal temsiline ilişkin özgün bir model sunduğunu ortaya koymaktadır. Sonuç olarak bu çalışma, iç mimarlık ve sergileme tasarımı disiplinleri açısından, müze kavramının sınırlarının genişlediğini ve deneyim odaklı mekânların kültürel bellek üretiminde giderek daha önemli bir rol üstlendiğini vurgulamaktadır.

Anahtar Kelimeler: Müzikal Bellek, Mekansal Sergileme, Hard Rock Kafe, Müze, İç Mekân Tasarımı

A SPATIAL EXHIBITION OF MUSICAL MEMORY: THE MUSEUM-INSPIRED INTERIOR DESIGN CONCEPT OF HARD ROCK CAFÉ

ABSTRACT

This study examines how representations of contemporary music culture in collective memory are experienced through spatial exhibitions, using the Hard Rock Cafe concept as an example. The study starts from the premise that the Hard Rock Cafe is not merely a thematic tourist cafe/restaurant but offers a unique concept that provides a narrative-based interior design approach akin to a museum experience. In this context, the space is considered not merely a place for food and beverage, but a hybrid experiential space where musical memory is displayed and memories are spatially reproduced. The research involved on-site field research and observation, including visits to examples in capital cities and metropolises in Asia and Europe, such as Ho Chi Minh City, Istanbul, Copenhagen, Amsterdam, and Athens. In all examples, it has been observed that musical instruments, stage costumes, various objects used in stage design, archival documents, antique album covers, and signed albums are displayed within a contextual narrative in the context of the venue design concept. Thus, it was determined that the concept aims not only for visitors to use the space for its intended function, but also to have a spatial experience that nourishes their musical memory in line with the brand identity and the museum-cafe concept. The Hard Rock Cafe presents a unique model for the spatial representation of musical memory, bringing together popular culture, consumption, and exhibition practices. Consequently, this study highlights that, from the perspective of interior architecture and exhibition design disciplines, the boundaries of the museum concept are expanding, and experience-oriented spaces are playing an increasingly important role in the production of cultural memory.

Keywords: Musical Memory, Spatial Exhibition, Hard Rock Cafe, Museum, Interior Design

1.GİRİŞ

Çağdaş mekânsal tasarım pratikleri, müze, restoran, mağaza gibi geleneksel işlevsel kategoriler arasındaki sınırların giderek geçirgen hâle geldiği bir dönüşüm sürecine işaret etmektedir. Kültürel üretim ve tüketim biçimlerinin iç içe geçtiği bu bağlamda mekân, yalnızca fiziksel bir kullanım alanı olmaktan çıkarak anlatı üreten, hikayesi olan, bellek inşa eden ve deneyimi yönlendiren aktif bir yapı hâline gelmektedir. Popüler kültür temsilleri ise bu dönüşümün en görünür örneklerinden biri olarak öne çıkmaktadır.

Hard Rock Kafe zinciri, popüler müzik kültürüne ait nesneleri iç mekân tasarımı aracılığıyla sergileyerek, ticari bir restoran işlevini müze deneyimine yakın bir anlatı kurgusuyla birleştiren

özgün bir mekânsal model sunmaktadır. Hard Rock Cafe'nin ticari mantığı, ilk olarak 90'ların sonunda teorize edilen "deneyim ekonomisi"dir (Guilman, 2017). Hard Rock Kafe (Hard Rock Café- HRC), dünya çapında temalı bir restoran zinciri olarak ürünlerine ve kurumsal menüsüne olan marka sadakati aracılığıyla müziği ve müzik hayranlığını teşvik etmektedir (Geraghty, 2014). Temalı Restoranların (Theme Restaurant -TR) satış stratejisi, bir deneyim yoluyla hizmet sunarak müşteri çekmektir. Bu mekanların sundukları deneyim nedeniyle müşterilerin zihninde kalıcı bir yer edinir (Calderon ve diğerleri, 2022)

Hard Rock'ın kurucuları, Londralılara fast food satma yönündeki ilk stratejik amaçlarının ötesine geçmiş, fikrin değerini artırmak için sürekli olarak fırsatlar keşfetmiş ve bunlardan yararlanmışlar; bu da Amerikan tarzı yemekleri karnaval benzeri bir atmosferde sunma stratejisinin ortaya çıkmasına yol açmıştır (Horner ve diğerleri, 2013). Bu atmosfer yeme-içme işlevi sunmanın ötesinde, yüzey tasarımlarında çağdaş bir sergileme mekânı deneyimleme, ürünlerin satıldığı satış alanı/mağaza kısmında marka ile bağ kurabilme, sahne aracılığı ile performans deneyimleyebilme gibi çok yönlü hizmetler sunarak müşterileri için bir marka kültürü oluşturmuştur. Bir şirketin müşteri tabanı, farklı hizmet işlevlerinden oluşan müşteri karşılaşmalarını içeren çeşitli müşteri ilişkilerinden oluşur. Buna müşteri yapısı denir (Kuisma & Niemi, 2016). Hard Rock müşteri odaklı deneyimsel yaklaşımıyla Dünya genelinde kendi müşteri yapısını ve hedef kitlesini oluşturmuştur. Hedef kitle gezmeyi ve yeni yerler deneyimlemeyi seven, başta Rock olmak üzere müzik tarihine ilgi duyan, sahne sanatları ve performansla alakalı, damak zevkine sahip, koleksiyonerlik eğilimi gösteren ve/veya bu beklentiler içerisinden kendi gustolarını oluşturan kimselerdir. Mekân, müziğin yakın tarihine ait seçili nesnelerin bağlamsal bir düzenleme içinde sunulması yoluyla ziyaretçiyi yalnızca tüketici değil, aynı zamanda kültürel belleğin aktif bir katılımcısı konumuna taşımaktadır. Bu yönüyle Hard Rock Kafe, müze kavramının kurumsal sınırlarının ötesine geçen çağdaş sergileme pratiklerini anlamak açısından da önemli bir örnek oluşturmaktadır.

Bu çalışmanın amacı, Hard Rock Kafe iç mekânlarının müzikal belleğin mekânsal temsili ve yeniden üretimi sürecinde üstlendiği rolü iç mimarlık ve sergileme tasarımı perspektifinden analiz etmektir. Araştırma, popüler müzik kültürüne ait nesnelerin sergilenme biçimlerinin mekânsal organizasyon, anlatı kurgusu ve deneyim tasarımı yoluyla nasıl anlam kazandığını incelemektedir. Aynı zamanda ticari bir mekân bağlamında müze pratiklerinin nasıl yeniden yorumlandığı ve bu durumun kolektif bellek üretimi üzerindeki etkileri tartışılmaktadır.

2. YÖNTEM

Araştırma nitel araştırma yöntemi çerçevesinde kurgulanmıştır. Çalışma kapsamında Avrupa ve Asya kıtalarında yer alan farklı Hard Rock Kafe örneklerinde yerinde gözlem ve mekânsal inceleme gerçekleştirilmiştir. İstanbul, Amsterdam, Kopenhag, Atina ve Ho Chi Minh kentlerinde bulunan mekânlar, farklı kültürel ve coğrafi bağlamlarda aynı konseptin nasıl yeniden üretildiğini incelemek amacıyla karşılaştırmalı olarak saha araştırması ve gözlem yöntemiyle değerlendirilmiştir. Diğer kentlerde bulunan örneklerin incelenmesinde ise literatür ve kaynak araştırmasından faydalanılmıştır.

Saha çalışmaları sırasında iç mekân organizasyonu, sergileme stratejileri, aydınlatma düzenlemeleri, vitrinleme teknikleri ve anlatı akışı sistematik biçimde belgelenmiştir. Elde edilen veriler, müze çalışmaları, kültürel bellek kuramları ve deneyim odaklı mekân tasarımı literatürü ışığında betimleyici ve yorumlayıcı analiz yöntemleriyle değerlendirilmiştir (Bennett, 1995; Falk & Dierking, 2016).

Bu çalışma, Hard Rock Kafe'nin yalnızca tematik bir turistik kafe/restoran işlevinden değil; müze deneyimine yakın, anlatı temelli bir iç mimari kurgu sunduğu özgün konseptinden hareket etmektedir. Mekân, yeme içme mekanı olmanın ötesine geçerek müzikal belleğin sergilendiği ve hatıraların mekânsal olarak yeniden üretildiği hibrit bir deneyim alanı olarak ele alınmaktadır.

3. BULGULAR VE TARTIŞMA

3.1 Müzikal Belleğin Maddi Kültür Olarak Sergilenmesi

Hard Rock Kafe iç mekânlarında sergilenen enstrümanlar, sahne kostümleri, albüm kapakları ve arşiv belgeleri, müzikal belleğin maddi taşıyıcıları olarak mekânsal anlatının merkezinde konumlandırılmaktadır. Assmann'ın kültürel bellek kuramında vurguladığı üzere, maddi nesneler geçmişle kurulan ilişkinin sürekliliğini sağlayan temel referans noktalarıdır (Assmann, 2011). Bu bağlamda sergilenen her nesne, yalnızca bireysel bir sanatçıya değil, kolektif müzik tarihinin belirli bir kesitine işaret etmektedir.

Nesnelerin mekân içinde kronolojik ya da tematik bir düzenle sunulması, rastlantısal bir koleksiyon anlayışından ziyade küratöryel bir yaklaşımı yansıtmaktadır. Bu düzenleme, ziyaretçinin mekân içindeki dolaşımını yönlendiren anlatısal bir akış oluşturmakta ve müzikal belleğin parçalı ancak bütüncül bir biçimde deneyimlenmesini mümkün kılmaktadır.

Konsept, ziyaretçilerin mekânı salt işlevsel ihtiyaçlarını karşılamak için kullanmalarının ötesine geçerek, marka kimliği doğrultusunda müzikal belleklerini beslemeyi ve zenginleştirmeyi

hedeflemektedir. Bu strateji, ticari bir mekânın nasıl kültürel bir deneyim alanına dönüşebildiğini göstermesi açısından önemlidir. Bu kültürel deneyim sahne performansları, koleksiyon değeri taşıyan ürünlerin satışı, özel günler için sunulan farklı konseptlerle de zenginleştirilmektedir.

3.2 Hibrit Mekân Kavramı ve Hard Rock Kafe'nin Mekânsal Kurgusu

Çağdaş iç mimarlık pratiklerinde hibrit mekân kavramı, farklı işlevlerin ve deneyim katmanlarının tek bir mekânsal organizasyon içinde bütünleşmesini ifade etmektedir. Bu yaklaşım, mekânın yalnızca fiziksel bir kullanım alanı olarak değil, aynı zamanda kültürel, simgesel ve deneyimsel bir yapı olarak ele alınmasını gerekli kılmaktadır. Sergileme tasarımı, müze, restoran, mağaza ve eğlence mekânı gibi geleneksel tipolojilerin keskin sınırları, günümüz deneyim odaklı tasarım anlayışı içinde giderek belirsizleşmektedir. Hard Rock Kafe bu bağlamda, yeme içme işlevi ile müze sergileme pratiğini aynı mekânsal kurgu içinde birleştiren belirgin bir hibrit model sunmaktadır. Bu iki işlev mekânın tematik ve fonksiyonel atmosferini oluşturmaktadır ve mekân estetiği bu doğrultuda şekillenmektedir. Bunun yanı sıra mekân organizasyonuna satış mağazası/alanı ve sahne ve performans alanı ekleyerek farklı kombinasyonlara da evrilebilen bir yapı sergilemektedir. 2014 yılında toplanan veriler ışığında Hard Rock Cafe markasının 147 kurumsal ve franchise kafesi bulunmaktadır. Hard Rock Cafe, Hard Rock International tarafından yönetilen 4 markadan biridir. Diğer markalar Hard Rock Otelleri, Kumarhaneleri ve Canlı Müzik Mekanlarıdır (Tanskanenn & Musto, 2015). Toplamda, dünya genelinde 60 ülkede 193 mekân bulunmaktadır. Aradan geçen on yılı aşkın sürede bu sayıda yükselmiştir. Buda markanın ve mekânsal konseptin evrenselliğini ortaya koyan değerli bir bulgudur.



Görsel 1-2 Hard Rock Kafe Paris Giriş ve Koridorlar Url-1

Hard Rock Kafe iç mekânları, geleneksel restoran tipolojisinin ötesine geçerek müze benzeri bir anlatı yapısı oluşturmaktadır. Mekânda sunulan gastronomik deneyim, sergilenen müzikal nesneler ve anlatılarla eş zamanlı olarak gerçekleşmekte; bu durum ziyaretçinin mekânla kurduğu ilişkiyi çok katmanlı hâle getirmektedir. Bennett'in müzeyi ideolojik ve pedagojik bir aygıt olarak tanımlayan yaklaşımı, Hard Rock Kafe bağlamında ticari bir çerçeve içinde yeniden yorumlanabilmektedir (Bennett, 1995). Mekân, belirli müzikal anlatıları görünür kılarak popüler kültürün seçilmiş temsillerini kurumsallaştırmaktadır. Bu temsiller koleksiyon ürünleri ve performanslarla da güçlendirilmektedir.

Hibrit mekân olgusu, Hard Rock Kafe örneğinde yalnızca işlevsel bir birleşme olarak değil, aynı zamanda anlatısal ve deneyimsel bir bütünleşme olarak karşımıza çıkmaktadır. Mekânsal organizasyon, ziyaretçinin mekân içindeki dolaşımını yönlendiren bilinçli bir kurguya dayanmaktadır. Giriş alanlarından ana salonlara, bar ve oturma bölümlerinden sergileme yüzeylerine kadar uzanan mekânsal dizilim, müzik tarihine dair tematik ya da kronolojik bir anlatı akışı oluşturacak biçimde tasarlanmaktadır. Bu durum, mekânın rastlantısal bir dekorasyon alanı olmaktan çıkarak, küratöryel bir yaklaşım sergileyen anlatı mekânına dönüşmesini sağlamaktadır.

Hard Rock Kafe iç mekânlarında sergilenen nesneler, müzikal belleğin maddi kültür unsurları olarak mekânsal kurgunun merkezinde yer almaktadır. Ünlü müzisyenlere ait enstrümanlar, sahne kostümleri ve arşiv belgeleri, Assmann'ın kültürel bellek kuramında tanımladığı üzere, geçmişle kurulan ilişkinin somut taşıyıcılarıdır (Assmann, 2011). Bu nesneler, bireysel sanatçı anlatılarının ötesinde, kolektif müzik tarihinin simgesel temsilcileri olarak konumlandırılmaktadır. Nesnelerin özgünlüğü, nostaljik ve otantik niteliği ve eşsizliği mekânsal deneyimin inandırıcılığını ve duygusal etkisini güçlendirmektedir.

Sergileme nesnelerinin mekân içindeki konumlandırılması, görsel ve algısal bir hiyerarşi oluşturmaktadır. Bazı nesneler merkezi akslar üzerinde vurgulanırken, bazıları mekânın çevresel yüzeylerine entegre edilerek keşfe dayalı bir deneyim sunmaktadır. Bu strateji, ziyaretçinin mekânla kurduğu ilişkiyi pasif bir bakıştan aktif bir keşif sürecine dönüştürmektedir. Falk ve Dierking'in müze deneyimini kişisel, bağlamsal ve fiziksel boyutların etkileşimi olarak ele alan modeli, Hard Rock Kafe mekânlarında belirgin biçimde gözlemlenebilmektedir (Falk & Dierking, 2016). Ziyaretçinin bireysel müzik geçmişi, mekânın sunduğu fiziksel düzen ve anlatılarla birleşerek öznel fakat kolektif bir deneyim üretmektedir.

Aydınlatma tasarımı, hibrit mekân kurgusunun önemli bileşenlerinden biridir. Spot aydınlatmalarla vurgulanan sergileme nesneleri, teatral bir etki yaratmakta ve bu dramatik atmosfer performans olgusunu mekânsal deneyimin merkezine taşımaktadır. Ambiyans aydınlatma ile desteklenen genel mekânsal atmosfer, yeme içme işlevinin gerektirdiği fiziksel ve görsel konforu korurken, sergileme deneyiminin dramatik niteliğini güçlendirmektedir. Bu yaklaşım, müzikal performansın geçici doğasını kalıcı mekânsal temsillere dönüştürmektedir.

Vitrinleme ve çerçeveleme tekniklerinin müze standartlarına yakın biçimde uygulanması, popüler müzik kültürüne ait nesnelere kurumsal ve sanatsal bir değer atfetmektedir. Ayrıca çerçeveler ve vitrinler üzerinde eserlerle ilgili etiketler ve belirteçler yer alması müze deneyimini güçlendirmektedir. Mekân, belirli müzikal anlatıları öne çıkararak popüler kültürün hangi unsurlarının hatırlanmaya değer olduğuna dair seçici bir temsil sunmaktadır.

Hibrit mekân yapısı, tüketim ve deneyim arasındaki ilişkiyi de yeniden tanımlamaktadır. Pine ve Gilmore'un deneyim ekonomisi yaklaşımında vurguladığı üzere, çağdaş tüketim biçimleri ürün ve hizmetlerin ötesinde, hatırlanabilir deneyimlerin sunulmasına odaklanmaktadır (Pine & Gilmore, 1999). Hard Rock Kafe'de yeme içme eylemi, sergileme ve anlatı deneyimiyle bütünleşerek ziyaretçinin mekânla kurduğu ilişkiyi duygusal ve simgesel düzeyde derinleştirmektedir. Mekân, bu yönüyle yalnızca bir restoran değil, anlatı üreten ve deneyim vadeden bir kültürel platform hâline gelmektedir. Bu bağlamda Hard Rock Kafe, çağdaş iç mimarlık ve sergileme tasarımı açısından hibrit mekân kavramının somut bir örneğini sunmaktadır. Mekân, işlevsel, anlatısal ve deneyimsel katmanları bir araya getirerek, popüler müzik kültürünün kolektif belleğini mekânsal olarak yeniden üretmektedir. Bu durum, ticari mekânların kültürel bellek üretimindeki rolünün giderek artığını ve müze kavramının epistemolojik sınırlarının genişlediğini göstermektedir.



Görsel 3 Hard Rock Kafe Ho Chi Minh Url-2 (Photo: DaveFlker)

3.3 Sergileme Stratejileri, Ziyaretçi Deneyimi ve Kültürel Bellek Üretimi

Hard Rock Kafe iç mekânlarında uygulanan sergileme stratejileri, klasik müze pratiklerinden beslenen ancak ticari bir bağlam içinde çağdaş bir anlayışla yeniden yorumlanan mekânsal düzenlemeler olarak dikkat çekmektedir. Sergilenen nesnelerin mekân içindeki dağılımı, ziyaretçinin hareketini yönlendiren bilinçli bir mekânsal hiyerarşi oluşturmaktadır. Sirkülasyon akıcı ve etkilidir. Bu hiyerarşi, merkezi alanlarda vurgulanan ikonik nesneler ile daha periferal bölgelerde konumlanan ikincil anlatı öğeleri arasında algısal bir denge kurmaktadır. Böylece ziyaretçi, mekânı yalnızca işlevsel bir restoran olarak değil, keşfedilmeyi bekleyen anlatısal bir bütün olarak deneyimlemektedir.

Anlatısal akış, mekânsal organizasyonun temel belirleyicilerinden biri olarak öne çıkmaktadır. Sergilenen nesneler, kronolojik bir müzik tarihi anlatısı ya da belirli temalar etrafında gruplanarak sunulmakta, bu durum ziyaretçinin mekân içindeki dolaşımını yönlendiren örtülü bir senaryo oluşturmaktadır. Bu yaklaşım, mekânın rastlantısal bir sergileme alanı olmaktan çıkarak küratöryel bir mantıkla kurgulanmasını sağlamaktadır. Falk ve Dierking'in müze deneyimini çok boyutlu bir öğrenme ve anlamlandırma süreci olarak ele alan modeli, Hard Rock Kafe mekânlarında belirgin biçimde gözlemlenmektedir (Falk & Dierking, 2016). Ziyaretçi, fiziksel çevre, kişisel müzik geçmişi ve sunulan anlatılar arasında kurduğu ilişki yoluyla deneyimi aktif biçimde üretmekte, belleğine kazıyarak anılar biriktirmektedir.

Aydınlatma dramaturjisi, sergileme stratejilerinin en güçlü bileşenlerinden biridir. Sahne aydınlatmasında düzenlenen performansların profesyonel ve yarı profesyonel kimlikleriyle uyumludur.

Spot aydınlatmalarla vurgulanan nesneler, sahnesel bir etki yaratarak müzikal performansın görsel ve duygusal izlerini mekâna taşımaktadır. Ambiyans aydınlatma ile desteklenen genel atmosfer, yeme içme işlevinin gerektirdiği konforu korurken, sergileme deneyiminin dramatik boyutunu güçlendirmektedir. Bu durum, performansın geçici doğasının mekânsal temsiller yoluyla kalıcı hâle getirilmesine olanak tanımaktadır.

Vitrinleme ve çerçeveleme tekniklerinin müze standartlarına yakın biçimde uygulanması, popüler müzik kültürüne ait nesnelere kurumsal bir değer atfetmektedir. Bu yaklaşım, Bennett'in müzenin kültürel hiyerarşileri yeniden üreten bir yapı olduğu yönündeki değerlendirmesiyle birlikte ele alındığında, Hard Rock Kafe'nin popüler kültürü meşrulaştıran bir temsil mekânı olarak işlev gördüğü söylenebilir (Bennett, 1995). Popüler müziğe ait nesneler, bu sergileme dili aracılığıyla gündelik tüketim nesneleri olmaktan çıkarak evrensel kültürel miras öğeleri statüsü kazanmaktadır.



Görsel 4 Hard Rock Kafe Tampa Florida, Url-3

Ziyaretçi deneyimi bağlamında Hard Rock Kafe, pasif tüketim anlayışının ötesine geçen katılımcı bir mekânsal pratik sunmaktadır. Ziyaretçi, yalnızca yemek yiyen bir kullanıcı değil,

sergilenen nesneler aracılığıyla müzikal anlatıyı takip eden, anımsayan ve kendi kişisel belleğini mekânsal deneyime dâhil eden aktif bir özne konumuna yükselmektedir. Assmann'ın kültürel bellek kuramında vurguladığı üzere, bireysel anımsama süreçleri kolektif hafıza çerçeveleri içinde anlam kazanmaktadır (Assmann, 2011). Hard Rock Kafe mekânları, bu çerçeveleri fiziksel olarak üreterek bireysel bellek ile kolektif anlatı arasında bir köprü kurmaktadır. Popüler kültür, tüketim ve bellek üretimi arasındaki ilişki, Hard Rock Kafe modeli üzerinden açık biçimde okunabilmektedir. Ticari tüketim ile kültürel deneyimin aynı mekânsal bağlamda sunulması, deneyim ekonomisinin iç mimarlık ölçeğindeki somut bir karşılığıdır. Pine ve Gilmore'un deneyim ekonomisi yaklaşımında belirttiği gibi, çağdaş tüketim pratikleri ürün ve hizmetlerin ötesinde, hatırlanabilir ve duygusal bağ kurulan deneyimlere odaklanmaktadır (Pine & Gilmore, 1999). Hard Rock Kafe'de sunulan deneyim, ziyaretçinin mekânla kurduğu ilişkiyi yalnızca anlık bir kullanım düzeyinde bırakmamakta, uzun süreli bir hafıza üretimine dönüştürmektedir.

Bu süreçte sergilenen nesneler ve anlatılar, popüler müzik kültürüne ait belirli sanatçıları, dönemleri ve türleri öne çıkararak kolektif belleğin seçici biçimde inşa edilmesine katkıda bulunmaktadır. Smith'in miras kavramını toplumsal olarak inşa edilen ve ideolojik yönleri olan bir süreç olarak ele alan yaklaşımı, Hard Rock Kafe örneğinde popüler müziğin miraslaştırılması üzerinden okunabilmektedir (Smith, 2006). Mekân, hangi anlatıların hatırlanmaya değer olduğuna dair örtük bir seçicilik sergilemekte, bu durum kültürel temsiliyet ve dışlama meselelerini gündeme getirmektedir. Hard Rock kafelerde gerçekleştirilen etkinlikler genellikle kentin kültürel belleğiyle uyumlu biçimde gerçekleştirilmektedir. Trash metal, heavy metal, speed metal türlerinde 1983 yılından beri müzik yapan küresel üne sahip müzik grubu Megadeth konser vermek için İstanbul'a geldiğinde Hard Rock Kafe'nin özel partisinde de bir akustik performans gerçekleştirmişlerdir. Etkinlikler genellikle rock müzik üzerine olmakla beraber mekân çeşitli müzik türlerinde profesyonel ve yarı profesyonel sanatçıları ağırlayarak hayranlarıyla samimi bir ortamda buluşmalarını sağlamaktadır. Örneğin Hard Rock Cafe Helsinki'de düzenlenen etkinlikler mekâna çeşitlilik getirmiş, şirketin görünürlüğünü artırmış ve s normal açılış saatlerini genişletecek başarılı bir etkinlik yaratmıştır (Sjöblom, 2021).

Bu konseptin bir diğer küresel getirisi de marka kültürü üzerinden yarattığı hayran potansiyelinin, mekânın çeşitli şehir ve ülkelerdeki şubelerini ziyaret etme amacıyla gerçekleştirdikleri gezilerin turizme katkılarıdır. Örneğin Hard Rock Café (HRC) tarafından

üretilen ve kafede satışa sunulan hatıra rozetlerini toplama ve koleksiyon oluşturma eğilimi hayran turizmi çerçevesinde ele alınabilir. Bu markanın hayranları üzerinde uyandırdığı Dünyanın dört bir yanındaki yerlere seyahat etmek ve benzersiz rozetler toplama arzusu, turizm ve hatıra eşya tüketimiyle ilişkili toplama uygulamaları etrafında dönen bir hayran diyaloğu yaratmaktadır (Geraghty, 2014). Markanın koleksiyon ürünleri pinlerle sınırlı değildir. Genel eğilimlerden hareketle; bardak, t-shirt, müzik aksesurları (pena, baget, v.b), anahtarlıkların da ülkelere, özel günlere ve şubelere özel tasarlanmış versiyonları mevcuttur. Buda endüstri ürünleri ve moda tasarımına ait nesnelerin koleksiyon değeri taşıyacak nitelikte üretilmesi ve satışa sunulmasıyla markanın yalnız iç mekân tasarımında değil diğer tasarım dallarında da multidisipliner yaklaşımla bir tasarım kültürü ürettiğini göstermektedir.

Şubeler genellikle turizm odak noktalarında konumlandırılmaktadır. Örneğin Helsinki şubesi, ana tren istasyonu ve kruvaziyer gemileri yolcularını hedeflemektedir (Tanskanen & Musto, 2015). Atina şubesi Monastiraki meydanına ulaşan Monastiraki metro istasyonuna yakın konumlanmıştır. İstanbul'da açılan ancak şu an kapalı olan geçmiş şubeler Ortaköy ve İstiklal Caddesi'nde hizmet vermişlerdir. Kopenhag şubesi Rashuspladsen isimli turistik merkezde yer almaktadır. Bu konumlandırma marka değerinin küreselleşmesine olanak sağlarken, turistik bölgelerin canlılığına katkı sağlamakta ve yeni gelişen turizm odak noktalarına değer katmaktadır. Bu niteliklerini de özgün müze-restoran stilinde iç mekanına borçludur. Giriş kısmında oluşturulan karşılama birimi kullanıcının yeni deneyimlediği bir mekân organizasyonuna olduğu kadar ve yeni deneyimleyeceği kent kültürüne de bir giriş aksıdır.

SONUÇ

Çalışma, Hard Rock Kafe'nin yalnızca marka kimliğini yansıtan tematik bir dekorasyon dili sunmadığı, aksine müzik tarihine dair belirli anlatıları seçerek mekânsal olarak kurumsallaştıran bir sergileme stratejisi geliştirdiği varsayımına dayanmaktadır. Bu doğrultuda araştırma, iç mimarlık disiplininin kültürel bellek, anlatı ve deneyim tasarımıyla kurduğu ilişkiye katkı sunmaktadır. Bu çalışma, Hard Rock Kafe iç mekânlarının popüler müzik kültürüne ait kolektif belleğin mekânsal olarak temsil edildiği ve yeniden üretildiği hibrit bir model sunduğunu ortaya koymaktadır. Mekân, geleneksel restoran işlevini aşarak, sergileme tasarımı, mekânsal anlatı ve deneyim odaklı iç mimarlık yaklaşımlarının bütünleştiği çok fonksiyonlu bir deneyim alanı olarak işlemektedir. Sergilenen nesneler, müzikal belleğin maddi kültür öğeleri olarak mekânsal kurguya dâhil edilmekte; ziyaretçi ise bu kurgu içinde aktif bir anlam üreticisi hâline gelmektedir.

İç mimarlık açısından değerlendirildiğinde, Hard Rock Kafe örneği, ticari mekânların kültürel bellek üretiminde üstlenebileceği rolleri görünür kılmaktadır. Sergileme tasarımı bağlamında ise klasik müzecilik anlayışlarının ticari mekânlarda nasıl yeniden yorumlanabildiği ve deneyim ekonomisiyle nasıl bütünleştiği ortaya konulmaktadır. Kültürel bellek çalışmaları açısından bakıldığında, mekân popüler müziğin miraslaştırılması sürecinde seçici ve anlatı temelli bir temsil modeli sunmaktadır. Bu yönüyle Hard Rock Kafe, müze kavramının genişleyen sınırlarını ve çağdaş mekânsal pratiklerin kültürel anlam üretimindeki etkisini anlamak için önemli bir vaka çalışması niteliği taşımaktadır.

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GÜNDÜZ KUŞAĞI YEMEK PROGRAMLARINDA ERKEKLİK İNŞASI: *ZUHAL TOPAL'LA YEMEKTEYİZ* ÖRNEĞİ

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ÖZET

Türkiye'de gündüz kuşağında yayınlanan Reality TV'nin yüksek izlenme oranlarına sahip formatları olan "yemek programları", toplumsal cinsiyet rollerinin yeniden inşa edildiği önemli medya metinleridir. Kalıp yargıların gündelik üretim alanı olan bu programlar toplumsal norm, değer, rollerin pekiştirme aracı olmaları sebebiyle araştırma alanı olarak zengin bir veri seti sunmaktadır.

Bu çalışma da ana akım televizyon yayıncılığının tematik kanalı olan TV8'in yüksek reyting oranlarına sahip olan Zuhal Topal'la Yemekteyiz programı üzerinden, geleneksel olarak dişil olarak kodlanan mutfak mekanına dahil edilen erkek katılımcıların, program içi mutfak pratikleri ve iletişim biçimlerini odağa almaktadır. Programdan elde edilen metinlerde toplumsal normların ve değerlerin ürettiği kalıp erkeklik kodlarının hangi stratejilerle yeniden kurulduğunu ve meşrulaştırıldığını incelemektedir. Çalışmanın araştırma kısmında programın bölümleri arasından amaçlı örneklemle seçilen yayınlardaki dile dair kodlar eleştirel söylem analizi yöntemi ile çözümlenmiştir.

Derlenen veri seti, program katılımcılarının yemek yapma serüveni anlatma biçimleri, kurulan sofra etrafında toplanan tüm katılımcıların kritik konuşmaları ve birbiriyle olan etkileşim örüntülerinden oluşmaktadır. Araştırma bulguları, erkek yarışmacıların mutfaktaki varlıklarını kurulan söylem hattı üzerinden gerekçelendirdiğini ortaya koymaktadır. İlk olarak yemek yapma pratiği, ev içi emek ve bakım bağlamından koparılarak teknik terminoloji ve profesyonellik vurgusuyla sunulmaktadır. Bu vurguyla yemek yapmak, uzmanlık gerektiren bir performans olarak yeniden tanımlanmaktadır. Bunun yanında erkeklik ve güç söylemi katılımcıların yemek tercihlerinde, sunum pratiklerinde ve kendi hayat hikayelerinin aktarımındaki kullanılan dilsel yapının ortaya koyduğu söylemde de ortaya çıkmaktadır. Ayrıca masa-sofra etrafında toplanan diğer katılımcılar ve sunucu etrafında oluşmaktadır. Yemeklerin puanlandığı bu bölümde erkek yarışmacıların, öğretici, düzeltici ve ölçüt koyucu bir dil benimsenmektedir. Sonuç olarak sıradan insanların katılığı yemek programlarında toplumsal cinsiyet rolleri eril rekabet ve sembolik otoriteyle yeniden inşa edilmektedir.

Anahtar Kelimeler: Televizyon sosyolojisi, hegemonik erkeklik, radyo-televizyon, medya temsili.

CONSTRUCTING MASCULINITY IN DAYTIME COOKING SHOWS: THE CASE OF *ZUHAL TOPAL'LA YEMEKTEYİZ*

ABSTRACT

Reality TV formats with high viewership ratings broadcast during daytime hours in Turkey, such as cooking shows are important media texts that reconstruct gender roles. These programs, which are a daily production arena for stereotypes, offer a rich data set for research because they serve as a means of reinforcing social norms, values, and roles.

This study focuses on the kitchen practices and communication styles within the program of male participants included in the kitchen space, traditionally coded as feminine, through the program *Zuhal Topal'la Yemekteyiz*, which has high ratings on TV8, the thematic channel of mainstream television broadcasting. It examines the strategies used to reconstruct and legitimize the stereotypical codes of masculinity produced by social norms and values in the texts obtained from the program. In the research part of the study, the codes related to language in the broadcasts selected from the program's episodes through purposive sampling were analyzed using critical discourse analysis.

The compiled data set consists of the ways in which program participants narrate their cooking experiences, the critical conversations of all participants gathered around the table, and their patterns of interaction with each other. The research findings reveal that male contestants justify their presence in the kitchen through the established discourse. First, the practice of cooking is presented with an emphasis on technical terminology and professionalism, detached from the context of domestic labour and caregiving. With this emphasis, cooking is redefined as a performance requiring expertise. In addition, the discourse of masculinity and power emerges in the participants' food preferences, presentation practices, and the discourse revealed by the linguistic structure used in the transmission of their life stories. Furthermore, it is formed around the other participants gathered around the table and the host. In this section, where the dishes are scored, a didactic, corrective, and judgmental language is adopted by the male contestants. As a result, gender roles are reconstructed in cooking shows featuring ordinary people through masculine competition and symbolic authority.

Keywords: Television sociology, hegemonic masculinity, radio-television, media representation.

YENİ TEMSİL DÜZENİ: BELGESEL FİLMDE YAPAY ZEKA VE HİPERGERÇEKLİK

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ÖZET

Bu çalışma, metin tabanlı sentetik ses ve görüntü üretimi, deepfake gibi yapay zeka destekli üretim tekniklerinin yaygınlaştığı bu yeni düzende belgesel sinemanın temel iddiası olan gerçeklik olgusunda oluşan kırılmaya odaklanmaktadır. Özellikle yüz canlandırma, ses taklit etme ve görüntü sentezleme gibi teknikler, belgeselin gerçeklikle kurduğu ilişkide geleneksel "belge" niteliğinin sınırlarını aşındırmaktadır. Ayrıca bu yeni anlatı düzeni temsil, özne ve gerçeklik ilişkisini yeniden inşa etmektedir.

Belgesel sinemada yaşanan bu dönüşüm, yapay zekayla yalnızca gerçeği anlatma değil, benzer biçimde gerçeği yeniden inşa etme işlevi kazanmasını da işaret etmektedir. Artık bu yapımlar, Jean Baudrillard'ın tanımladığı simülakr düzlemine yerleşmekten ziyade, simülakr mantığına yaklaşan bir eşikte durmaktadır. Bu bağlamda, etik sınırlar, izleyici algısı ve temsilin güvenilirliği gibi unsurlar, yapay zeka destekli temsillerin "gerçekmiş gibi işleyen ama gerçek olmayan" içeriklerle dolu bir hipergerçeklik düzeninde yeniden tanımlanmaktadır.

Bildiride, kuramsal çerçevedeki bu iddia, yapay zeka destekli kısa deneysel belgesel örnekleri olan *Gerçek Ötesi* (2025), *Another Body* (2023), *Roadrunner: A Film About Anthony Bourdain* (2021), *Welcome to Chechnya* (2020) filmleri üzerinden somutlaştırılmaktadır. Seçilen bu yapımlar, yapay zeka müdahalesinin görünürlüğünü, doğrulama ve etik gerekçelendirme yaklaşımlarını karşılaştırmalı olarak ele almamıza olanak tanıyan örneklerdir. Filmler, gerçeğin yokluğunda üretilen ve yine gerçeklik gibi tüketilen içerikleriyle izleyiciye yalnızca bilgi sunmakla kalmaz, aynı zamanda duygusal, estetik ve ideolojik olarak kodlanmış bir biçimde, gerçekliği yeniden kuran bir medya deneyimi yaşatır.

Anahtar Kelimeler: Belgesel film, simülasyon kuramı, hipergerçeklik, dijital temsil, yeni medya.

NEW REPRESENTATION ORDER: ARTIFICIAL INTELLIGENCE AND HYPERREALITY IN DOCUMENTARY FILM

ABSTRACT

This study focuses on the break in the phenomenon of reality, which is the fundamental claim of documentary cinema, in this new order where text-based synthetic voice and image production, and AI-supported production techniques such as deepfakes are becoming widespread. Techniques such as facial animation, voice imitation, and image synthesis, in particular, are eroding the boundaries of the traditional "documentary" quality in the relationship that documentaries establish with reality. Furthermore, this new narrative order is reconstructing the relationship between representation, subject, and reality.

This transformation in documentary cinema indicates that artificial intelligence has gained the function of not only narrating reality but also reconstructing it in a similar manner. These productions now stand at a threshold approaching the logic of simulacra rather than settling into the plane of simulacra as defined by Jean Baudrillard. In this context, elements such as ethical boundaries, audience perception, and the reliability of representation are being redefined in a hyperreality order filled with AI-supported representations that "function as if they were real but are not real".

In the paper, this claim within the theoretical framework is illustrated through concrete examples of AI-assisted short experimental documentaries: *Beyond Reality* (2025), *Another Body* (2023), *Roadrunner: A Film About Anthony Bourdain* (2021), and *Welcome to Chechnya* (2020). The films do not merely provide information to the viewer with their content produced in the absence of reality and consumed as if it were reality; they also offer a media experience that reconstructs reality in an emotionally, aesthetically, and ideologically coded form.

Keywords: Documentary film, simulation theory, hyperreality, digital representation, new media.

JOSEPH HAYDN'IN OP. 3 NO. 5 ESERİNİN "SERENADE ANDANTE CANTABILE" BÖLÜMÜ ÜZERİNE KEMAN–PİYANO DÜZENLEMESİ: YAPISAL VE İCRA BOYUTLARIYLA BİR TRANSKRİPSİYON ÇALIŞMASI

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ÖZET

Bu çalışma, Joseph Haydn'ın yaylı çalgılar dörtlüsü için bestelemiş olduğu Op.3 No. 5 eserinin "Serenade Andante Cantabile" bölümünü keman–piyano ikilisi için yeniden düzenlemeyi amaçlayan bir transkripsiyon araştırmasıdır. Çalışmada, eserin özgün kuartet yapısı korunarak iki çalgının tanısal, teknik ve icrasal özelliklerine uyumlu bir aktarım süreci tasarlanmıştır. Araştırmada nitel içerik analizi yönteminden faydalanılmış; orijinal partitür melodik, motif yapıları ayrıca armonik süreç ve doku özellikleri bakımından incelenmiştir. Bu analiz doğrultusunda keman ve piyano çalgı özelliklerine uygun şekilde yeniden düzenlenmiş, motiflerin çalgılar arasında dağılımı, eşlik yapılarının yeniden kurgulanması ve ifade karakterinin korunması göz önünde bulundurulmuştur. Elde edilen bulgular, kuartet yapısından duo yapısına geçişte eserin biçimsel bütünlüğünün korunabildiğini, aynı zamanda yeni bir icra perspektifi kazanıldığını göstermektedir. Bu yönüyle çalışma, klasik dönem eserlerinin farklı çalgı kombinasyonlarına uyarlanmasına yönelik uygulamalı bir örnek sunacağı, bununla birlikte bundan sonra yapılacak olan transkripsiyon çalışmalarına katkı sağlayacağı düşünülmektedir.

Anahtar kelime: Keman-Piyano, Joseph Haydn, Transkriprisyon

VIOLIN–PIANO ARRANGEMENT OF JOSEPH HAYDN'S OP. 3 NO. 5 WORK, "SERENADE ANDANTE CANTABILE" MOVEMENT: A TRANSCRIPTION STUDY IN STRUCTURAL AND PERFORMANCE DIMENSIONS

ABSTRACT

This study is a transcription research project that aims to rearrange the "Serenade Andante Cantabile" section of Joseph Haydn's Op. 3 No. 5, composed for string quartet, for violin and piano duet. The study preserves the original quartet structure of the work and designs a transcription process compatible with the tonal, technical, and performance characteristics of the two instruments. Qualitative content analysis was utilised in the research; the original score was examined in terms of its melodic and motivic structures, as well as its harmonic processes and textural characteristics. In line with this analysis, the piece was rearranged to suit the

characteristics of the violin and piano, taking into account the distribution of motifs between the instruments, the reconfiguration of the accompaniment structures, and the preservation of the expressive character. The findings show that the formal integrity of the piece can be preserved in the transition from quartet to duo structure, while also gaining a new performance perspective. In this respect, the study is expected to provide a practical example of adapting classical period works to different instrument combinations and to contribute to the transcription literature.

Keywords: Violin-Piano, Joseph Haydn, Transcription

GİRİŞ

Barok ile Romantik dönem arasında yer alan Klasik Dönem müziği J. S. Bach'ın ölümü olan 1750 yılından L. V. Beethoven'in ölümüne (1827) kadar süregelen müzikal gelişim çağıdır. Bu dönemin temel özelliği Sonat formu ile öne çıkmaktadır. Sonat allegrosu ile yapılanan bu formdan hareketle orkestraya uyarlanmış Senfoni, Konçerto, Yaylılar dörtlüsü gibi müzikal türlerde bu formlardan ortaya çıkmıştır (Say, 2009 :298). Bu dönem biçimsel açıdan tutarlı, yalın anlatım ve çalgılar arası eşitlik ilkesiyle klasik batı müziği için önemli bir yere sahiptir.

Bu dönemde oda müziği, özellikle yaylı çalgılar dörtlüsü aracılığıyla bestecilerin estetik ve kompozisyon yaklaşımlarını yansıtan temel türlerden biri hâline gelmiştir. Klasik dönem eserlerinin farklı çalgı kombinasyonları için yeniden düzenlenmesi, özgün yapının korunarak yeni icra olanakları sunulmasını sağlayan önemli bir uygulama alanı olarak öne çıkmaktadır. Viyana klasikleri olarak bilinen Haydn, Mozart ve Beethoven piyano sonatlarından hareketle diğer solo çalgılar için yazdıkları sonatların dışında, aynı biçimi koruyarak trio, kuartet ve kentetler bestelemişlerdir (Mimaroğlu,1999:70).

Bu dönemin önemli bestecilerinden olan J. Haydn, 1732 yılında Avusturya'nın doğusu ile Macar sınırına yakın bir yerleşim yeri olan Rohrau'da dünyaya gelmiştir. İlk müzik eğitimini köy öğretmeninden alan besteci, daha sonra altı yaşlarında Hainburg'a yakın bir kasabaya müzik eğitimine gönderilmiştir. Genellikle okul ve kilisede müzik yaparak zamanını geçiren Haydn, bu süreçte Keman ve Klavsen çalmayı öğrenmiş, ayrıca güzel bir sese sahip olduğu için Viyana'da St. Stephan Kilisesi koro şefi Reuter tarafından korosuna çağrılmış ve Viyana'ya yerleşmiştir (Webster, 2002). Müzik yaşamını Viyana'da sürdürmeye devam eden Haydn, Kont Morzin orkestrasında şeflik görevine kadar yükselmiştir. Şeflik görevinin avantajıyla bu dönemde 30 senfoni, 6 yaylılar için trio, orkestra için 12 menuet, klavsen konçertoları, korno için konçerto ve çok sayıda divertimento ve sonat bestelemiştir (Say, 2005). Bu süreçte Mozart

ile tanışıp güçlü bir dostluk kurmuştur. Bestelerine bu dönemde de devam eden besteci 1791 yılında İngiltere'ye gidip Salomon Konserleri olarak da bilinen yapıtlarını bu süreçte gerçekleştirmiştir. Avusturya'ya döndükten sonra 6 Salomon Senfonisini yazmış ve bu dönemde sağlığı bozulan besteci 1809 yılında hayatını kaybetmiştir (Say, 2010; 290).

AMAÇ

Bu çalışmanın amacı, Joseph Haydn'ın yaylı çalgılar dörtlüsü için bestelemiş olduğu Op. 3 No. 5 eserinin "*Serenade Andante Cantabile"* bölümünü, özgün yapısal ve ifade özelliklerini koruyarak keman–piyano ikilisi için transkripsiyon yoluyla yeniden düzenlemek; bu süreçte keman için yeni düet materyalleri oluşturmak, yay tekniklerine yönelik uygulamaları ortaya koymak ve böylece keman eğitim sürecine katkı sağlamaktır.

ARAŞTIRMA VE BULGULAR

Durum tespitine yönelik nitel araştırma yöntemlerinden faydalanılarak oluşturulan çalışmada Joseph Haydn'ın yaylı çalgılar dörtlüsü için bestelemiş olduğu Op. 3 No. 5 eserinin "*Serenade Andante Cantabile"* bölümü doküman analizi ile keman piyano üzerine yeniden düzenlenmiştir. Nitel araştırma, gözlem, görüşme ve doküman analizi gibi veri toplama tekniklerinden yararlanarak, olay ve olguları kendi doğal bağlamları içerisinde derinlemesine ve bütüncül bir biçimde incelemeyi amaçlayan sistematik bir süreç olarak tanımlanmaktadır (Yıldırım ve Şimşek, 2008).

Yapılan bu çalışmada ise Cook'un 2013 yılında yayınladığı çalışmasından hareketle transkripsiyon sürecinde yalnızca melodik ve armonik unsurların değil aynı zamanda icra ve kazanımların belirlenmesi teorisi ile transkripsiyon düzenlenmiştir.

Çalışmanın evrenini Klasik dönem eserleri, örneklemini ise keman- piyano düeti için uygun olduğu değerlendirilen bu dönemin önemli bestecisi J. Haydn'ın Op. 3 No. 5 eserinin "Serenade *Andante Cantabile* bölümü oluşturmaktadır. Bu örnekleme yöntemi, olasılığa dayalı olmayan ve rastgele seçimin söz konusu olmadığı durumlarda, belirli özellikleri taşıyan örneklemler üzerinden bir ya da birden fazla özel durumun derinlemesine incelenmesini amaçlayan bir yaklaşımdır (Büyüköztürk vd., 2019).

String Quartet Op. 3 No. 5 Serenade Andante Cantabile Bölümü Keman Transkripsiyonu

Joseph Haydn'ın *String Quartet Op. 3 No. 5* adlı eserinin *Serenade Andante Cantabile* bölümü, keman ve piyano için yeniden ele alınarak bir transkripsiyon çalışması olarak düzenlenmiştir. Bu çalışmanın temel amacı, hem pedagojik hem de müzikal açıdan işlevsel bir repertuvar eseri ortaya koymaktır.
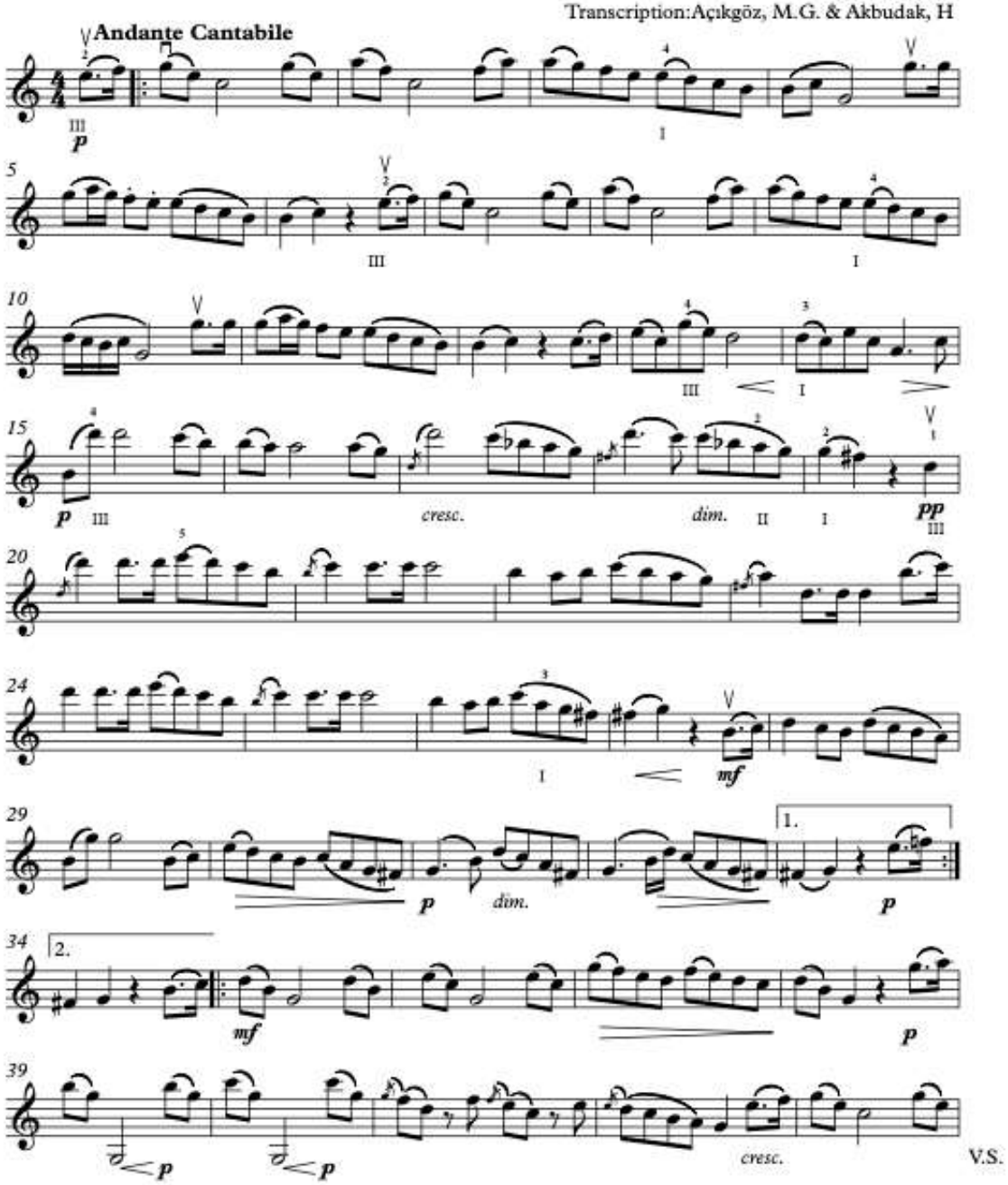
Hazırlanan transkripsiyon, özellikle keman eğitiminde öğrencilerin 1., 2. ve 3. pozisyonları rahatlıkla kavrayabilmelerini destekleyecek biçimde tasarlanmıştır. Eserde, pozisyon geçişleri doğal ve dengeli bir akış içerisinde ele alınmış; öğrencinin sol el tekniğini güvenli ve kontrollü biçimde geliştirmesi hedeflenmiştir. Bunun yanı sıra, legato ve détaché yay tekniklerinin etkin bir şekilde kullanılmasına olanak tanıyan müzikal yapı, sağ el tekniğinin gelişimine katkı sağlamayı amaçlamaktadır.
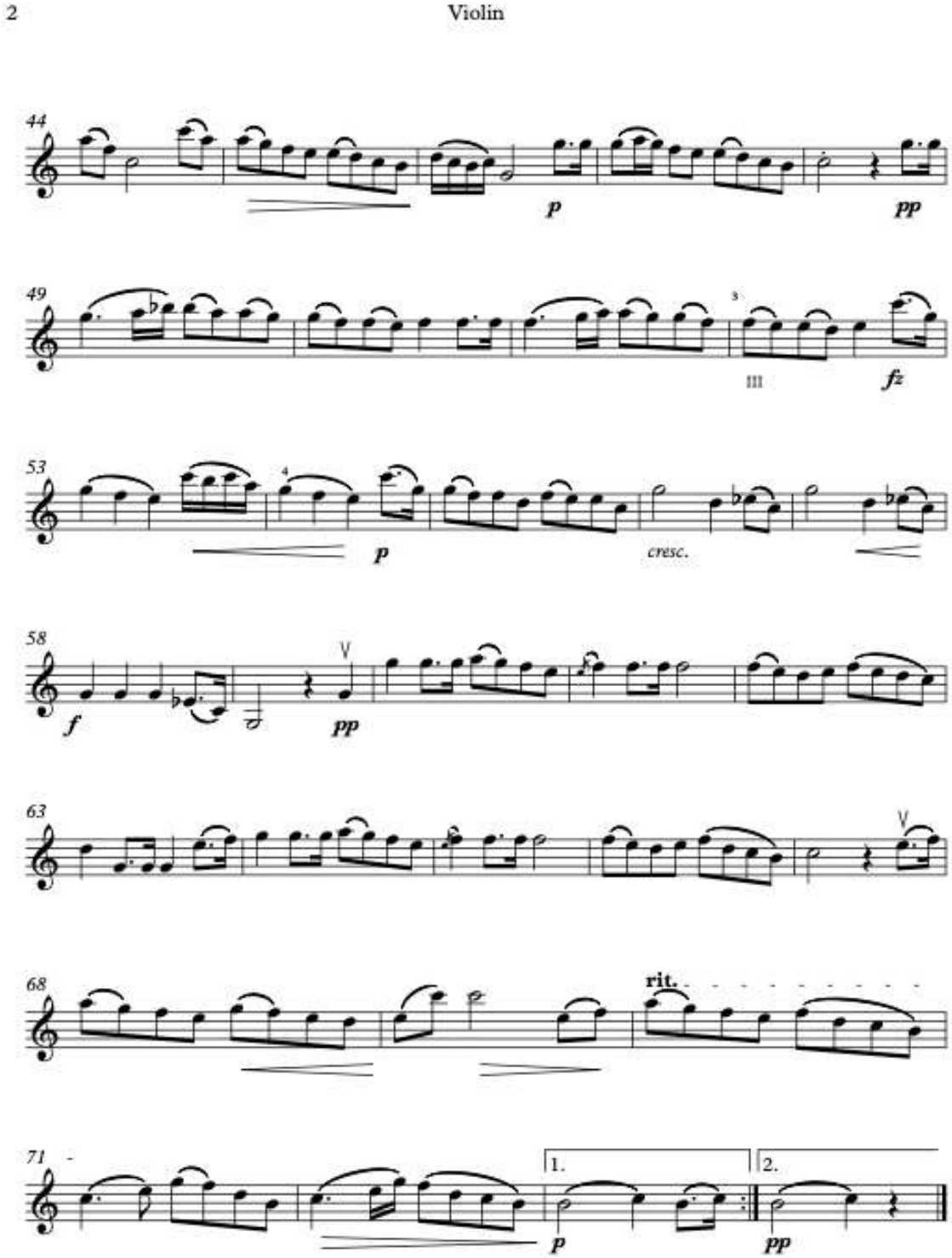
Violin

String Quartet Op.3 No. 5

Serenade

Joseph Haydn
Transcription:Açıkgöz, M.G. & Akbudak, H





Şekil 1: String Quartet Op. 3 No. 5 Serenade Andante Cantabile Bölümü Keman Transkripsiyonu

Bu çalışmada keman partisi, öğrencinin pozisyon hâkimiyetini geliştirmeye yönelik bilinçli bir kurguyla ele alınmıştır. Eserin 3. pozisyonda başlaması, öğrencinin bu pozisyona erken aşamada alışmasını amaçlamakta; devamında 1. pozisyona geçilerek temel el yerleşimi pekiştirilmektedir. İlerleyen bölümlerde yeniden 3. pozisyona dönüş ve ardından tekrar 1. pozisyona geçiş sağlanmasıyla, iki pozisyon arasında süreklilik oluşturulmuştur. Bu döngüsel yapı, öğrencinin 1. ve 3. pozisyonlar arasında kontrollü ve işlevsel geçişler yapabilme becerisini desteklemeyi hedeflemektedir.

Eser genel olarak Do Majör tonalitesi içinde ilerlemektedir. Ancak 17. ölçüden itibaren kullanılan değiştirici işaretler, tonal yapıya yeni renkler kazandırmakta ve müzikal anlatımı zenginleştirmektedir. Bu geçici tonal sapmalar, öğrencinin Do Majör ton içerisinde karşılaşabileceği alterasyonları tanımasına olanak sağlamakta; aynı zamanda pozisyon algısının ve entonasyon bilincinin gelişmesine katkıda bulunmaktadır.

Bu yönüyle söz konusu transkripsiyon, yalnızca teknik bir düzenleme değil, keman eğitiminde pozisyon kullanımını derinleştirmeyi amaçlayan pedagojik bir çalışma niteliği taşımaktadır.
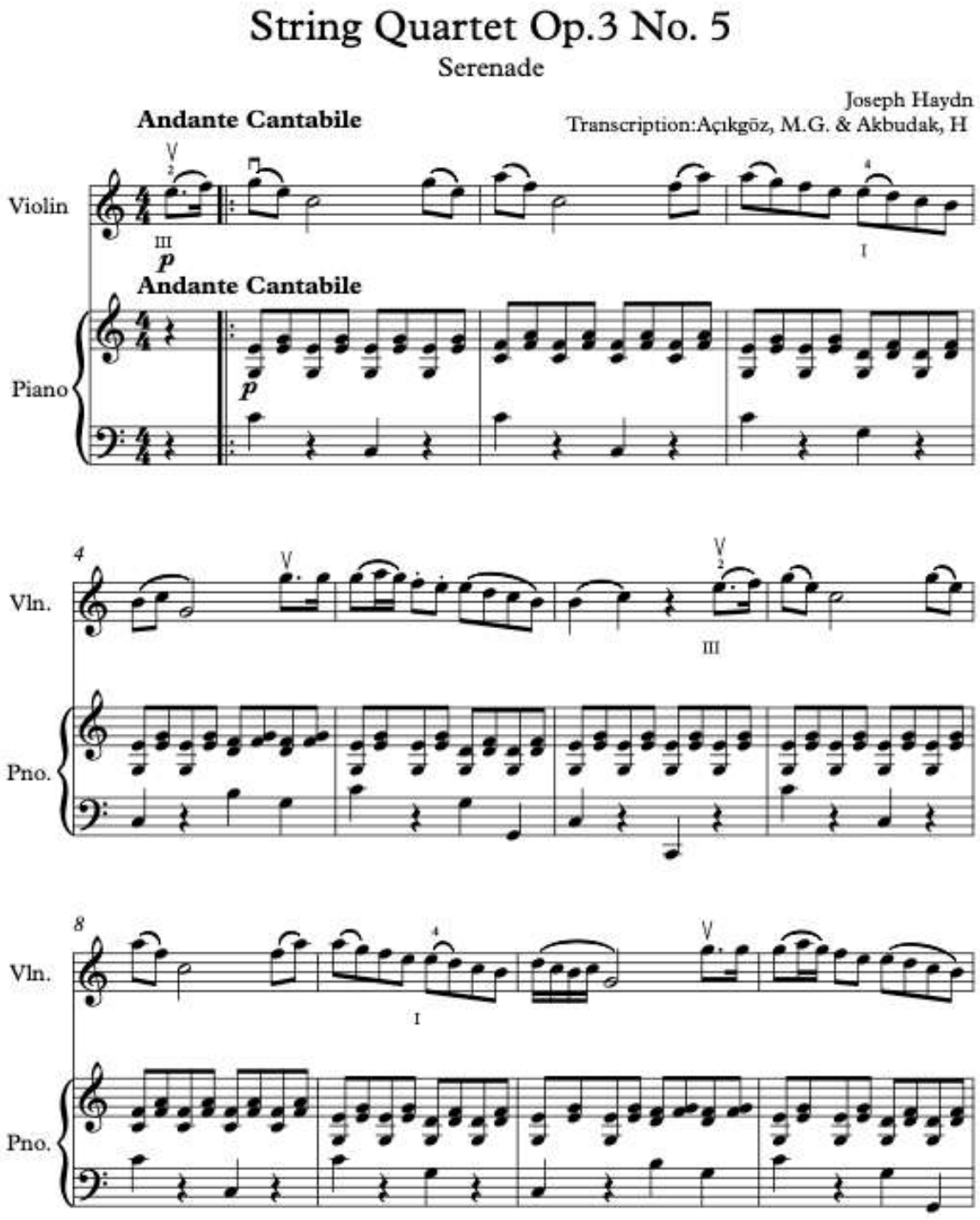
String Quartet Op. 3 No. 5 Serenade Andante Cantabile Bölümü Keman ve Piyano Transkripsiyonu
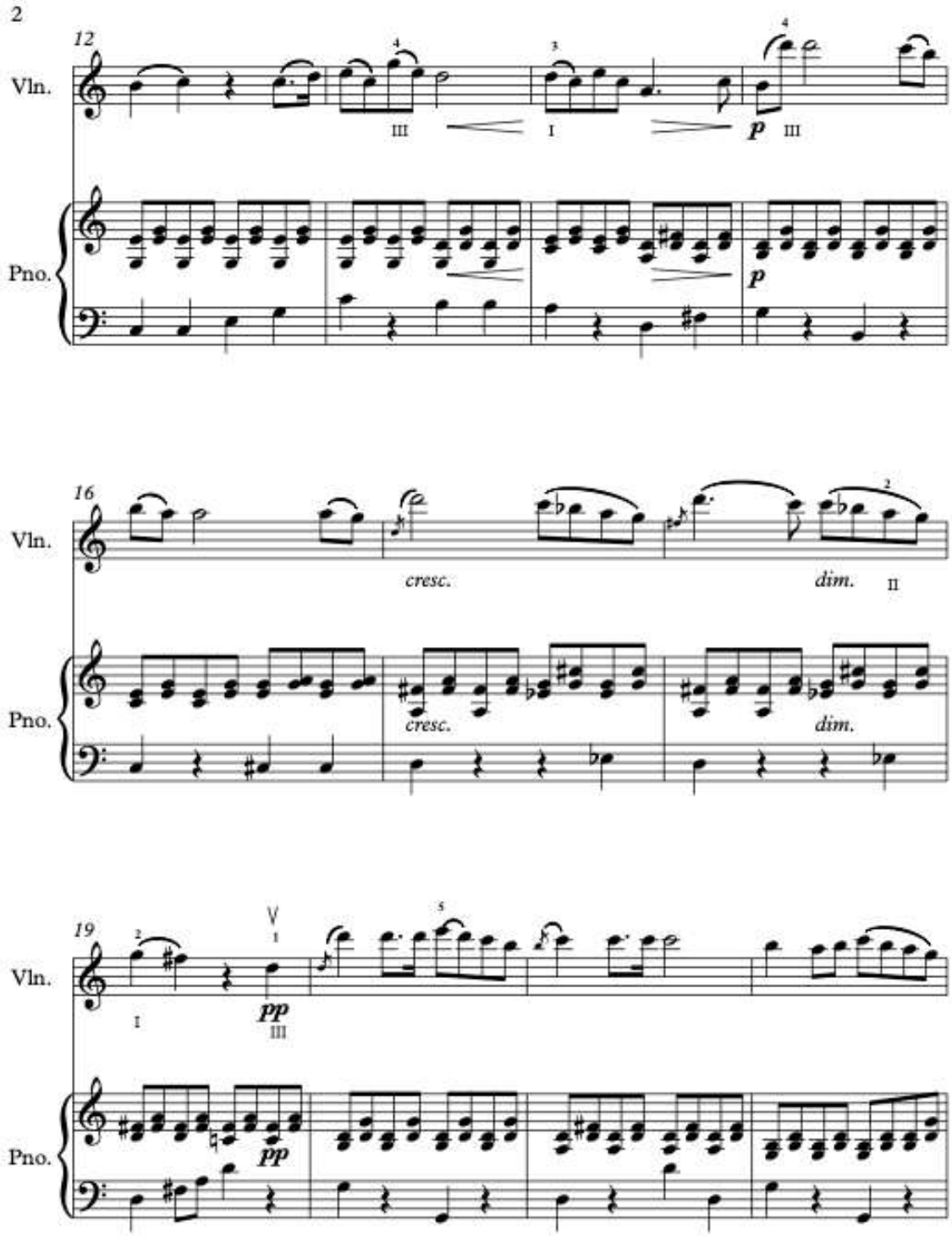
Bu transkripsiyon çalışmasında, eserin özgün yazım anlayışını korumak temel bir çıkış noktası olarak ele alınmıştır. Bu doğrultuda ikinci keman, viyola ve çello partilerinin piyano düzenlemesinde, ilgili çalgıların özellikleri mümkün olduğunca gözetilmiş, piyano açısından ise icrası rahat ve işlevsel bir eşlik dokusu oluşturulmasına özen gösterilmiştir. Düzenleme sürecinde indirgemeci bir yaklaşım benimsenmiş; böylece hem eserin dokusal dengesi korunmuş hem de piyanonun eşlik rolünü doğal bir biçimde üstlenmesi sağlanmıştır.
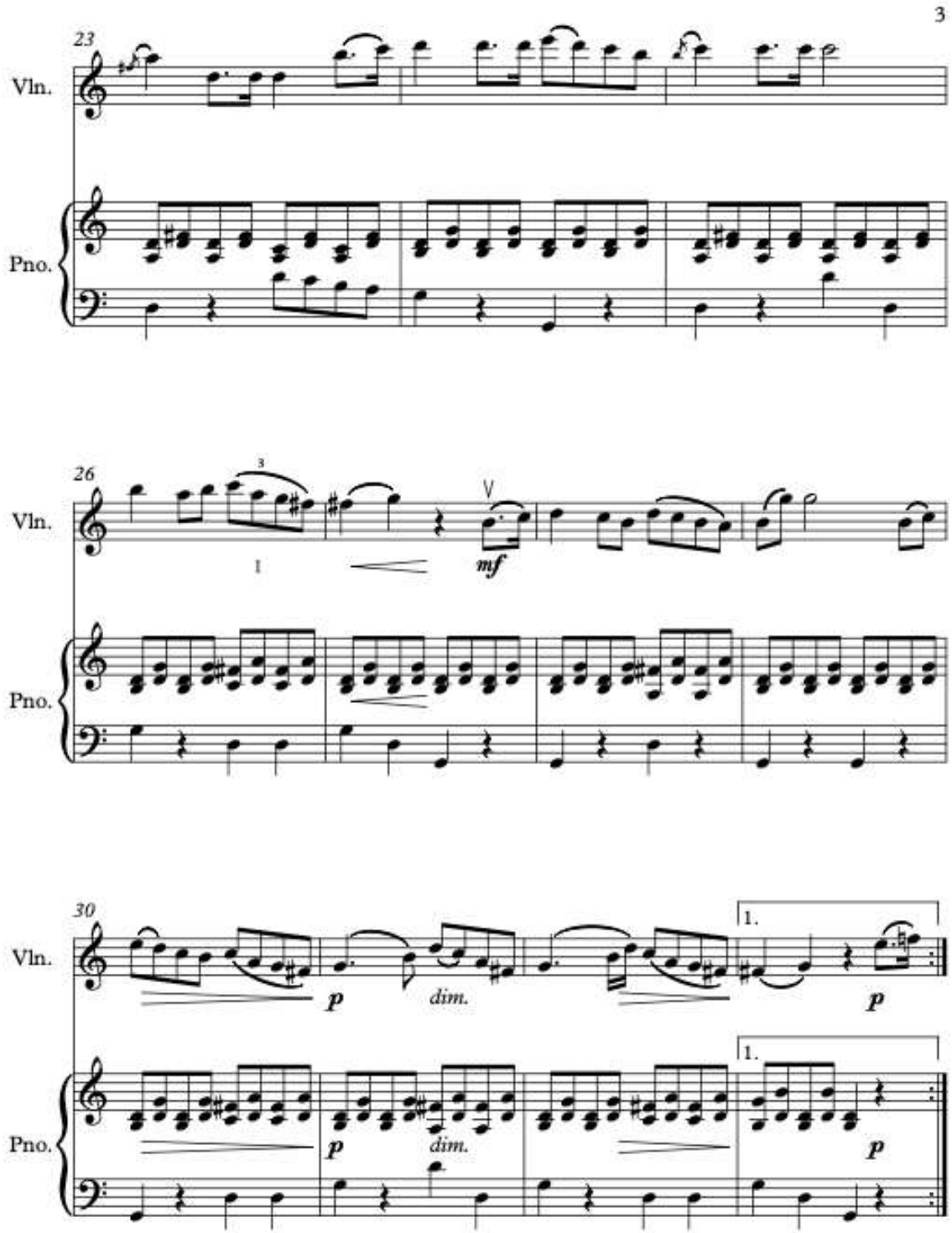
Piyano partisi genel olarak, sağ elin eşlik figürlerini, sol elin ise bas çizgisini taşıdığı bir yapı üzerine kurulmuştur. Bu tercih, yaylı dörtlü yazısındaki fonksiyonel dağılımın piyanoya aktarılmasına olanak tanırken, eserin armonik temelinin açık ve anlaşılır bir biçimde duyulmasını hedeflemektedir. Böylece piyano, solo kemanı destekleyen ve eserin form bütünlüğünü muhafaza eden bir eşlik işlevi üstlenmektedir.
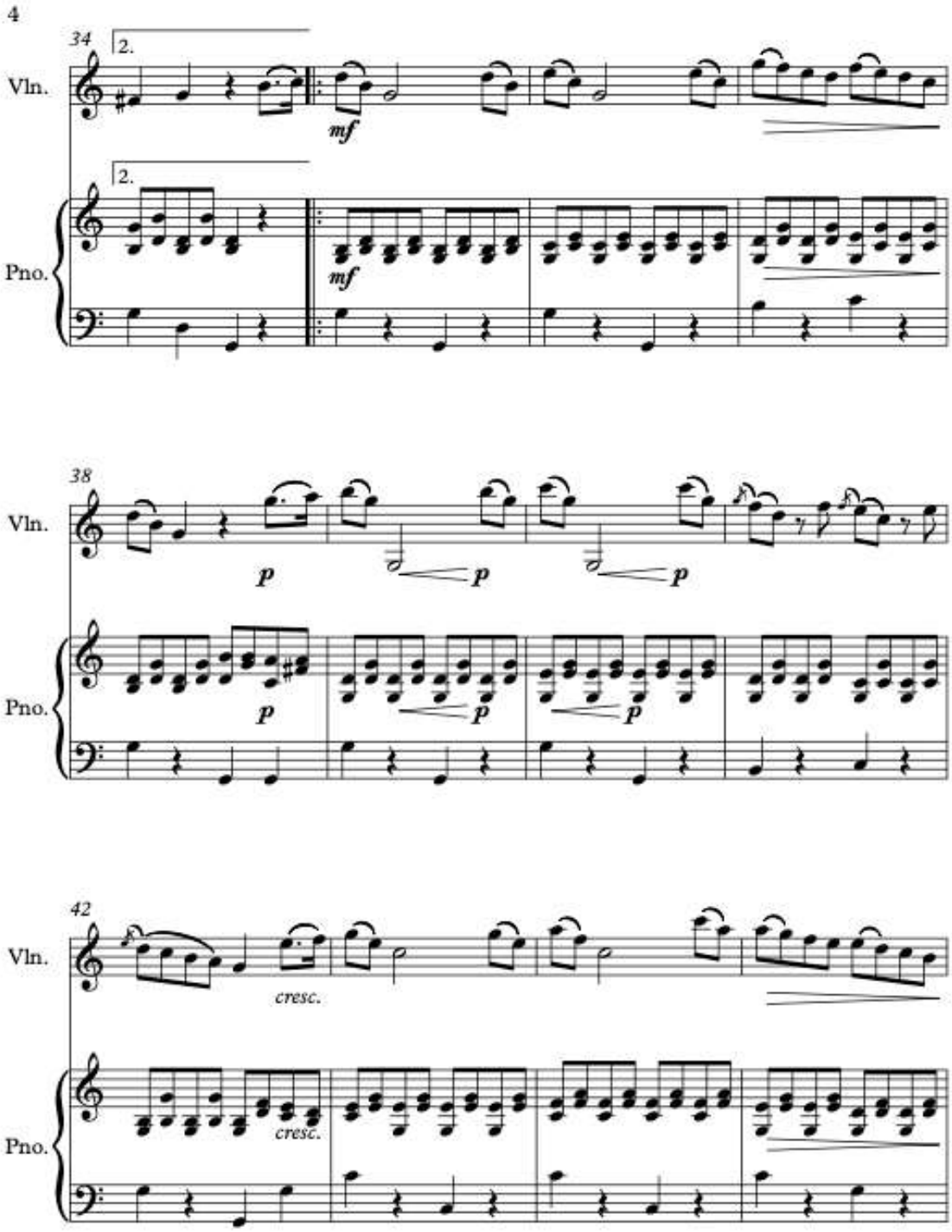
Eserde melodik anlatımın ağırlıklı olarak birinci keman tarafından taşındığı göz önünde bulundurularak, transkripsiyonda bu çizgi solo keman partisi olarak öne çıkarılmıştır. Diğer yaylı çalgıların üstlendiği destekleyici roller ise piyano partisi içerisinde değerlendirilmiş; bu sayede solo keman ile piyano arasında dengeli ve şeffaf bir müzikal ilişki kurulmuştur.
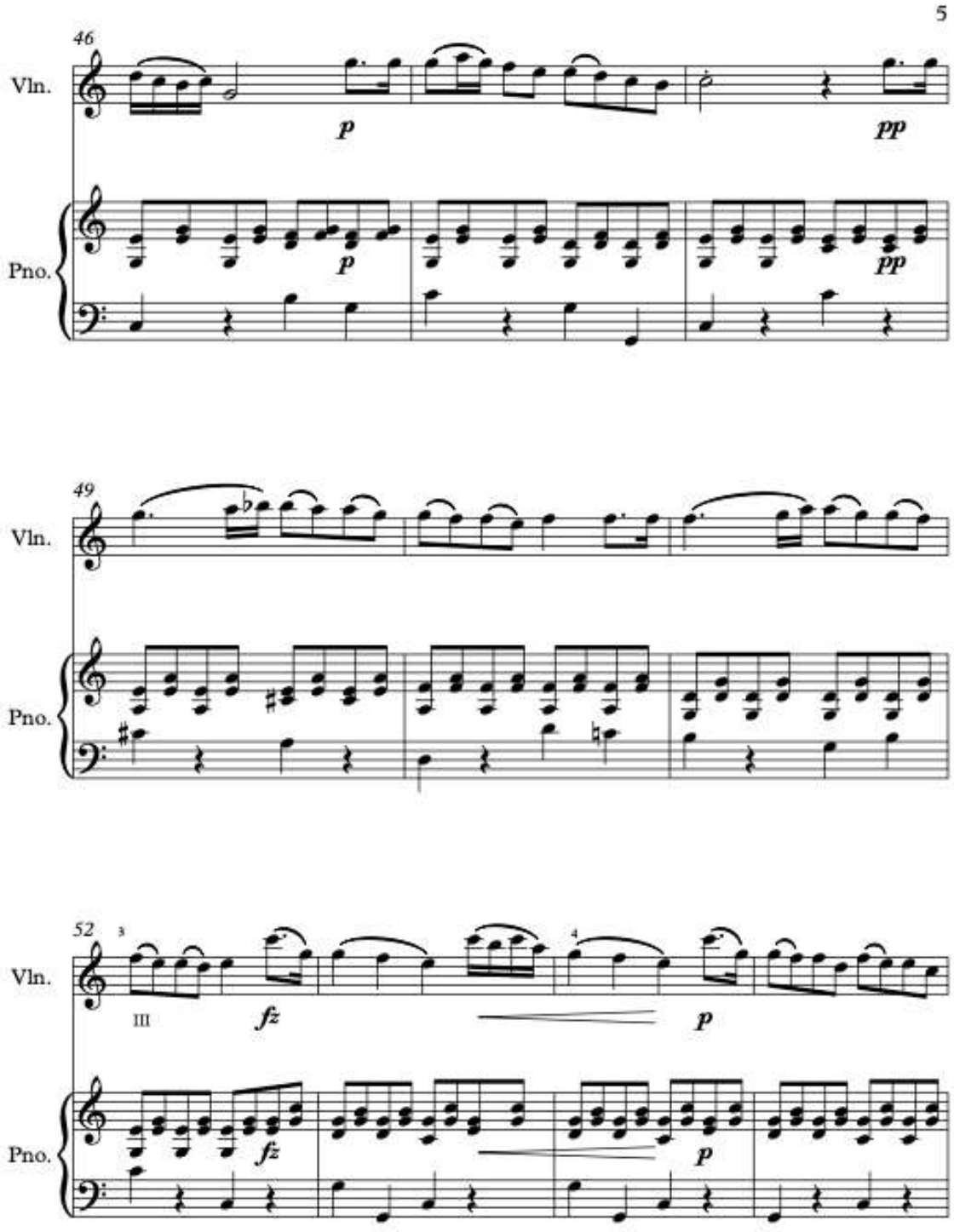
Dinamikler açısından, eserin orijinal nüshasına sadık kalınmış; ancak müzikal ifadenin daha belirgin hâle gelmesi amacıyla bazı bölümlerde crescendo ve decrescendo gibi dinamik geçişler notasyonda özellikle vurgulanmıştır. Bu eklemeler, icracının eserin ifade dünyasını daha net kavrayabilmesine katkı sağlamayı amaçlamaktadır.
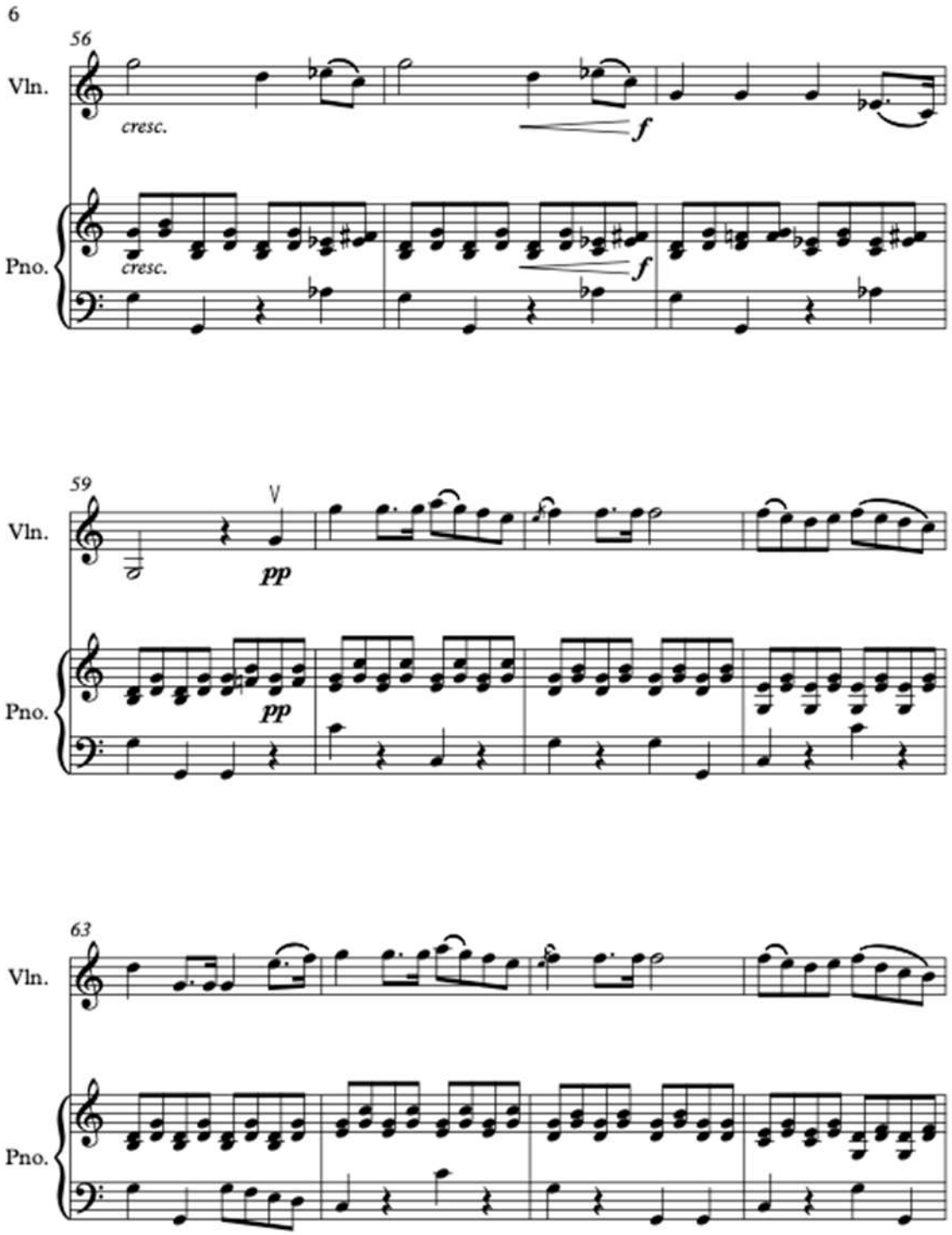

String Quartet Op.3 No. 5
Serenade
Joseph Haydn
Transcription:Açıkgöz, M.G. & Akbudak, H
Andante Cantabile
Violin
Andante Cantabile
Piano
Vln.
Pno.
Vln.
Pno.
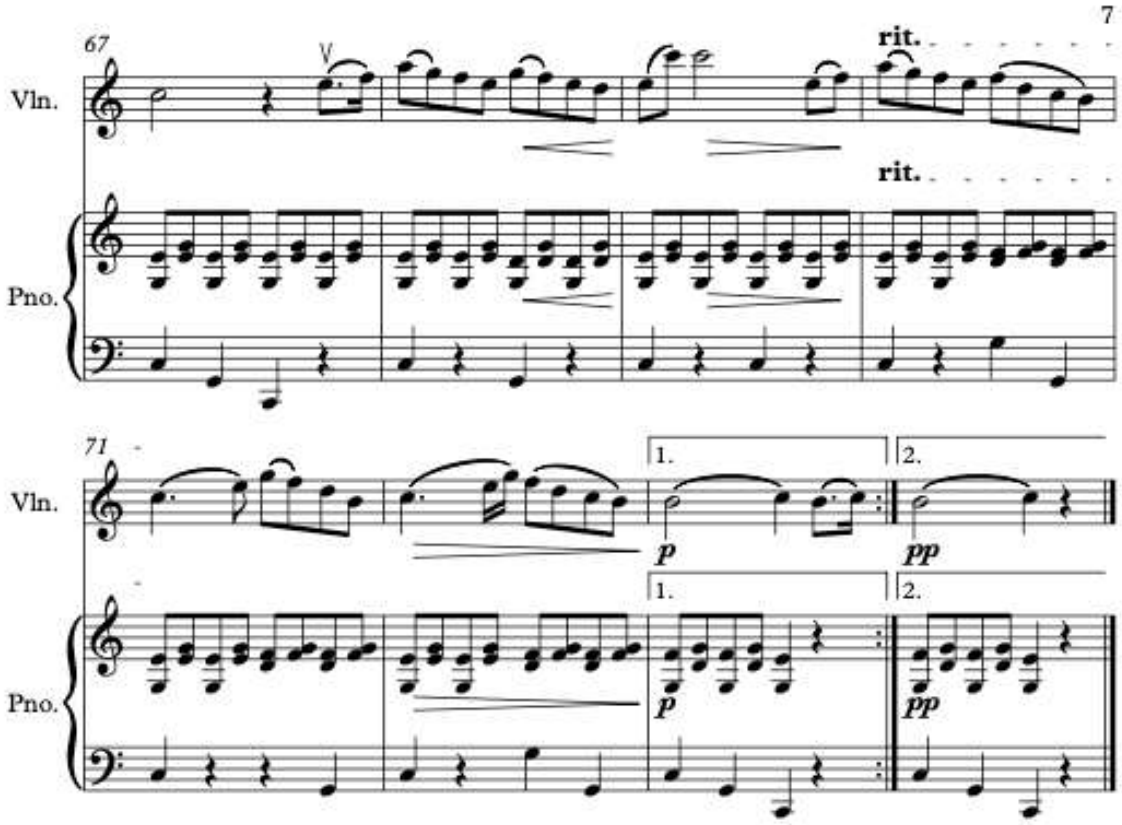

2
12
Vln.
Pno.
p
16
cresc.
dim.
19
pp


3
23
Vln.
Pno.
26
3
I
V
mf
Vln.
Pno.
30
1.
p
dim.
p
1.
p
dim.
p
Vln.
Pno.


4
34
2.
Vln.
mf
2.
Pno.
mf
38
Vln.
p
p
p
Pno.
p
p
p
42
Vln.
cresc.
Pno.
cresc.


5
46
Vln.
p
pp
Pno.
p
pp
49
Vln.
Pno.
52
3
4
Vln.
III
fz
p
Pno.
fz
p


6
56
Vln.
cresc.
f
Pno.
cresc.
f
59
Vln.
V
pp
Pno.
pp
63
Vln.
Pno.



Şekil 2: String Quartet Op. 3 No. 5 Serenade Andante Cantabile Bölümü Keman ve Piyano Transkripsiyonu

SONUÇ

Bu çalışma kapsamında, Joseph Haydn'ın yaylı çalgılar dörtlüsü için bestelemiş olduğu Op. 3 No. 5 eserinin "*Serenade Andante Cantabile"* bölümü, keman–piyano ikilisi için transkripsiyon yoluyla yeniden düzenlenmiştir. Düzenleme sürecinde eserin özgün biçimsel yapısı, melodik dili ve ifade karakteri korunmaya çalışılmış; yaylı dörtlü yazısının işlevsel dağılımı, keman ve piyano çalgılarının teknik ve icrasal özellikleri doğrultusunda yeniden ele alınmıştır.

Transkripsiyon sonucunda, kuartet dokusunun duo formasyonuna aktarılmasında eserin müzikal bütünlüğünün büyük ölçüde muhafaza edilebildiği görülmüştür. Özellikle keman partisinde pozisyon geçişlerinin bilinçli bir kurguyla düzenlenmesi, öğrencilerin 1. ve 3. pozisyonlar arasında kontrollü ve işlevsel bir kullanım geliştirmesine olanak tanımaktadır. Legato ve détaché yay tekniklerinin doğal müzikal akış içerisinde yer alması, çalışmanın pedagojik değerini artıran unsurlar arasında yer almaktadır.

Piyano partisi ise eserin eşlik karakterini destekleyecek biçimde ele alınmış; yaylı dörtlüde ikinci keman, viyola ve çelloya ait işlevler, piyanonun teknik olanakları göz önünde bulundurularak sade ve icrası rahat bir doku içerisinde düzenlenmiştir. Bu yaklaşım, hem armonik yapının net bir biçimde duyulmasını sağlamış hem de solo keman ile piyano arasında dengeli bir müzikal ilişki kurulmasına katkı sunmuştur.

Klasik dönem müzik pratiği açısından değerlendirildiğinde, eserlerin farklı çalgı kombinasyonları için düzenlenmesi dönemin icra geleneğiyle örtüşen yaygın bir uygulamadır. Bu bağlamda söz konusu transkripsiyon, tarihsel bir temele dayanmakta ve günümüz müzik eğitimi ile icra ortamlarına işlevsel bir repertuvar örneği sunmaktadır.

Sonuç olarak bu çalışma, keman–piyano literatürüne pedagojik ve icrasal açıdan kullanılabilir bir eser kazandırmanın yanı sıra, Klasik dönem oda müziği eserlerinin güncel eğitim süreçlerine uyarlanmasına yönelik yapılacak benzer çalışmalara da katkı sağlayacak nitelikte değerlendirilmektedir

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TÜRKİYE'DE DÜZENLENEN OPERA ŞAN YARIŞMALARININ SİSTEMATİK OLARAK İNCELENMESİ

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ÖZET

Bu çalışma, Türkiye'de ulusal ve uluslararası alanda düzenlenen şan yarışmalarını geçmişten günümüze betimsel olarak incelemeyi amaçlamaktadır. Araştırmada, söz konusu yarışmalar tür, kapsam, düzenleyen kurum, süreklilik, yarışmanın yapıldığı yer, repertuvar özellikleri ve genç opera sanatçılarına sunduğu sanatsal katkılar açısından ele alınmıştır. Nitel araştırma yöntemlerinden doküman analizi deseninin kullanıldığı araştırmada; akademik literatür, yarışmaları organize eden kurum ve kuruluşların resmi web siteleri, kültür ve sanat platformları ile basın yayın organlarının sayfalarında yer alan bilgilere ulaşılmıştır. Araştırma bulguları, Türkiye'de ulusal ve uluslararası olarak gerçekleştirilen şan yarışmalarının, süreklilik ve sayı açısından yetersiz kaldığını ortaya koymuştur. 32 yıla yakın bir süredir yapılan yarışma kültürü göz önüne alındığında, doküman analizi sonucunda şimdiye kadar toplamda sekiz yarışmanın yapılmış olması ve günümüzde aktif olarak beş yarışmanın varlığını sürdürüyor olması sınırlayıcı bir durum olarak karşımıza çıkmaktadır. Türkiye'de aktif olan şan yarışmaları; Uluslararası Leyla Gencer şan yarışması, Siemens Türkiye opera yarışması, İzmir ulusal genç solistler şan yarışması, Ulusal Suna Korad şan yarışması ve Leyla Pınar barok şan yarışması olarak varlığını sürdürmektedir. Değinilen yarışmalardan bazıları her sene bazıları ise iki senede bir yapılmakta olup, genç sanatçıların akademik başarı yolunda onlara destek vermektedir. Ayrıca bu yarışmaların sayısının artırılarak sistematik bir bütünlüğe kavuşturulması, arşivlenmesi, kurumsal bir kimlik kazanması ve ulusal düzeyde koordine edilmesi; mesleki gelişim basamaklarının başında olan genç opera sanatçılarına uluslararası kariyer, repertuvar disiplini, eğitim programı ve yurt dışında staj gibi imkanlar sağlayacaktır. Bu çalışma, Türkiye'de düzenlenen şan yarışmalarına ilişkin dağınık bilginin tek kaynak altında toplanması ve genç sanatçı adaylarına yol göstermesi açısından önemlidir. Bu bağlamda, Türkiye'de gerçekleştirilen ulusal ya da uluslararası tüm yarışmaların üç büyük şehir dışında farklı illeri de kapsayacak şekilde yapılması ve yarışma jüri üyelerinin opera anasanat dallarıyla etkileşimde bulunup ustalık sınıfları gerçekleştirmesi önerilmektedir.

Anahtar Kelimeler: Yarışma, Şan Yarışması, Türkiye Opera, Leyla Gencer, Suna Korad.

A DESCRIPTIVE EXAMINATION OF OPERA VOCAL COMPETITIONS ORGANIZED IN TURKEY

ABSTRACT

This study aims to descriptively examine national and international singing competitions held in Turkey from the past to the present. The research analyzes these competitions in terms of type, scope, organizing institution, continuity, location, repertoire characteristics, and artistic contributions to young opera artists. Using a qualitative research method, document analysis, the study accessed information from academic literature, official websites of organizing institutions, cultural and artistic platforms, and press and media outlets. The research findings reveal that national and international singing competitions in Turkey are insufficient in terms of continuity and number. Considering the nearly 32-year history of singing competitions, the document analysis shows that only eight competitions have been held to date, with only five currently active, which is a limiting factor. The active singing competitions in Turkey are: The Leyla Gencer International Singing Competition, the Siemens Turkey Opera Competition, the Izmir National Young Soloists Singing Competition, the National Suna Korad Singing Competition, and the Leyla Pınar Baroque Singing Competition. Some of these competitions are held annually, while others are held biennially, supporting young artists on their path to academic success. Furthermore, increasing the number of these competitions, bringing them into a systematic and integrated structure, archiving them, giving them an institutional identity, and coordinating them at the national level would provide young opera artists, who are at the beginning of their professional development, with opportunities such as international careers, repertoire discipline, training programs, and internships abroad. This study is important in terms of gathering scattered information about singing competitions held in Turkey under a single source and guiding young artist candidates. In this context, it is suggested that all national or international competitions held in Turkey should be held in different provinces outside the three major cities, and that competition jury members should interact with opera main art branches and conduct masterclasses.

Keywords: Competition, Voice Competition, Turkish Opera, Leyla Gencer, Suna Korad.

1. GİRİŞ

Opera, birçok disiplini içerisinde barındıran (Aktakka, 2024) ve bu farklı disiplinlerin aynı yapı içerisinde sahnelenmesine imkân tanıyan çok boyutlu sanatsal ve tasarımsal bir sahne sanatıdır. Bir opera temsili; libretto (metin), reji, müzik, orkestra, solist ve koro sanatçıları, koreografi,

dekor, kostüm, ışık ve sahne tasarımı olmak üzere geniş bir sahne yapıtı olarak görülmektedir. Söz konusu disiplinleri, opera sanatı dışında başka herhangi bir sanatta görmek mümkün görünmemektedir. Bunun yanı sıra, opera temsili sürecinde her şeyin bir bütün ve iletişim halinde olması gerekmektedir. Reji, orkestra ve solistler çok iyi olsa da, koro ya da dekor kötü olduğunda bu durum bütün dengelerin bozulmasına yol açabilmektedir. Operanın büyük ölçekli ve sanatsal yapısının gelişimi, aynı zamanda kültürel boyutu da beraberinde getirmektedir. Yukarıda sayılan disiplinleri bir araya getirmek hem birçok sanat kolunun gelişim sürecini etkilemekte hem de bu sanatların bütüncül yaklaşımla kazanımlarını arttırmaktadır. Nitekim bu koşulları sağlamak için altyapı ve parasal desteklerin de önemli olduğunu vurgulamak gerekmektedir. Bu nedenle opera sanatı, içerdiği çok disiplinli ve yüksek maliyetli yapısı nedeniyle, uygulamada değinilen koşulları gerçekleştirebilen sanayi ve ticaret açısından gelişmiş toplumlarda daha güçlü biçimde varlık gösterebilmektedir. Bu durumu yansıtan örneklerden biri Almanya olarak gösterilebilir. Hitler dönemi ve II. dünya savaşı sonrasında Almanya'nın, şehirlerin yeniden yapılanma sürecinde kültür ve sanat kurumlarını toplumsal iyileşme ve demokratikleşmenin önemli bir parçası olarak gördüğü, bu doğrultuda ülkenin gelişim sürecini sanatla şekillenen bir temel üzerine kurmayı amaçladığı düşünülmektedir. Nitekim Hitler dönemindeki yanlışların ve yaşanan acıların bir daha yaşanmaması için, sanat kurumlarının insanlara yol gösterici olmasının hedeflendiği düşünülmüş olabilir. Bugün Almanya'nın dünya ekonomisindeki konumu ve kültürel gelişmişliği değerlendirildiğinde, bu tercihin ne kadar doğru ve stratejik bir karar olduğu açıkça görülmektedir. Yaklaşık 80'den fazla operası bulunan Almanya dışında, sanat kurumları kültürel ve ekonomik önem arz eden diğer ülkeler arasında, İtalya, Fransa, Birleşik Krallık, İngiltere, Rusya ve Amerika sayılabilir. Ülkemize gelindiğinde ise, Türklerin opera ile tanışmasının Osmanlı dönemine kadar uzandığı söylenebilir. Bunun en net göstergesi, Avrupa'ya gönderilen elçilerin dönüşte yazdıkları sefaretnamelerdir. Elçilerin sefaretnamelerde opera sanatından söz etmeleri, saray çevresinde bu yeni sanat türüne karşı bir ilginin olmasını sağlamış, sonrasında ise 1797 yılı III. Selim döneminde Topkapı Sarayı'nda yabancı bir topluluk opera temsili sunmuştur. 18. ve 19. yüzyıllarda da elçilerin raporlarında opera sanatından bahsetmeleri, bu ilginin devam ettiğinin bir göstergesidir. Bu dönemde, özellikle İtalyan opera geleneğini örnek alınmış, İstanbul'da tiyatro binalarının yapılmasıyla birlikte opera temsilleriyle daha sık karşılaşılmıştır. Ayrıca Osmanlı'nın opera sanatını yakından takip ettiği, İtalya'dan hocalar getirilerek eğitimler verdirdiği, ve buna ek olarak, G. Verdi'nin operalarının, İtalya'daki dünya prömiyerlerinden

birkaç yıl sonra İstanbul'da sahnelendiği araştırma sonucunda elde edilmiştir (Ertekin, 2007, s.1).

İlerleyen yıllarda II. Mahmut'un 1826 yılında Yeniçeri Ocağı'nı kaldırması ve yerine batı tarzında bir ordu (Asakir-i Mansure-i Muhammediye) kurması, müzik alanında modernleşme adına yapılan hareketlerin önünü açmıştır. Sonrasında mehterhane kapatılmış, 1827 yılında batı tarzında askeri müzik icra eden Muzıka-i Hümâyun kurulmuş ve müzik alanında gerçekleşen en belirgin adımlardan biri atılmıştır (Şenoğlu, 2024). Bunun sonucu olarak, Osmanlı'nın çok sesli müzik birikimi Cumhuriyet'e geçiş döneminde, Muzıka-i Hümâyun ve Dârülelhan gibi kurumlar sayesinde (Çakar, 2015), hem eğitim hem de aktarıcı bir kültür merkezi olarak işlev görmüş, müzik türlerinin kayıt altına alınması ve yayımıyla Türkiye'de kurumsal müzik eğitiminin temelleri atılmıştır (Kolukırık, 2018). Muzıka-i Hümâyun'un Cumhuriyet'e kesintisiz biçimde ulaşmış olması ve bugünkü Cumhurbaşkanlığı Senfoni Orkestrası'nın temeli olarak kabul edilmesi, söz konusu modernleşme hareketinin Türk müzik kurumları üzerinde ne kadar kalıcı ve dönüştürücü bir etki yarattığını göstermektedir (Şenoğlu, 2024).

Cumhuriyet dönemine gelindiğinde ise, Cumhuriyet'in kültürel dönüşüm politikalarının en dikkat çekici unsurlarından biri olarak Mustafa Kemal Atatürk'ün opera sanatına verdiği önem söylenebilir. Ankara'da konservatuvarın bulunmadığı yıllarda dahi opera sanatına yönelik çalışmaların başlatılması, operanın geleceğine yönelik güçlü bir yapının göstergesidir (Kılınç, 2018, s. 27). Bu çerçevede Ahmet Adnan Saygun'un, Atatürk'ün isteğiyle bestelemiş olduğu Özsoy operası, Türkiye'de ulusal opera anlayışının oluşmasında atılan ilk büyük adımlardan biri olarak değerlendirilmektedir (Kılınç, 2018, s. 27; Şakalar ve Sağer, 2018). Böylelikle Atatürk'ün kültür ve sanat devrimi, Türkiye'de modern sanat kurumlarının gelişiminin temelini oluşturmuş ve özellikle çok sesliliğin benimsetilmesi yönündeki bu yaklaşım müzikal kültürel zemini hazırlamıştır (Bayındır Uluskan, 2022, s.43).

Mustafa Kemal Atatürk, Türk halk müziğini temel alan, ancak batı'nın geliştirdiği çoksesli teknik ve yöntemlerle beslenen yeni bir müzik anlayışı hedeflemiştir (Ertekin, 2007, s. 1). Bu amaç doğrultusunda, devlet burslarıyla Avrupa'ya yetenekli gençler gönderilmiş, bu gençler ise ülkelerine geri döndüklerinde ulusal Türk müziğini temel alarak, müziğimizin evrensel bir boyuta taşınmasını sağlamış, müzik ve sahne sanatları alanında gelişime yön verecek bir kadronun oluşmasını sağlamıştır. 1930'lardan itibaren bu genç müzisyenlerin yurda dönmesiyle birlikte opera alanında somut adımlar atılmıştır. Ankara'da 1924 yılında Musiki Muâllim Mektebi'nin, İstanbul'da ise Darülelhân'ın kurulmasıyla birlikte, yurt dışında eğitim almış genç

öğretim üyelerinin bu kurumlarda görev alarak öğrenci yetiştirmeye başlamaları; hem opera besteciliği hem de opera yorumculuğu alanlarında umut vadeden bir sürecin başlangıcını oluşturmuştur (Ertekin, 2007, s. 1). Bu gelişim, yalnızca dönemin bestecilerinin bireysel girişimlerine dayanmamakta; aksine Cumhuriyet'in müzik politikalarının bilinçli ve planlı bir sonucunu yansıtmaktadır. Cumhuriyet'in ilanıyla birlikte çoksesli müziğe yönelik çalışmalar devlet desteğiyle belirgin şekilde ivme kazanmış; Atatürk'ün öncülüğünde yürürlüğe giren eğitimde birlik yasası, nota temelli müzik öğretiminin yerleşmesine zemin hazırlamıştır (Sağlam ve Özgür, 2024). Sonrasında ise Dârülelhan'ın konservatuvara dönüştürülmesi, müzikte kurumsallaşmanın önemli bir dönüm noktası olarak görülmüştür (İlyasoğlu, 1998). Cumhuriyet Dönemi'nde gerçekleştirilen müzik devrimi, ulusal operanın doğuşunu tetikleyen temel faktörlerden biri olmuştur (Ertekin, 2007).

Yukarıda değinilen bilgiler ve tarihsel gelişim süreci, genç opera sanatçılarının kariyer olanakları ve mesleki gelişim süreçlerini doğrudan etkileyen bir sürecin başlangıcıdır. Genel yapı hakkında bilgi verilmeksizin konuya giriş yapılması, Türkiye'de bu sanatın ilerleyiş sürecinde yapılan gelişmelerin net anlaşılmasını mümkün kılmamaktadır.

Kültür ve sanat politikalarının sonuçları hızlı bir şekilde ilerlerken, 1936 yılında Ankara Devlet Konservatuvarı kurulmuş, şan ve opera bölümünün başına Karl Ebert getirilmiştir. Başarılı çalışmalarıyla Türk operasının gelişimine büyük katkılar sağlayan Karl Ebert'in ulusal opera oluşturma çabaları sürerken, İstanbul'un da bu sürece pasif kalmadığı görülmektedir. İstanbul'da özellikle müzikli oyunlar ve operet uyarlamaları gibi daha hafif sahne yapıtlarının sahnelenmesi, kentte opera kültürünü hazırlayan önemli etkinlikler olmuştur (Ertekin, 2007). 1970 yılına gelindiğinde ise, Türkiye'de opera ve bale genel müdürlüğü kurulmuş, Ankara operası'nın bir kolu olarak İstanbul devlet opera ve balesi kurulmuştur. Bu süreç, 1982'de İzmir devlet opera ve balesi, 1990'da Mersin devlet opera ve balesi, 1997'de Antalya devlet opera ve balesi, 2008'de ise Samsun devlet opera ve balesi olarak ayrı birimler halinde kurulmuş, tümü Ankara'daki merkezi yapıya bağlanmıştır (T.C. Kültür ve Turizm Bakanlığı Devlet Opera ve Balesi Genel Müdürlüğü, 2010).

Böylece Türkiye'ye sanatın temellerinin yayılması daha aktif bir hale gelmiş, yayılan bu kıvılcım devlet opera ve balesinin farklı şehirlere yaptıkları turneler aracılığıyla Türkiye'nin farklı birçok iline ulaşmıştır. 2008 yılı itibariyle opera ve bale kurumlarının kurulduğu yeni bir il bulunmamakla birlikte, söz konusu sanat dallarının kayda değer yayılım göstermesi sonucunda, birçok üniversite bünyesinde konservatuvarlara bağlı sahne sanatları bölümleri

içerisinde opera-şan ana sanat dalları kurulmuştur. Hâlihazırda, özel üniversiteler dahil olmak üzere yaklaşık yirmi kurumda opera eğitimi verilmekte olup, bu okullardan mezun olan öğrenciler kariyerlerini yurt içi ve yurt dışında sürdürmektedir. Bununla birlikte, ülkemizde opera ve bale kurumlarının sayısının sınırlı sayıda olması, mezun öğrencilerin farklı kariyer olanaklarına yönelmelerini zorunlu kılmaktadır. Bu olanaklar arasında ulusal ve uluslararası yarışmalar ile yurt dışı master programları yer almaktadır. Bu doğrultuda düşünüldüğünde, opera sanatının kurumsal sürekliliğinin sağlanmasında yarışmaların öncü bir rol üstlendiği söylenebilir.

Yarışmalar, genç opera sanatçılarına farklı kültürlerin kapılarını aralamanın yanında, genç sanatçıların yeteneklerini sergileyebildikleri, profesyonel kariyer fırsatları elde edebildikleri ve sanat dünyasında kendilerini kanıtlayabildikleri rekabetçi bir ortamın içerisine dahil etmektedir. Ayrıca Ergene'nin (2022) belirttiği üzere yarışmalar, genç müzisyenlerin yeteneklerini ulusal ve uluslararası platformlarda sergileme olanağı yaratmakta, profesyonel müzik dünyasının gerçekliğine uyum sağlamalarını kolaylaştırmaktadır (s.2). Cline (1985) ise, toplum, kariyer ve kişisel gelişim üzerinde yarışmaların çok boyutlu bir role sahip olduğunu vurgulamaktadır.
Bu perspektifte ve yukarıda verilen bilgiler dahilinde düşünüldüğünde, opera sanatının tüm dünyada hem birçok disiplini birleştirici gücü hem de oyun ve müzik çatısının birbirini desteklemesinden kaynaklı yayılımı diğer sanatlara göre daha fazla olmuştur. Bunun farklı etkenleri olsa da, insan hayatının ilk ve en önemli basamağının ses olduğu düşünüldüğünde, diğer enstrümanlardan ayrışması daha net anlaşılmaktadır. Öte yandan ülkemizde sanat kurumlarının mezun sanatçı adaylarının istihdamına yeteri kadar cevap verememesi sınırlayıcı bir durum olsa da, genç sanatçılar ulusal ve uluslararası yarışmalarla dünyanın birçok yerinde sahne alabilme ve seslerini duyurabilme imkanına sahip olabilmektedir. Bu araştırmada, Türkiye'de hangi şan yarışmalarının düzenlendiği, hangi aralıklarda ve ne kadar süredir yapıldığı gibi soruların cevaplanması amaçlanmış ve sistematik olarak tüm yarışmaların tek tablo halinde sunulması sağlanmıştır. Söz konusu yarışmaların, ilan edilme süreci ve Türkiye'de hangi ulusal yarışmaların gerçekleştirildiğine dair bilgiler mevcut veriler ışığında sınırlı olduğundan, bu çalışma genç opera sanatçısı adaylarının kariyer ve gelişim süreçlerinde bilgilendirici ve yol gösterici olma açısından da önem arz etmektedir.

2. Araştırmanın amacı ve kapsamı

Bu araştırma, Türkiye'de opera alanında gerçekleştirilen ulusal ve uluslararası olarak düzenlenen şan yarışmalarının, kronolojik gelişimini, özelliklerini ve repertuvarlarına yönelik bilgileri tablo halinde ve karşılaştırmalı olarak incelemeyi amaçlamaktadır. Bu çalışmada yer alan uluslararası yarışmalar, kapılarını dünya genelinde tüm katılımcılara açmıştır. Araştırma kapsamında, Sedat-Gürel-Güzin Gürel sanat ve bilim vakfı tarafından gerçekleştirilen şan yarışması (1993-2015), Leyla Gencer şan yarışması (1995-günümüz), Siemens opera yarışması (1998-günümüz), Ulusal genç solist yarışması (2008-günümüz), İstanbul Barok derneği tarafından düzenlenen Barok üslûpta şarkı ve aryalar şan Yarışması (2016-günümüz), Yalçın Davran şan yarışması (2019) ve Suna Korad şan yarışması (2023-günümüz) incelenmiştir. Ayrıca Beniç (2021)'in Türkiye'de şan yarışmaları son 32 yılda yapılmaya başlandığı ifadesi de verilen tarihleri desteklemektedir.

3. YÖNTEM

3.1. Araştırma deseni

Bu araştırma, Türkiye'de opera - şan alanında gerçekleştirilen ulusal şan yarışmalarının (yarışma adı, düzenleyen kurum, başlangıç yılı ve günümüzde devam edip etmediği, düzenleme sıklığı, kapsamı ve hedef kitlesi) birçok içeriğini betimsel ve karşılaştırmalı olarak ele almayı amaçlamaktadır. Nitel araştırma yöntemlerden doküman analizi deseninin kullanıldığı araştırmada, yarışmalara ilişkin bilgiler, düzenleyen kurumların web sayfaları, arşiv duyuruları ve paylaşılan yönergeler aracılığıyla elde edilmiştir. Söz konusu araştırmada, dokümanların bulunması, seçilmesi, değerlendirilmesi ve sentezlenmesi gibi aşamalar izlenmiştir. "Belgesel tarama olarak da bilinen doküman analizi, araştırma verilerinin birincil kaynağı olarak çeşitli dokümanların toplanması, gözden geçirilmesi, sorgulanması ve analizi olarak tanımlanabilen bilimsel bir araştırma yöntemidir" (Sak, Şahin Sak, Öneren Şendil ve Nas, 2021, s.228-230). Bu çerçevede çalışmada, hem ilgili literatür bağlamında akademik çalışmalardan yararlanılmış (Türkiye'de opera sanatının gelişim süreci ve yarışma kazanımları vb.) hem de şan yarışmalarına ilişkin bilgiler (yarışma web siteleri, yönergeler, ilanlar, duyurular, başvuru sayfaları, ödüller vb.) doküman incelemesi yoluyla incelenmiştir.

3.2. Veri toplama teknikleri

Veri toplama tekniği olarak doküman incelemesi deseninin kullanıldığı araştırmada, akademik yayınlardan, tezlerden ve kitaplardan yararlanılmıştır. Şan yarışmalarına ilişkin bilgilere akademik kaynaklardan ulaşmanın sınırlı olması dolayısıyla, veriler, Leyla Gencer şan

yarışması, Sedat Güzin Gürel vakfı, Siemens opera yarışması, Ulusal genç solist şan yarışması ve İstanbul barok derneği gibi kurumsal kaynaklardan, medya ve basın haberlerinden, kültür ve sanat dergilerinden, yarışmaları düzenleyen kuruluşların web sitesinde ve arşiv kayıtlarında bulunan duyuru / yönerge ve ödül gibi sayfalardan elde edilen dokümanlar aracılığıyla toplanmıştır.

3.3. Verilerin analizi

Çalışmada; yarışmanın adı, ulusal kurumsal niteliği, düzenleyen kurum ve kuruluş bilgisi, düzenleme sıklığı (yıllık periyod), hedef kitle, repertuvar bilgisi vb. veriler, ilgili kaynaklardan ve yarışma web sitelerinden elde edilmiş, ulaşılan veriler tablo haline dönüştürülmüş ve betimsel olarak analiz edilerek tablo halinde özetlenmiştir. Ayrıca yarışmalara ilişkin bilgileri karşılaştırma kolaylığı için tablo düzeni tercih edilmiştir.

4. BULGULAR

Yukarıda değinilen yarışmalara ilişkin açıklayıcı bilgiler, yarışmaların gelişimi, kronolojik sıralaması ve bulguları aşağıda hem açıklayıcı hem de tablo olarak verilmiştir. Yarışmaların özellikle son 32 yılda ağırlığını arttırdığı düşünüldüğünde, açıklama sıralaması en eski yarışmadan en yeniye doğru sıralanmıştır. Bu bağlamda, ilk olarak Sedat Gürel-Güzin Gürel sanat ve bilim vakfı tarafından düzenlenen yarışmalara ilişkin bilgilere değinilmiştir.

4.1. Sedat Gürel - Güzin Gürel Uluslararası Şan Yarışması (1993 - 2015)

Sedat Gürel - Güzin Gürel sanat ve bilim vakfı, Türkiye'de opera şan alanında 1993 yılında ilki yapılan I. Uluslararası şan yarışması ile Türkiye'de gerçekleştirilen en erken dönem yarışma organizasyonunun öncü kurumu olmuştur. Bu vakfın amacı, yetenekli olup maddi anlamda parasal ihtiyacı olan gençlere destek olmak, onların sanat yolculuğunda eğitim süreçlerine katkıda bulunmaktır (Andante, 2011). Bunun dışında, ulusal ve uluslararası yarışmalar, masterclass, opera workshop, opera prodüksiyonları, ses sempozyumları ile de aktif sanat vakfı görevini sürdürmektedir.

Vakıf, Uluslararası şan yarışması adıyla şimdiye kadar opera alanında üç, lied alanında ise iki olmak üzere beş yarışma organize etmiştir. Bunun dışında piyano ve keman yarışmaları da düzenlemiştir. Ancak bu çalışmanın konusu, opera alanı olduğu için diğer bilgilere özet niteliğinde değinilmiştir. Uluslararası şan yarışmalarının I.'si 1993 yılında, II.'si 2011 yılında, III.'sü ise 2015 yılında yapılmıştır. 1993 yılında yapılan yarışma, Türkiye'de uluslararası düzeyde düzenlenen ilk opera yarışmalarından biri olma özelliğini taşımakta olup, genç opera sanatçısı adaylarının, uluslararası arenada seslerini duyurmalarına katkı sağlamıştır. Bu

yarışmalarda repertuvar içeriği lied ve opera aryası şeklinde belirtilmiş olup, yarışmalara başvuru için kadın şarkıcıların 18-30, erkek şarkıcıların ise 18-32 yaş aralığında olmaları gerekmektedir. Bununla birlikte yarışmalar için genel repertuvar, iki lied ve dört arya şeklinde belirlenmiştir.

Bunun dışında vakıf, I.'si 2007 yılında, II.'si ise 2010 yılında olmak üzere iki kez Ulusal Lied yarışması düzenlemiştir. Bu yarışmalar aracılığıyla, Türkiye'de şan sanatının sadece opera aryaları ile sınırlı olmadığı, oda müziği ve lied literatürüne ilişkin repertuvarın da dahil edilerek, vakfın opera sanatının gelişimine destek olduğu söylenebilir. Söz konusu yarışmaların seçici jürisinde, uluslararası platformdan opera sanatçıları, rejisörler ve opera yönetmenlerinin yer alması, hem genç sanatçı adayları arasında rekabetçi yapıyı arttırmış hem de Türkiye'nin opera alanında görünürlüğünü yükseltmiştir (Sedat Gürel-Güzin Gürel Sanat ve Bilim Vakfı, 2024).

4.2. Leyla Gencer Şan Yarışması (1995 - Günümüz)

Sedat Gürel-Güzin Gürel sanat ve bilim vakfı'nın 1993 yılında düzenlediği ilk şan yarışması Türkiye'de öncü olmuş, 2 yıl sonra 1995 yılında Leyla Gencer'in anısına ithafen 2. şan yarışması organizasyonu duyurulmuştur. Batı ülkelerinde "La Diva Turca", "La Gencer" ve "La Regina" unvanlarıyla tanınan Leyla Gencer, hem seçkin opera sahnelerinde hem de resitallerinde büyük hayranlık uyandırmış sanatçılarımızın başında gelmektedir (Ertekin, 2007, s.69). 3-9 Eylül 1995 yılında ilki gerçekleştirilen Leyla Gencer şan yarışması, ilk ilan edildiğinde Yapı Kredi Uluslararası Leyla Gencer şan Yarışması adıyla düzenlenmiş, zaman içerisinde uluslararası arenada ve dünyada bilinen en prestijli opera yarışmalarından biri haline gelmiştir (İstanbul Kültür Sanat Vakfı, 2024).

Evren ve Gök (2023) ise, Leyla Gencer şan yarışmasının, opera türünde Türkiye'de düzenlenen en eski, en köklü ve en önemli yarışmalardan olduğunu ifade etmiştir (s.2031). Yarışma iki senede bir yapılmakta olup, üçüncüsü 1999 yılında İstanbul'da yaşanan ve acı kayıpları olan deprem felaketi nedeniyle 2000 yılında yapılmıştır. Bu sürecin sonrasında, uzun zaman ara verilmiş ve yarışmanın dördüncüsü, İstanbul Kültür Sanat Vakfı (İKSV) tarafından Milano La Scala Tiyatro Akademisi işbirliğiyle Doğuş Grubu ve Garanti Bankası sponsorluğunda, T.C. Dışişleri Bakanlığı'nın desteği ve Borusan Holding'in katkılarıyla 2006 yılında kaldığı yerden devam etmiştir (İstanbul Kültür Sanat Vakfı, 2024).

2026 yılında 11.'si düzenlenecek olan yarışmaya, şimdiye kadar yaklaşık 20 farklı ülkeden sarkıcılar katılmıştır. Buradan hareketle, yarışmanın uluslararası prestiji ve niteliği daha net görülmektedir. Başvuru için adayların 18-32 yaş aralığında olması gerekmekte, ve repertuvar

olarak farklı dönem ve dillerden opera aryaları seslendirmeleri gerekmektedir. Leyla Gencer yarışmasına katılıp derece alan çoğu şarkıcı, uluslararası platformda kendine yer edinmiş, La Scala gibi dünyanın en büyük ve merkezi operalarında solist olma durumuna erişmiştir. Bu da yarışmanın gerek içeriğinin, gerekse de jüri yapısının ne kadar güçlü olduğunu göstermektedir. Leyla Gencer şan yarışması 1995 yılından 2025'e kadar farklı aralıklarla düzenlenmiş ve günümüze kadar saygınlığını korumuştur. Geçmişten günümüze birçok önemli yorumcu kariyerine Leyla Gencer şan arışması gibi prestijli müzik yarışmalarıyla başlamıştır. Bu yarışmalardaki başarıları sayesinde önemli kariyer basamaklarına ulaşmışlardır (Evren ve Gök, 2023, s.2030). Madak (2019) ise, bu yarışma ile çok sayıda genç yetenek keşfedilmiş ve onların uluslararası sahnelerde yer edinmesine katkı sağlanmıştır.

4.3. Siemens Opera Yarışması (1998 - Günümüz)

Siemens opera yarışması, Türkiye'de gerçekleştirilen üçüncü ve ilk ulusal nitelikli şan yarışmasıdır. Her ne kadar adında opera yarışması geçse de, aslında diğer yarışmalar gibi şan yarışması kullanımının daha doğru olacağı düşünülmektedir. Yarışma, ilk olarak 1993 yılında Siemens sanat ödülleri adıyla yapılmış, burada resim, heykel ve film kategorilerinde ödüller verilmiştir.

1998 yılı itibariyle Türkiye'de eğitim alan genç opera sanatçılarına uluslararası platformlarda adlarını duyurabilmeleri için öncülük etmiş, geçerliliğini günümüze kadar (26. yıl) korumuştur. Ayrıca 2007 yılına kadar Türkiye'de düzenlenen tek ulusal opera yarışması olarak faaliyetini sürdürmüş, 2022 yılında ise, başvuru ve ön eleme sürecinin çevrim içi bir boyuta taşıyarak Türkiye'nin ilk hibrit opera yarışması olmuştur (Siemens Türkiye, 2024).

Siemens ulusal opera yarışmasına başvuru yapacak adayların 18-30 yaş aralığında olmaları, repertuvar olarak ise 1'i Mozart olmak üzere toplamda 3 opera aryasının seslendirilmesi gerekmekte ve eserlerin orijinal dilleri ve ezber olmaları gerekmektedir (Siemens Türkiye, 2024). Buna ek olarak yarışma, sadece T.C. vatandaşlarına açık olup, farklı ülkelerden başvuru yapılamamaktadır.

4.4. Ulusal Genç Solist Yarışması (2007-Günümüz)

Ulusal genç solist yarışması, Türkiye'de düzenlenen dördüncü şan yarışması olup, ikinci ulusal nitelikte ikinci şan yarışmasıdır. Bu yarışma, üniversite ve profesyonel olmak üzere iki kategori içerisinde değerlendirilmekte ve bu yönüyle diğer yarışmalardan ayrılmaktadır. Üniversite kategorisine sadece lisans bir, iki ve üçüncü sınıf öğrencileri katılım sağlayabilmekte olup,

lisans dördüncü sınıftan itibaren tüm mezun genç sanatçılar, korist ya da solist opera sanatçıları profesyonel kategorisinde yarışmak zorundadırlar.

Yarışma, ilk olarak 2007 yılında Rotary kulübü kültür sanat komitesi tarafından düzenlenmiştir. İlerleyen yıllarda ise, Rotary bölge 2440, İzmir Büyükşehir Belediyesi ve Dokuz Eylül Üniversitesi Devlet Konservatuvarı işbirliği ile gerçekleştirilmiştir. 2026 yılı 6-9 Şubat tarihleri arasında 18.'si düzenlenecek olan yarışmanın jürisinde ulusal ve uluslararası deneyime sahip sanatçılar yer almakta olup, jüri her yıl farklılık gösterebilmektedir (Genç solist yarışması, 2025).

4.5. Barok Üslûpta Şarkı ve Aryalar Şan Yarışması (2016-günümüz) Leyla Pınar Barok Şan Yarışması

2016 yılı itibariyle düzenlenen yarışma, İstanbul Barok derneğinin desteğiyle yapılmakta olup, adından da anlaşılacağı üzere yarışma sadece Barok Üslûpta Şarkı ve Aryaları kapsamaktadır. Bu yönüyle diğer yarışmaların repertuvar içeriğinden ve kapsamında ayrılan yarışma, genç opera sanatçılarının barok dönem repertuvarını ve inceliklerini ne kadar ustalıkla yapabildiğini ve Barok dönem şarkı söyleme stiline ilişkin dinamikleri nasıl gerçekleştirdiklerini gözlemlemektedir. Barok arya formunda yer alan şarkılar, genel olarak Da Capo formunda yazılmış, (ABA formu) ikinci A formuna dönüşte şarkıcıların yorumsal yeteneklerini görmek ve geliştirmelerine imkân tanınması amaçlanmıştır.

Barok dönemin geleneksel yapısını ve tınısını yansıtmak adına, yarışmada eşlik olarak klavsen kullanılmaktadır. İlk aşamada, yarışma yönergesinde belirtilen üç ya da dört aria antiche eserden biri seslendirilmekte, ikinci aşamada ise ses türüne uygun olarak ilan edilen zorunlu repertuvar listesinden eserlerin seçilmesi gerekmektedir (İstanbul Barok Derneği, 2024).

2021 yılında İstanbul barok derneğinin kurucusu Leyla Pınar'ın vefat etmesi üzerine, 2022 yılı itibariyle yarışmanın adı Leyla Pınar Barok şan yarışması olmuştur.

4.6. Prof. Yalçın Davran Anısına Ulusal Şan Yarışması (2019)

Avrupa birliği yerel sivil toplum kuruluşları hibe programı kapsamında (Ankara devlet konservatuvarlılar derneği, 2019) 2019 tarihinde bir kereye mahsus olmak üzere gerçekleştirilen ve Ankara Devlet Konservatuvarlılar Derneği (ADK-DER) tarafından düzenlenen yarışma, devlet opera ve balesi eski müdürü Yalçın Davran anısına gerçekleştirilmiştir (Sanattan yansımalar, 2019). Yarışma hibe programı kapsamında gerçekleştirildiği için ikincisi yapılmamıştır. Ancak ilerleyen yıllarda devam edip etmeyeceği konusunda net bir bilgi bulunmamaktadır.

4.7. Ulusal Suna Korad Şan Yarışması (2023-günümüz)

Paris'te National Opera'da sahneye çıkan ilk Türk solist olan Suna Korad, dünyanın birçok önemli opera evinde sanatını icra etmiş; resitalleri ve plak çalışmalarıyla geniş bir beğeni toplamıştır. La Scala solistleriyle birçok yapımda rol alan Korad, Avrupa'nın farklı ülkelerinde konuk sanatçı olarak sahneye çıktığı operalarda da büyük takdir görmüştür. Suna Korad, aynı zamanda Devlet Sanatçısı unvanı ile onurlandırılmış değerli yorumcularımızdandır (Ertekin, 2007, s.70).

2023 yılında İstanbul Opera Derneği tarafından genç opera sanatçılarının kariyerlerine destek olmak amacıyla (Andante, 2023) düzenlenen ve Çamlıbel Vakfı'nın teşvik ödülleri sponsoru olduğu (Çamlıbel Vakfı, 2024) Suna Korad'ın anısına gerçekleştirilen yarışmanın, 2026 yılı itibariyle üçüncüsü düzenlenecektir. Yarışma 18-32 yaş arasında yer alan genç sanatçıların katılımına açık olup, opera sanatına yetenekli yeni seslerin kazandırılmasını amaçlamaktadır.

Aşağıda verilen tabloda, başlangıçtan günümüze kadar varlığını sürdüren şan yarışmalarına ilişkin bilgiler yer almaktadır.

Tablo 1. Türkiye'de Düzenlenen Şan Yarışmalarının Yapısal Özellikleri

Başlangıç Yılı	Yarışma Adı	Kapsamı	Düzenleyen Kurum(lar)	Yer	Repertuvar	Açıklama
1993	Sedat Gürel Güzin Gürel Vakfı I. Uluslararası Şan Yarışması	Uluslararası	Sedat Gürel Güzin Gürel Sanat ve Bilim Vakfı	İstanbul	Opera / Lied	Türkiye'de düzenlenen ilk uluslararası şan yarışmasıdır. Yarışmanın I.'si 1993, II'si 2011, III. ise 2015 yılında düzenlenmiştir.
1995	Uluslararası Leyla Gencer Şan Yarışması	Uluslararası	İstanbul Kültür Sanat Vakfı (İKSV) Borusan Sanat La Scala Tiyatrosu Akademisi	İstanbul	Opera aryaları	Uluslararası alanda Türkiye'nin en prestijli şan yarışmasıdır. 1995'ten itibaren farklı aralıklarla düzenlenmektedir. Finalistlere Borusan Filarmoni Orkestrası eşliğinde konser verme şansı verilmektedir.
1998	Siemens Ulusal Opera Yarışması	Ulusal	Siemens Türkiye	İstanbul	Opera aryaları	Türkiye'de düzenlenen ilk ulusal

						yarışma olup, bu sene (2026) 27.si düzenlenecektir. Genç opera sanatçılarına burs ve yurt dışı fırsatları sunmaktadır.
2007	Ulusal Genç Solist Yarışması	Ulusal	Rotary bölge 2440, İzmir Büyükşehir Belediyesi D.E.Ü. Devlet Konservatuvarı	İzmir	Opera Operet ve Lied	Türkiye'de düzenlenen ikinci ulusal şan yarışmasıdır. Üniversite ve Profesyonel olmak üzere iki kategoriyi kapsamaktadır.
2007	Ulusal Lied Yarışması	Ulusal	Sedat Gürel Güzin Gürel Vakfı	İstanbul	Lied	Türkiye'de yapılan ilk lied yarışmasıdır. I.'si 2007 II.'si ise 2010 yılında gerçekleştirilmiştir.
2016	Barok Üslûpta Şarkı ve Aryalar Şan Yarışması	Uluslararası	İstanbul Barok Derneği	İstanbul	Barok opera aryaları	Türkiye'de Barok repertuvar içeren ilk ve tek şan yarışmasıdır. 2022 yılı itibariyle Leyla Pınar Barok şan yarışması adıyla düzenlenmektedir.
2019	Prof. Yalçın Davran Ulusal Şan Yarışması	Ulusal	Ankara Devlet Konservatuvarlılar Derneği (ADKDER)	Ankara	Opera	AB STK Hibe desteğiyle bir kereye mahsus olarak 2019 yılında düzenlenmiş şan yarışmasıdır.
2023	Ulusal Suna Korad Şan Yarışması	Ulusal	İstanbul Opera Derneği Çamlıbel Vakfı Özel Ödülü	İstanbul	Opera	Türkiye'de ulusal kategoride gerçekleştirilen ve 2026 yılında 3.'sü düzenlenecek olan şan yarışmasıdır.

Yukarıda verilen tabloda, şan yarışmalarının karşılaştırılmalı analizi yer almaktadır. Tablo incelendiğinde, başlangıçtan günümüze kadar düzenlenen şan yarışmalarının ulusal boyutu, kronolojik sıralaması, kapsamı, düzenleyen kurum ve yarışmanın yapıldığı yer bilgisi, repertuvar ve yarışma hakkında genel bilgilendirmeler yer almaktadır.

5. SONUÇ, TARTIŞMA VE ÖNERİLER

Bu araştırmada, Türkiye'de klasik müzik alanı opera-şan repertuvarı üzerine yapılan yarışmaların genel çerçevesi incelenmiştir. Sonuçlar, şan yarışmalarının özellikle 1990'lı

yıllardan itibaren ve son 32 yılda kurumsallaştığını göstermektedir. İlk olarak 1993 yılında Sedat Gürel-Güzin Gürel bilim ve sanat vakfı'nın öncülüğünde yapılan uluslararası şan yarışması, sonrasında birçok kurum ve kuruluşun desteğiyle günümüze kadar ulaşmayı başarmıştır. Bunlar düzenleme tarihine göre; Leyla Gencer uluslararası şan yarışması, Siemens ulusal opera yarışması, ulusal genç solist yarışması, Barok üslûpta şarkı ve aryalar şan yarışması, Prof. Yalçın Davran ulusal şan yarışması ve ulusal Suna Korad şan yarışması olarak sıralanabilir. Bu yarışmalar dışında, uluslararası platformda başka ülkelerde düzenlenen şan yarışmalarının Türkiye elemeleri de ülkemizde yapılmaktadır (Uluslararası Belvedere Hans Gabor şarkı yarışması, Grandi Voci uluslararası şan yarışması ve Neue stimmen opera yarışması vb.). Ayrıca yarışmaların genel olarak üç büyükşehirde toplandığı görülmektedir. Leyla gencer gibi uluslararası prestije sahip bir sanatçının Safranbolu'da doğduğu düşünüldüğünde, yarışmaların farklı şehirlerde imkânı olmayan gençlere ulaştırılması da gereklilik arz etmektedir.

Şan yarışmalarının, son 32 yıllık süreçte sekiz yarışma olarak varlığını sürdürmüş olması önemli olsa da, mevcut yapı içinde aktif olarak yapılan şan yarışması sayısı şu an beş adettir. Bu sayı oldukça düşük olmakla birlikte, Türkiye'de Koç, Sabancı, Zorlu, Eczacıbaşı, Doğuş grubu, THY gibi birçok holding ve köklü kuruluş varlık göstermesine rağmen, sadece beş şan yarışmasının vakıf ya da belediye imkanlarıyla düzenlenmesi kültür ve sanat politikaları açısından dikkat çekici bir eksiklik olarak değerlendirilmektedir. Türkiye'de televizyon ve popüler müzik yarışmalarının fazlalığına rağmen, klasik müzik odaklı yarışmaların sayısının ne yazık ki sınırlı olduğu görülmektedir. Yarışmalar, genç opera sanatçısı adaylarına farklı kariyer kapıları aralamanın yanında, onlara uluslararası arenada Türkiye'yi temsil etme hakkı da vermektedir. Eğitim programları ve burs olanakları, sadece genç sanatçıların gelişimine katkı sağlamakla kalmamakta, aynı zamanda yarışmalar aracılığıyla yurt dışındaki eğitim kurumlarıyla bağlantı kurulmasına ve bu sanatçıların mesleki yaşama kazandırılmasına olanak tanımaktadır.

Yarışmalar; genç opera sanatçılarının yeteneklerini sergilediği, sanat dünyasında kendilerini kanıtlayabildiği, sahnede deneyim kazanarak performansını ve psikolojisini yönettiği, opera alanında türk ve yabancı uzman jüri üyelerinin geri bildirimi ile mesleki gelişimine katkı sağladığı, uluslararası ağlar ile kariyer olanaklarını arttırdığı, opera camiasında tanınırlık kazandığı, opera repertuvarını disiplin çerçevesinde hazırlayarak genişlettiği, sahne motivasyonunu arttırarak özgüven kazandığı, burs ve yurt dışında staj imkanı elde ettiği, sahne

deneyimi ile performansını geliştirdiği geniş ölçekli ve önemli bir araç haline gelmiştir. Ancak bu yapının daha sistematik hale getirilmesi gerekmektedir. Çünkü bu ve benzeri durumlar, Türkiye'de opera sanatının aktif bir şekilde ilerlemesine ve görünürlüğünün artmasına önemli katkılar sağlayacaktır. Hâlihazırda opera duyurularının yapıldığı her site kendinden bağımsız olup, tüm yarışmalara erişim ve duyuru gibi alanların bir çerçevede toplandığı site ne yazık ki bulunmamaktadır. Dolayısıyla bazen genç sanatçılar, arkadaş ya da tanıdık aracılığıyla yarışmalardan haberdar olabilmektedirler. Bu anlamda sistemin, arşivlenerek ve kurumsal kimliğe sahip olacak şekilde koordine edilmesi, yarışma duyurularının daha fazla kişiye ulaşmasını da destekleyecektir.

Aşağıda çalışmaya ilişkin öneriler yer almaktadır:

Her ne kadar şan yarışmaları sınırlı sayıda olsa da, bu yarışmaların diğer enstrumanları kapsayacak biçimde arttırılması,

Düet, trio, kuartet ve kentet gibi küçük toplulukları içeren yarışmalar ilerleyen yıllarda planlanması,

Devlet opera balesi genel müdürlüğü, kültür bakanlığı ve belediyelerin destekleriyle genç sanatçıların daha çok sahnede yer alması,

29 Ekim, 19 Mayıs, 30 Ağustos gibi özel günlerde konservatuvar öğrencilerinin sahneye çıkmasına fırsat verilmesi,

Müze konserleri, resim sergileri ve açılış gibi resmi organizasyonlarda belirli yeterliliğe sahip konservatuvar öğrencisi ya da mezun öğrencilerin katılımının sağlanması,

Türkiye'de gerçekleştirilen ulusal ya da uluslararası tüm yarışmaların üç büyük şehir dışında farklı illeri de kapsayacak şekilde yapılması,

Yarışmaların Türkiye içerisinde uygun şartlara sahip illeri kapsayacak şekilde ön eleme ayağının sağlanması,

Türkiye'de yer alan konservatuvarlar ve devlet opera ve balesi gibi resmi kurumlara yazılar gönderilerek yarışmalara yönelik daha fazla duyurunun yapılması ve ilginin artırılması,

Yarışmaların, bünyesinde konservatuvar bulunan üniversitelerin etkinlik salonunda gerçekleştirilmesi,

Yarışma jüri üyelerinin opera anasanat dallarıyla etkileşim içerisinde bulunup ustalık sınıfları gerçekleştirmesinin, genç sanatçıların mesleki gelişim sürecine olumlu katkı sağlayacağı düşünülmekte ve önerilmektedir.

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ARKEO-TERAPİ AN'A TANIKLIK ETMEK: ÇOK KÜLTÜRLÜ ANDA VE BURADA OLMA HALİ

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ÖZET

Bu bildiri, Arkeo-terapi kavramını, bireyin geçmişle kurduğu ilişki üzerinden "an'a tanıklık etme" ve "anda ve burada olma" deneyimi bağlamında ele almayı amaçlamaktadır. Arkeo-terapi, arkeolojik mekânlar, nesneler ve katmanlı tarihsel bağlamlar aracılığıyla bireyin zamansal farkındalığını derinleştiren, bedensel-duygusal deneyimi destekleyen bütüncül bir yaklaşım olarak ele alınmaktadır. Çok kültürlü arkeolojik alanlar, farklı uygarlıkların izlerini aynı mekânda barındırarak bireye geçmiş, şimdi ve gelecek arasında ilişkisel bir süreklilik sunar. Bu bağlamda arkeo-terapi, mindfulness temelli "anda olma" pratiğini tarihsel ve kültürel tanıklıkla bütünleştirerek bireyin kendilik algısını güçlendirmeyi hedefler. Bildiride, arkeolojik alanlarda gerçekleştirilen duyusal farkındalık, sembolik anlamlandırma ve yaratıcı ifade temelli uygulamaların; travma sonrası iyileşme, kültürel aidiyet, kolektif bellek ve duygusal düzenleme süreçlerine katkısı tartışılmaktadır. Sonuç olarak arkeo-terapinin, çok kültürlü bağlamda bireyin hem kişisel hem de kolektif deneyimlerine tanıklık etmesini sağlayan disiplinler arası ve yenilikçi bir terapi yaklaşımı sunduğu savunulmaktadır. Bu çalışma ile psikoloji, sanat, arkeoloji, Gestalt Teoriden hareketle çok kültürlü coğrafyalardaki terapötik uygulamalara da yer verilecektir.

Anahtar Kelimeler: Arkeo-Terapi, Anda ve Burada Olma, Çok Kültürlülük, Kolektif Bellek, Farkındalık, Kültürel Aidiyet

ARCHAEO-THERAPY AS WITNESSING THE MOMENT: A MULTICULTURAL STATE OF BEING IN THE HERE AND NOW

ABSTRACT

This paper aims to examine the concept of archaeo-therapy within the framework of "witnessing the moment" and the experience of "here and now," based on the individual's relationship with the past. Archaeo-therapy is conceptualized as a holistic approach that enhances temporal awareness and supports embodied and emotional experience through archaeological sites, objects, and layered historical contexts. Multicultural archaeological spaces, by encompassing traces of multiple civilizations within the same locale, offer individuals a sense of relational continuity between past, present, and future. In this context,

archaeo-therapy seeks to strengthen self-perception by integrating mindfulness-based practices of presence with historical and cultural witnessing. The paper discusses the contributions of sensory awareness, symbolic meaning-making, and creative expression–based practices conducted in archaeological settings to processes of post-traumatic recovery, cultural belonging, collective memory, and emotional regulation. It is argued that archaeo-therapy provides an innovative and interdisciplinary therapeutic approach that enables individuals to witness both personal and collective experiences within a multicultural context. Drawing on psychology, art, archaeology, and Gestalt theory, the study also addresses therapeutic practices implemented in multicultural geographies.

Keywords: Archaeo-therapy, Here and Now, Multiculturalism, Collective Memory, Awareness, Cultural Belonging

GİRİŞ

Arkeo Terapi, Freud'un «bilinçaltı kazı alanı» benzetmesinden hareketle antik kentlerin geçmişimizi anlamak ve kendimizi keşfetmek için mistik birer keşif alanı olduğu düşüncesi; Arkeoloji, sanat ve sanatla terapi alanlarının birleşiminden oluşan uygulamaların bütünüdür. Sanat Terapisi ise sanat ile psikoterapinin birleştirilmesinden oluşan, oldukça çözümleyici ve etkili bir terapi biçimidir. Ülkemizde resim terapisi alt başlığı genel olarak sanat terapisi adı altında kullanılmaktadır. Tarih öncesi dönemden günümüze kadar farklı kültürlerde, topluluklarda, ilk insanlarda dahi kendini dışavurum olarak gösteren sanat, psikoterapi ile birleşerek bilinçaltına hızlı ve direk inerek bireyin ruh halini yansıtmada ve ruhsal hastalığını adlandırmada oldukça etkilidir. Arkeo terapi de sanat terapisinin içinde kimlik bulan Kültürel miras terapileri ile harmanlanan kıymetli bir alandır.

Ana tanıklık etmek arkeolojide oldukça önemli bir kavramdır. Farkındalık olarak bireyin kazandığı mistik antik ortamda toprağın altında var olanı bulma, bulduklarını heyecanla ortaya çıkarma ve de döneminin nesnesine tanıklık etme noktasında hem bulma anına hem de döneminin sanatına, varlığına tanıklık eder. Ana tanıklık ederken birey şu noktalara dikkat çeker: Kişinin kendi anla yaşadığı ilişkiye yargısızca bakabilme, Anı idealize etmeden ya da suçlamadan görme, Anın koşullarını, sınırlarını ve aktardıklarını fark etme, "Görmek" ama "haklı çıkarmaya çalışmamak" ya da neden orada olduğunu ön yargı ile dillendirmemek.

Arkeoloji, insanlar, mekânlar, nesneler, bilgiler, soylar, ekosistemler ve dünya görüşleri arasındaki bağlantıları ortaya çıkarmak ve pekiştirmek için henüz yeterince kullanılmamış bir potansiyele sahiptir. Bu tür karşılıklı bağlantılar, bireylere ve topluluklara sağlık ve iyi oluşun

temelini oluşturan kimlikler, ilişkiler ve yönelimler kazandırır. Özellikle mekân odaklı bir araştırma olarak uygulanan arkeoloji, sömürgeciliğin dünya genelindeki yerli halklar arasında yaygın olan zararlı bir etkisi olan kültürel stresi dengeleyebilir (Holtorf, 2021). Arkeoloji ile kültürel miras alanı da kendini gösterebilir. Bazı çalışmalarda farklı coğrafyaların karşılaştırılmasında ve kültürel belleğin kolayca kavranmasında kültürel miras terapileri de kullanılabilir.

SONUÇ

Sanat ve sanat terapisi farklı iki olgudur. Sanat haz veren herhangi bir şeydir ve mutluluk verir, estetik kaygısı vardır. Sanat terapisinde ise böyle bir kaygıdan söz edilemez ve psikolog/psikiyatr tarafından kişiye özel terapötik program oluşturularak uygulanır ve bir süreçten oluşur (Öz Çelikbaş, 2019:34). Arkeo terapide bizler; arkeologlar, sanat eğitimciler, sanat terapistleri, psikologlar, antropologlar ve kültürel miras alanı ile restorasyon ve koruma alanından geniş bir ekip ile daha sağlıklı çalışmalar yapabiliriz.

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EĞİTİMDE SANATLA TERAPİ: DEWEY, NAUMBURG, KRAMER, MALCHIODI, STEINER, STERN

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ÖZET

Bu bildiri, eğitimde sanatla terapinin kuramsal ve uygulamalı temellerini John Dewey, Margaret Naumburg, Edith Kramer, Cathy Malchiodi, Rudolf Steiner ve Daniel Stern'in yaklaşımları doğrultusunda ele almayı amaçlamaktadır. Dewey'in deneyimsel öğrenme ve estetik yaşantı kavramları, sanatın eğitim ortamlarında anlamlı öğrenmeyi destekleyen bir süreç olduğunu ortaya koymaktadır. Naumburg'un dinamik sanat terapisi yaklaşımı, sanat ürünlerini bireyin içsel dünyasına açılan sembolik bir dil olarak değerlendirirken; Kramer, sanat yapma sürecinin doğrudan iyileştirici ve yapılandırıcı gücüne vurgu yapmaktadır. Malchiodi'nin çağdaş sanat terapisi çalışmaları, özellikle travma, duygusal düzenleme ve psikososyal iyilik hâli bağlamında eğitim ortamlarında sanat temelli müdahalelerin önemini ortaya koymaktadır. Steiner'in bütüncül eğitim anlayışı, sanatı bilişsel, duygusal ve ruhsal gelişimi bütünleştiren temel bir araç olarak ele alır. Stern'in ilişkisel gelişim ve öznel deneyim kuramı ise sanatla terapinin bağlanma, kendilik gelişimi ve duygusal farkındalık süreçlerindeki rolünü açıklamaktadır. Bildiri, sanatla terapinin eğitimde çok boyutlu gelişimi destekleyen disiplinler arası bir yaklaşım sunduğunu savunmaktadır. Aynı zamanda disiplinler arası boyuttan disiplinler üstü bir boyuta geçilen günümüz çağında sanatın da dönüşüm yaşarken müfredatlarla desteklenebileceğine değinilmiştir.

Anahtar Kelimeler: Sanatla Terapi, Eğitim, Deneyimsel Öğrenme, Duygusal Gelişim, Bütüncül Eğitim, Psikososyal İyilik Hâli

ART THERAPY IN EDUCATION: DEWEY, NAUMBURG, KRAMER, MALCHIODI, STEINER, STERN

ABSTRACT

This paper aims to examine the theoretical and practical foundations of art therapy in education through the perspectives of John Dewey, Margaret Naumburg, Edith Kramer, Cathy Malchiodi, Rudolf Steiner, and Daniel Stern. Dewey's concepts of experiential learning and aesthetic experience highlight art as a process that supports meaningful learning in educational settings. Naumburg's dynamic art therapy approach conceptualizes artistic products as a symbolic language that provides access to the individual's inner world, whereas Kramer emphasizes the

inherently healing and structuring power of the art-making process itself. Malchiodi's contemporary contributions to art therapy underscore the significance of art-based interventions in educational contexts, particularly in relation to trauma, emotional regulation, and psychosocial well-being. Steiner's holistic educational philosophy regards art as a fundamental means of integrating cognitive, emotional, and spiritual development. Stern's theories of relational development and subjective experience further elucidate the role of art therapy in attachment, self-development, and emotional awareness. The paper argues that art therapy offers an interdisciplinary approach that supports multidimensional development in education. Additionally, it addresses the possibility of supporting art—currently undergoing transformation in an era marked by a shift from interdisciplinary to transdisciplinary perspectives—through curriculum-based practices.

Keywords: Art Therapy, Education, Experiential Learning, Emotional Development, Holistic Education, Psychosocial Well

Carl Gustav Jung (1875–1961), Sanat terapisinin kuramsal temellerini atmıştır. Mandala çalışmaları; Arketipler ve semboller ile alana imge kavramını getirmiştir. Aktif imgeleme tekniği ile dışsallaştırma kavramının önemine değinmiştir. Sanatı ruhsal dengelemenin aracı olarak görmüştür ve bu sebeple psikoterapilerinde sanat ve metaforları sıklıkla kullanmıştır.

Margaret Naumburg (1890–1983), Sanat terapisinin Amerika'daki kurucusudur. "Dinamik Sanat Terapisi"nin öncüsüdür. Dinamik psikoterapiler günümüzde hala kullanılan hızlı sağaltımı ile meşhur bir yöntemdir. Naumburg, sanatı bilinçdışının dili olarak görmüştür. Freud'un psikanalitik yaklaşımından etkilenmiştir. Sanat ürünlerini terapi sürecinin merkezine koymuştur.

Adrian Hill (1895–1977), "Art Therapy" terimini ilk kullanan kişidir ve literatüre kazandırmıştır. İngiliz sanatçı ve yazardır ve de çok iyi bir ressamdır. Tüberküloz tedavisi sırasında resmin iyileştirici etkisini fark etmiştir. Sanatın hastane ortamlarında kullanılmasını savunmuştur. Sanat terapistliği mesleğinin gelişmesine katkı sağlamıştır.

Elinor Ulman (1910–1991), Sanat terapisi literatürünün gelişimini sağlamıştır. İlk sanat terapisi dergisini kurmuştur. Psikodinamik sanat terapisi yaklaşımını geliştirmiştir. Klinik sanat terapisi alanında önemli çalışmalar yapmıştır.

Edith Kramer (1916–2014), sanat eğitimcisi olarak Sanatın iyileştirici sürecine odaklanan yaklaşım olan "Sanat olarak terapi" yaklaşımını savunmuştur. Sanat yapma sürecinin kendisini iyileştirici kabul etmiştir. Yaratıcılığın egoyu güçlendirdiğini vurgulamıştır. Çocuk ve

ergenlerle çalışmalarıyla tanınır. Sanat eğitimcilerine sanat terapilerini tanıtmak için de oldukça emek harcamıştır. Bugünkü kimliğini sanat terapileri Kramer'e borçludur.

Rudolf Steiner (1861–1925), Avusturyalı filozof, eğitimci ve düşünürdür. Antroposofi akımının kurucusudur. Waldorf (Steiner) Eğitimi'nin temellerini atmıştır. Eğitim, sanat, tarım (Biodinamik tarım), tıp ve mimari alanlarında etkili olmuştur. İnsanı beden–ruh–zihin bütünlüğü içinde ele almıştır. "Eğitimin amacı, özgür düşünen bireyler yetiştirmektir." Sözüyle de tanınır.

Arno Stern (1924–2023), Alman kökenli eğitimci ve araştırmacıdır. "İz Oluşumu (Formülasyon)" kavramının geliştiricisidir. Malort (Resim Atölyesi)'nin kurucusudur. Çocukların çizimlerinin öğretilmeden, yönlendirilmeden ortaya çıkması gerektiğini savunmuştur. Sanatı bir performans değil, doğal bir ifade süreci olarak ele almıştır. Çocuk gelişimi, yaratıcılık ve pedagojide önemli etkiler bırakmıştır. "Çocuk çizmez, iz bırakır." Sözüyle de literatüre iz bırakmıştır.

Cathy Malchiodi, Amerika'da yaşayan ve günümüzde yaşayan aktif eğitimler veren, sanat terapisinin öncü isimlerinden birisidir. Dr. Cathy Malchiodi, dünyaca tanınan bir sanat terapisti, akademisyen ve yazardır. Özellikle travma, çocuklar ve ergenler, yaratıcı ve dışavurumcu terapiler alanlarında uzmanlaşmıştır. Sanat terapisini bilimsel ve kanıta dayalı yöntemlerle birleştirerek alanın gelişmesine büyük katkı sağlamıştır.

The Art Therapy Sourcebook ve Creative Interventions with Traumatized Children gibi temel eserleriyle tanınır. Çalışmaları, sanat terapisinin iyileştirici gücünü uluslararası düzeyde görünür kılmıştır.

SONUÇ

Sanat insan yaşamına yön verme, rahatlatma, anlamlı kılma ve kolaylaştırma gibi sebeplerle bahsettiğimiz ilişkilerden uzak değildir. İnsan olmak, doğanın verilerini kullanarak düzenlemek, biçimlendirmek, yeni üretim eylemleri için kullanmak demektir. Çünkü üretim olduğu sürece insan, alanını genişletir, ortamını daha iyi anlama olanağı bulur (Kandinsky, 1993:64).

Sanat terapisinde amaç kişinin kendisini kelime kullanmadan simgelerle anlatması olduğundan, kişi her türlü görsel sanatın ekspresyonist sembollerini dışavurum aracı olarak kullanabilir (Öz Çelikbaş, 2019: 32).

Sanat terapi seansları uzman psikolog ve psikiyatrlar tarafından yapılmaktadır. Bu noktada eğitimcilere düşen görev de sanat ve terapinin görsel sanatlar eğitimi alan öğrenciler ve bu

alanda çalışan eğitimciler tarafından terapi olarak yapılmadığı sadece sanat terapi uygulayıcısı olarak görsel sanatlar uzmanının bulunduğu detayını unutmaması ve bireylerde bu konuda farkındalık yaratması önemli bir noktadır.

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A REVIEW ON USE OF UAV'S IN POSTAL SERVICES

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ABSTRACT

The growing interest and market for unmanned aerial vehicles (UAV) manufacturing and operation offer opportunities in many areas of service and operation. With the elimination of the need for a fuselage or cabin with a capacity for crew or passengers, it appears that the overall weight of a UAV will be lower than its manned counterparts. This advantage is beneficial and particularly efficient, as weight is the factor that most influences the performance of an airship. However, this performance superiority also leads to some setbacks in terms of the ship's reliability. This makes the commercial use of these vehicles a somewhat sensitive issue and not suitable for certain tasks and operations, especially on and around populated areas. As of December 2025, many companies are working on the use of UAVs in commercial applications, but there are still some obstacles to this goal. This study aims to give an idea of the gains and losses of the methods that can be used in the light of the approach of the public and aviation authorities of these capabilities. As a result of the examinations and comparisons, it will be seen that with the use of unmanned systems, existing activities can be increased and the pool and opportunities of commercial activities can be expanded. However, these gains are not possible due to the rules in the legislation followed by the civil aviation authorities, especially regarding operations over residential areas. In order to overcome this obstacle, it is aimed to limit various risks and to limit situations that are examined especially under weather risks and generally examine collision events with other aircraft. To achieve this, it depends on the development of detect and avoid or, with the newly accepted definition, detect and avoid capabilities, especially the use of methods that can detect obstacles with high resolution and sensitivity, especially in a city environment with high traffic. The aim of this article is to provide a meaningful examination by evaluating the methods, devices and their advantages and disadvantages between each other.

Keywords: UAV, internet of things (IoT), last parcel delivery, sense-and-avoid, autonomous delivery

1. INTRODUCTION

Use of mechanical and electrical methods to both ease and improve the work done by humans has been a primary goal behind the industrial revolution. The approaches, methods and material and tools developed ever since have also been aiming to achieve this goal. As the speed of progress has been ever increasing, the technologies sometimes appear before the guidelines which they should be employed within. Use of unmanned systems are one such technology, the systems have been improving at a great pace in the past years and obtaining goals that even now appear to be quite aspiring.

However, these achievements remain within the limitations of legislations which permit certain operations and not permit others. As one can imagine, integration of unmanned systems into certain spaces proves to be an immense danger if the necessary precautions are not taken. It is at this point it remains to decide which and what is indeed a precaution that can prevent any and all unwanted circumstances and more importantly, the circumstances that remain out of our awareness. The legislation imposed by the leading aviation authorities are quite similar in this matter usually require similar things if an unmanned aerial vehicle is to be flown in an urban area. These are namely, reducing the ground and air risks as well as making the system visible to various methods of surveillance, both visually and electronically (EASA 2024)(FAA 2023). Reducing ground risks or ground risk mitigation comes in the form of reducing the kinetic energy of the system should it fail, therefore limiting the damage it can cause in case of a collision with a structure, object or persons on the ground. In academic research it has also been constructed as a total risk consisting of three main possibilities, namely, the possibility of the event, possibility of impacting a person and lastly the possibility of a fatal impact (La Cour-Harbo, A. 2017). While this is a quite straightforward precaution to take, it becomes apparent quickly that in order to reduce the fatality of an impact, either the UAV needs to be lighter and/or travel at a slower speed, which limits the use and capability of the systems greatly. While the weight of the system itself can be reduced to some extent by using better materials and improving the architecture, reducing the weight of the possible payloads makes completing certain missions, if not all, impossible. Even more, the use of parachutes is another method for reducing the damage of a possible collision, while a plausible approach for missions being

conducted in open areas and at great speeds by larger UAV models, this also has limited usefulness when it comes to medium sized rotary wing UAVs.

Reducing air risks, however, is a goal that can be obtained without having to limit the operational capability of the UAV systems to be used. The criteria for mitigating air risks are to make sure that the UAV can safely employ detect-and-avoid capabilities. The objective in this effort is to prevent collision instead of making a collision less dangerous as opposed to ground risk mitigations (Mcfadyen & Mejias, 2016). This fact itself is a convincing point for any operator as it is sensibly the desired approach. The capabilities, however, remain to be more economically burdensome to obtain rather than simply limiting payload weight. While there are numerous ways in which the UAVs can be equipped to gain a level of DAA abilities, the most capable approaches require powerful equipment which are both expensive and require higher energy and computing capability on the UAV, making it three expensive components instead of simply one (Carrio et al., 2017).

2. MATERIAL AND METHODS

Viewing the requirements and approaches stated in the previous chapter to achieve a capability to perform certain missions using UAVs, it becomes visible that adapting a detect-and-avoid capability in order to mitigate air risks appears more feasible and desirable for any operator. Current devices and their economic prices vary, simple electro-optic cameras which can work in the visible wavelength cost little compared to more capable and sensitive light detection and ranging (LİDAR) laser sensor systems (Yu & Zhang, 2015). It should therefore be studied which system has an advantage in these proposed mission parameters within high density environments such as cities and other areas. (Albaker & Rahim, 2009)

2.1 Cameras

Being devices that have been developed and achieved a certain maturity technology wise, cameras offer possibly the largest selection of payloads which the operators can choose from. While most of these devices are quire compact and light, requiring very little power and complexity to work and detect obstacles, they are however limited in their ability to safely and precisely detect obstacles (Gageik et al., 2015). As a camera captures an image, the resolution and saturation value simply provides objects to be separated from each other easily. However, the main short coming is the fact that there is no way to obtain depth analysis between these objects, namely the obstacles and the background from the UAV's perspective (Lu et al., 2018). Presence of even thinner and smaller obstacles such as electric wires or transparent and

reflective ones make the process of discerning objects from one another even more difficult for the system (Tang et al., 2022). While there are certain approaches developed and improved to enhance the capability of these rudimentary devices in detecting sensitive obstacles in highly saturated backgrounds such like in cities, these capabilities can only hope to achieve the accuracy that more sophisticated devices easily can obtain. It is seen therefore that while cameras provide an economically sustainable approach for detect and avoid capabilities, their success is limited due to the nature of their working process.

2.2 Radar

As a technology which has even deeper roots than electro-optical and infrared cameras, radars, more specifically air-to-air radars have been relied on heavily in military aircraft due to their extensive range. While larger and by far heavier than electro-optical cameras, radars provide a somewhat capable obstacle detection with depth understanding. As the system acts like an active sensor, sending energy out into the environment it is working on, it naturally consumes a lot more power as compared to electro-optical cameras. While radars, depending on the model and quality of the device can detect very sensitive, small obstacles very far away from themselves, the rays eventually separate from one other a good deal as the distance travelled increases. Moreover, while radars provide excellent operational capability in poor visual environments, a situation which electro-optical cameras are very ill-suited for and provide range information on detected obstacles, they have very poor size, weight and power consumption characteristics (Fasano et al., 2016). On top of this the natural inclination of radars to provide irrelevant data due to the high obstacle saturation in the foreseen environments, sometimes even being blinded by the extreme load of return signals, hints higher computing costs on processing devices as well as human operators.

2.3 Lidar

While not exactly a new technology, lidar sensors have been seeing more and more use in civil areas from UAVs to even cell phones and cars with certain features. Simply put, while working quite similarly to radar sensors, lidar sensors gain the upper hand due to their capability to separately detect obstacles instead of being overwhelmed by the noise in highly saturated environments. Due to the working principle of the sensor, lidars provide an apparent advantage over radar systems in highly contested areas while still obtaining the advantage of successful operation in poor visibility conditions over electro-optical cameras. As it can be expected, while lidar sensors still pose some disadvantages due to their size, weight and power requirements

when compared against their electro-optical counterparts, the main limiting factor is the field of vision (FOV) of the sensor. The use of the sensor has some approaches which sometimes regard the sensor itself as a standalone system, namely a 3D lidar, while some approaches suggest using the sensor along with other accompanying methods which are mechanical scanning which provides lighter weight and lower power consumption (Mohta et al., 2018). The computing power requirement again seems to be a factor while some also argue that point density and FOV as discussed earlier is the limiting factor in front of lidar sensors being used widespread (Aldao et al., 2022).

3. RESULTS AND DISCUSSION

Viewing these suggested methods and devices which can be used to provide a UAV with a stable level of DAA capabilities, it is not a day and night difference regarding which system offers the best solution. Considering several factors which contribute to the choice of the system to be used, size, weight, power consumption, computing power requirement and of course the price of the equipment which will likely be as equally important to an operator, it quickly becomes apparent that no single approach will offer the best performance in all of these factors in a wide variety of mission types. However, narrowing the mission type and the environment which it is expected to be performed in, electro-optical cameras and lidar systems appear to be able to perform a fulfilling job in medium density environments. This idea comes forward from the assumption that the use of UAVs for cargo deliveries in large cities with high skylines and dense air spaces is several steps ahead and the first uses of such systems will likely take place in less crowded and spacious areas. Therefore, as standalone systems or as complimentary systems which will be used to nullify the weak points in the operation of each other as suggested in 2D lidar architecture, it gains a certain foothold that both electro-optical cameras and 2D lidars complemented by them can safely hope to achieve both a sensitive and successful DAA capabilities. Moreover, this approach should also remain somewhat low cost which is a major advantage in order to allow the UAV airframe to be lighter, also reducing ground risks in tandem. The lighter and smaller 2D lidar sensors also benefit the operator as this means that heavier and larger payloads can be attached to the UAV system, rendering its improving its mission capabilities further.

CONCLUSIONS

This study has been completed with the objective of identifying the main factors that are currently limiting the use of UAVs in cargo delivery missions which as expectedly shall be

taking place in residential areas and the approaches that may be taken to overcome them. While there are numerous ways and sensors that can be and likely are being used to approach this problem, the most common architectures have been studied and compared. The results of this study provides insight into the sensors and procedures can be used to overcome regulatory obstacles against the use of UAVs in such missions.

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MARDİN İLİ MİDYAT İLÇESİNDE KUYUMCULUK SEKTÖRÜNDE FAALİYET YÜRÜTEN İŞLETMELERİN SORUNLARININ TESPİTİ

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ÖZET

Değerli madenlerin eski çağlardan beri başta üst düzey aristokratların, burjuva sınıfının, saray hanedanlarının ve zengin halkın sofralarını ve yaşam alanlarını süslediği bilinmektedir. Aynı zamanda daha şık, gösterişli, haşmetli ve güzel görünmek için çeşitli yöntemler ile işlenmiş değerli madenleri takı aksesuarları olarak da kullanmışlardır. Kıymetli madenler kategorisinde olup günümüzde önemli yatırım araçları arasında ilk sıralarda yer alan altın ve gümüş madenleri tıpkı eski çağlarda olduğu gibi halen ev ve iş yerlerinde dekoratif süs eşyası ve takı kullanımında önemli bir yere sahiptir. Özellikle altın eski çağlardan bu yana gücün ve güneşin sembolü olarak ifade edilirken gümüş madeni ise güneşi temsil etmiştir. Yine geçmiş dönemlerde değerli metallerin işlenmesi ve kullanıma sunulması zanaatkârlar tarafından yapılırken, günümüzde nüfus artışı, arz ve talepteki farklılıklar, alım-satım faaliyetlerindeki değişkenlerin etkisiyle de hızla büyüyerek sektör haline gelmiştir. Elbette büyümenin olumlu sonuçları olduğu kadar beraberinde çeşitli problemlerin de yaşandığı söylenebilir. Bu çerçevede ele alındığında kuyumculuk sektörü için de aynı durumun geçerli olabileceği değerlendirmesi yapılmaktadır. Ülkemiz özelinde değerlendirildiğinde yaşanan sorunların başında vergi mevzuatının yetersizliği, kalifiye eleman yetersizliği, ayar problemleri, teknoloji yetersizliği, pazarlama ve tanıtım problemleri yer almaktadır. Yapacağımız çalışma ile yüzyıllardır kuyumculuk alanında önemli bir yere sahip olan ve günümüzde kültür turizminin de etkisiyle ziyaretçi sayısının artmış olduğu Mardin ili Midyat ilçesindeki kuyumcuların yaşadıkları sorunları araştırmayı hedeflemekteyiz. Araştırma yapılırken öncelikle literatür taraması

yapılacaktır. Literatür taraması sonunda araştırma soruları belirlenecektir. Bu araştırma soruları dikkate alınarak saha çalışması yürütülecektir. Saha çalınmasında, nitel veri toplama yöntemlerinden ‘’Görüşme metodu’’ nun alt başlığı olan ‘’Yapılandırılmamış görüşme’’ metodu kullanılacaktır. Araştırmada Mardin ili Midyat ilçesindeki kuyumcularla farklı zamanlarda görüşmeler yapılarak sektörde yaşadıkları sorunların tespiti sağlanacak ve tespit edilen bu sorunlara Birleşmiş Milletlerin çalışma alanı olan ‘’Sürdürülebilir Kalkınma Amaçları’’ arasından ‘’Eşitsizliklerin Azaltılması (10)’’ ve ‘’Sorumlu Üretim ve Tüketim (12)’’ konularını da kapsayacak şekilde çözüm önerileri sunulacaktır.

Anahtar Kelimeler: Kuyumculuk, kuyumculuk sektörü, Midyat kuyumcularının sorunları

DETERMINATION OF PROBLEMS OF BUSINESSES OPERATING IN JEWELRY SECTOR IN MIDYAT DISTRICT OF MARDIN PROVINCE

ABSTRACT

It is known that precious metals have adorned the tables and living spaces of high-level aristocrats, bourgeois class, palace dynasties and wealthy people since ancient times. At the same time, they used precious metals processed with various methods as jewelry accessories in order to look more stylish, showy, majestic and beautiful. Gold and silver mines, which are in the category of precious metals and are among the top investment tools today, still have an important place in the use of decorative ornaments and jewelry in homes and workplaces, just like in ancient times. Gold, in particular, has been expressed as a symbol of power and the sun since ancient times, while silver mines have represented the sun. Again, while in the past, precious metals were processed and offered for use by craftsmen, today, with the effect of population growth, differences in supply and demand, and variables in buying and selling activities, it has grown rapidly and become a sector. Of course, it can be said that growth has positive results as well as various problems. When considered within this framework, it is evaluated that the same situation may be valid for the jewelry sector. When evaluated specifically for our country, the main problems experienced are inadequacy of tax legislation, inadequacy of qualified personnel, calibration problems, inadequacy of technology, marketing and promotion problems. With the study we will conduct, we aim to investigate the problems experienced by jewelers in Midyat district of Mardin province, which has an important place in the field of jewelry for centuries and where the number of visitors has increased with the effect of cultural tourism today. While conducting the research, a literature review will be conducted first. Research questions will be determined at the end of the literature review. Field work will

be conducted by considering these research questions. In the field work, the ‘’Unstructured interview’’ method, which is the subtitle of ‘’Interview method’’ from the qualitative data collection methods, will be used. In the research, interviews will be conducted with jewelers in the Midyat district of Mardin province at different times to identify the problems they experience in the sector and solution proposals will be presented for these identified problems, including the subjects of "Reducing Inequalities (10)" and "Responsible Production and Consumption (12)" from the "Sustainable Development Goals", which are the working areas of the United Nations.

Keywords: Jewellery, jewellery sector, problems of Midyat jewellers

TEHLİKELİ BÖLGE SINIFLANDIRMASI VE HVAC TASARIMINA ETKİSİ: GAZ MOTORLU JENERATÖR ORTAMI İÇİN BİR VAKA ANALİZİ

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ÖZET

Patlayıcı gaz atmosferlerinin mevcut olduğu endüstriyel tesislerde, ilgili hacmin tehlike bölgesi sınıflandırmasının tayin edilmesinde; gaz veya buharın karakteristik özellikleri, sızıntının kaynağı ve doğası, operasyonel proses koşulları ve ekipmanların tasarımı gibi faktörlere ek olarak, ortamdaki havalandırma sisteminin performansı da kritik bir mühendislik parametresi olarak belirleyici rol oynamaktadır. IEC 60079-10-1 standardı, patlayıcı gazların oluşturduğu potansiyel tehlikenin, sadece bir kaçak kaynağının mevcudiyetine değil, aynı zamanda bu kaçak neticesinde ortamda ulaşılabilecek gaz konsantrasyonunun seviyesine bağlı olduğunu açıkça belirtmektedir. Bu bağlamda, optimum düzeyde tasarlanmış bir havalandırma sistemi, gaz/buhar birikimini önleyerek, patlayıcı atmosfer oluşumunu engeller ve gazı ortamdan uzaklaştırır; bu sayede tehlikeli alan sınıflandırmasının derecesini düşürür. Bu metodolojide HVAC sistemi artık yalnızca konfor odaklı pasif bir mekanik tertibat olmaktan çıkıp, patlama riskini önlemeye yönelik aktif bir güvenlik fonksiyonu rolünü üstlenmektedir. Bu çalışmada, gaz yakıt kullanarak elektrik üretilmesine yarayan Gaz Motorlu Jeneratör ekipmanı incelenerek bulunduğu ortam için gerekli tasarım kriterlerine göre HVAC tasarımını gerçekleştirilmesi bir vaka analizi olarak sunulmuştur. Bu çalışma kapsamında, ekipmanın tasarım spesifikasyonlarında belirtilen maksimum ve minimum çalışma sıcaklıkları ile ortamdaki gaz konsantrasyonu değerleri temel alınarak, gerekli havalandırma debisi hesaplanmış ve buna uygun fan seçimi gerçekleştirilmiştir. Ayrıca, yaz ve kış mevsimlerindeki operasyonel gereklilikleri karşılayacak optimum fan debisinin belirlenmesi de bu çalışmanın kapsamına dahil edilmiştir. Bu sayede, hem gaz motorlu jeneratör ekipmanının tasarım ve işletme gereksinimleri titizlikle karşılanmış hem de ortamın patlamadan korunma şartlarını sağlayarak güvenli bir çalışma ortamı oluşturulmuştur.

Anahtar Kelimeler: Tehlikeli Bölge Sınıflandırması, Gaz Motorlu Jeneratör, Patlayıcı Ortamlar, Endüstriyel HVAC Tasarımı

HAZARDOUS AREA CLASSIFICATION AND ITS IMPACT ON HVAC DESIGN: A CASE STUDY OF A GAS ENGINE GENERATOR ENCLOSURE

ABSTRACT

In industrial facilities where explosive gas atmospheres may be present, the performance of the ventilation system provided in the area is a critical engineering parameter that plays a decisive role in determining the hazardous area classification of the volume, alongside factors such as the gas or vapor characteristics, the nature and source of the release, operational process conditions, and equipment design. The IEC 60079-10-1 standard emphasizes that the potential hazard posed by flammable gases is not solely related to the mere presence of a release but also to the concentration level the gas can attain within the atmosphere following this release. Consequently, a well-engineered ventilation system prevents gas/vapor accumulation by effectively removing the hazardous substance before an explosive atmosphere can form, thereby leading to a reduction in the degree of hazardous area classification. Within this methodology, the HVAC system transitions from being a passive mechanical arrangement used for comfort purposes to an active safety function critically for preventing ignition. This study presents a case study focusing on the HVAC design for an environment housing a Gas Engine Generator unit, which is utilized for electricity generation using gaseous fuel. The design is executed based on the requisite design criteria specific to the equipment's operating environment. Based on the maximum and minimum operating temperatures specified in the equipment design requirements, along with the required ambient gas concentration limits, the necessary ventilation airflow rate was calculated, and the appropriate fan selection was performed. The determination of the optimal fan flow rate to meet the essential environmental conditions for both summer and winter operations was also carried out within the scope of this study. Consequently, this approach ensures the fulfillment of both the design and operational requirements of the gas engine generator equipment, while simultaneously establishing the necessary conditions for the enclosure to be explosion-protected.

Keywords: Hazardous Area Classification, Gas Engine Generator, Explosive Atmospheres, Industrial HVAC Design

PROJENİN AMACI

Projemizin amacı Gaz yakıt kullanarak elektrik üretilmesine yarayan Gas Engine Generatör ekipmanını incelemek ve Gerekli tasarım kriterlerine göre HVAC tasarımını gerçekleştirmektir..

TEMEL TANIMLAR

Ex-proof (Explosion Proof):
Patlayıcı gaz atmosferi bulunan ortamlarda kullanılmak üzere tasarlanmış, kıvılcım veya aşırı sıcaklık oluşturarak ateşleme kaynağı yaratmayacak şekilde üretilmiş ekipmanları ifade eder. Ex-proof tasarım, ekipmanın bir iç patlama gerçekleşse bile bu patlamanın dış ortama yayılmasını engellemesi esasına dayanır.

Ex-proof Ekipman:
Belirli bir patlayıcı atmosfer sınıfında kullanılmak üzere sertifikalandırılmış elektrikli veya mekanik ekipmanlardır. Ekipman üzerinde ATEX veya IECEx sertifikasyon bilgileri, gaz grubu (IIA, IIB, IIC), sıcaklık sınıfı ve koruma yöntemi (Ex d, Ex e, Ex p, Ex n vb.) belirtilir.

IEC (International Electrotechnical Commission):
Elektrik, elektronik ve ilgili teknolojiler için uluslararası standartlar yayımlayan organizasyondur. Patlayıcı ortamlara yönelik birçok küresel standardın ana kaynağı IEC'dir.

IEC 60079 Serisi:
Patlayıcı gaz, buhar ve toz ortamlarına yönelik tasarım, kurulum, ekipman seçimi ve güvenlik gerekliliklerini belirleyen uluslararası standart setidir. Bu seri; tehlikeli alan sınıflandırmasını (IEC 60079-10), koruma tiplerini (IEC 60079-0, 60079-1 vb.), test yöntemlerini ve uygulama detaylarını içerir.

IEC 60079-10-1 (Tehlikeli Alan Sınıflandırması – Gaz Ortamları):
Patlayıcı gaz atmosferlerinin oluşma olasılığına göre çalışma sahalarının Zone 0, Zone 1 ve Zone 2 olarak sınıflandırılmasını açıklayan temel standarttır. Gaz yayılım kaynağı, kaçak frekansı, seyrelme, havalandırma etkinliği gibi kriterlere göre bölge sınıfları belirlenir.

API (American Petroleum Institute):
Petrol, doğal gaz ve petrokimya sektörlerinde kullanılan tesis ve ekipmanlar için tasarım, operasyon ve güvenlik standartları yayımlayan Amerika merkezli organizasyondur.

API 505 (Tehlikeli Saha Sınıflandırması – Gaz Ortamları):
Patlayıcı atmosfer bulunan bölgelerde elektrikli ekipman yerleşimi için saha sınıflandırması yapan standarttır. Zone tabanlı sınıflandırmayı (Zone 0, 1, 2) tanımlar ve IEC yaklaşımı ile uyumludur.

Ex-proof Zone (Tehlikeli Bölge Sınıfları):
Patlayıcı gaz atmosferinin oluşma ihtimaline göre bölge sınıflandırması yapılır:

- Zone 0: Patlayıcı atmosferin sürekli veya uzun süre mevcut olduğu alanlar.
- Zone 1: Normal çalışma sırasında patlayıcı atmosfer oluşması muhtemel alanlar.
- Zone 2: Normal çalışma sırasında patlayıcı atmosfer oluşması beklenmeyen, olsa bile kısa süreli oluşan alanlar.

LEL — Low Explosion Level (Alt Patlama Limiti):
Bir yanıcı gazın tutuşabilmesi için havada bulunması gereken en düşük konsantrasyondur. Bu konsantrasyonun altındaki gaz-hava karışımları tutuşamaz. Örneğin hidrojen için LEL yaklaşık %4'tür.

UEL — Upper Explosion Level (Üst Patlama Limiti):
Bir yanıcı gazın çok yüksek konsantrasyonda bulunması nedeniyle oksijenle yeterli temas oluşturamadığı için artık tutuşamayacağı üst sınırdır. Hidrojen için UEL yaklaşık %75'tir.

Patlayıcı Atmosfer (Explosive Atmosphere):
Yanıcı gaz, buhar veya tozun havayla belli oranlarda karışarak, uygun bir ateşleme kaynağı ile temas ettiğinde patlama oluşturabilecek karışım oluşturduğu ortamdır. LEL–UEL aralığı bu ortamı ifade eder.

Kaçak Debisi (Leak Rate):
Bir ekipman veya proses hattından ortama sızan gazın birim zamanda kaçan miktarıdır (m^3/s, m^3/h). Tehlikeli alan sınıflandırması ve havalandırma hesaplarının önemli girdilerinden biridir.

Seyreltme (Dilution):
Kaçan gazın havalandırma ile karıştırılarak tehlikeli konsantrasyon aralığının altına düşürülmesi işlemidir. Havalandırma debisi arttıkça seyreltme etkisi artar.

Havalandırma Etkinliği (Ventilation Effectiveness):
Havanın hacim içinde ne kadar eşit ve etkin dağıldığını gösterir. Ölü bölgelerin bulunmaması, gazın birikmesini engellemek için kritiktir.

ACH — Air Changes per Hour (Saatlik Hava Değişim Sayısı):
Bir hacmin bir saatte kaç kez tamamen taze hava ile yenilendiğini gösteren parametredir. Ex-proof tasarımlarda yüksek ACH, gazın birikmesini engelleyerek Zone düşürme amacıyla kullanılır.

H_2 Dedektörü:

Batarya odaları ve hidrojen oluşma riski bulunan alanlarda hidrojen gazını algılayan sensördür. Genellikle LEL'in %10–25 seviyelerinde alarm üretir.

Gaz Grubu (Gas Group):

Patlayıcı gazların tutuşma özelliklerine göre sınıflandırılmasıdır. IEC'e göre IIA, IIB ve IIC grupları bulunur; IIC en tehlikeli grup olup hidrojen ve asetileni kapsar.

Sıcaklık Sınıfı (Temperature Class):

Ekipmanın yüzey sıcaklığının hangi maksimum değere kadar çıkabileceğini belirten sınıflamadır. T1–T6 arası sınıflar bulunur; T6 en düşük maksimum yüzey sıcaklığına sahip, en güvenli sınıftır.

Ex-proof İşaretleme Kodu ve Alt Bileşenlerinin Açıklaması

Patlayıcı atmosferlerde kullanılan elektrikli ve mekanik ekipmanlar, ilgili standartlara (IEC 60079, ATEX, IECEx) uygun olarak işaretlenir. Bu işaretleme kodları, ekipmanın hangi ortamda, hangi gaz grubunda, hangi sıcaklık sınıfında ve hangi koruma yöntemiyle güvenli şekilde kullanılabileceğini gösterir.

Kodlama, bir ekipmanın nerede, nasıl ve hangi koşullarda kullanılabileceğini belirleyen eksiksiz bir güvenlik bilgisidir.

Ekipman Grubu (Equipment Group)

Patlayıcı ortamlar iki ana "grup" altında sınıflandırılır:

Grup I – Madencilik

Metan (CH_4) gibi gazların bulunduğu maden ocakları.

Yeraltı uygulamalarında kullanılır.

Ekipman, mekanik darbelere ve kömür tozuna karşı daha sıkı gerekliliklere sahiptir.

Grup II – Endüstriyel Tesisler

Kimya, petrokimya, rafineri, LPG-LNG tesisleri, boya fabrikaları vb.

En yaygın kullanılan gruptur.

Ex-proof işaretlerde genellikle II ibaresi görülür.

Kategori ve Kullanım Tipi (Equipment Category)

ATEX sisteminde ekipman kategorisi, risk seviyesine göre belirlenir:

- Kategori 1 (1G / 1D):
  Sürekli ya da uzun süre patlayıcı atmosfer bulunan bölgeler (Zone 0 / Zone 20).

- Kategori 2 (2G / 2D): Normal çalışma sırasında patlayıcı atmosfer oluşması muhtemel bölgeler (Zone 1 / Zone 21).
- Kategori 3 (3G / 3D): Normal çalışma sırasında patlayıcı atmosfer oluşması beklenmeyen bölgeler (Zone 2 / Zone 22).

“2G” → Zone 1 için uygun.
“2” kategorisi yüksek koruma gerektirir;
“G” ibaresi ise gaz ortamlarında kullanılabileceğini ifade eder.

Ex İşareti (“Ex”)

Ex ibaresi, ekipmanın patlama riskine karşı özel olarak tasarlandığını gösteren temel semboldür.

ATEX ve IECEx sistemlerinde ortak olarak kullanılır.

Koruma Tipi (Protection Concept / Method)

Koruma tipi, ekipmanın patlamayı nasıl önlediğini açıklar.
IE C 60079 serisinde en sık kullanılan koruma tipleri şunlardır:

Ex d — Alevsızdırmaz Muhafaza (Flameproof)

- İç patlama dışarı yayılmaz.
- Gövde patlamayı içeride tutar.
- Motorlar, aydınlatmalar, panolar için yaygın.

Ex e — Artırılmış Güvenlik (Increased Safety)

- Kıvılcım çıkarabilecek hiçbir parça bulunmaz.
- Yüksek izolasyon ve uygun malzeme kullanımıyla güvenlik sağlanır.
- Klemens kutuları, motor terminalleri için yaygın.

Ex n — Sınırlı Enerji (Non-sparking)

- Zone 2 için kullanılır.
- Kıvılcım üretme ihtimali çok düşüktür.

Ex p — Basınçlandırma (Pressurization)

- İç atmosfer temiz hava/azot ile basınçlandırılır.
- Gaz girişine izin verilmez.
- Kontrol odaları, MCC odaları vb.

Ex i — Kıvılcım Güvenliği (Intrinsic Safety)

- Devredeki enerji seviyeleri kıvılcım oluşturmayacak kadar düşüktür.
- Ölçüm, enstrümantasyon, sensörler için.

Ex t — Toz Koruması (Dust Protection)

- Toz patlaması ihtimali olan ortamlar için.

Ex m — Dökme İçinde Kapsülleme (Encapsulation)

- Elektrik bileşenleri reçine veya jel içinde gömülür.

Ex q — Kum Dolgusu (Powder Filling)

- İç bileşenler kuvars kumu benzeri malzemeyle kaplanır.

Gaz Grubu (Gas Group Classification

Patlayıcı gazlar ateşleme enerjisine göre gruplandırılır:

IIA – En düşük riskli grup

- Propan, bütan, metanole yakın gazlar.

IIB – Orta seviyede tehlikeli gazlar

- Etilen, benzen, etanol ortamları.

IIC – En tehlikeli gazlar

- Hidrojen (H_2)
- Asetilen
- Karbon sülfür gibi düşük tutuşma enerjili gazlar.

IIC ekipman, IIA ve IIB için de kullanılabilir.

Sıcaklık Sınıfı (Temperature Class)

Ekipmanın yüzey sıcaklığının maksimum ne kadar artabileceğini gösterir. Bu önemlidir çünkü ekipman yüzey sıcaklığı LEL seviyesindeki bir gazı tutuşturabilir.

Sınıflar:

Sınıf	Maks. Yüzey Sıcaklığı
T1	450°C
T2	300°C
T3	200°C
T4	135°C
T5	100°C
T6	85°C

Equipment Protection Level (EPL) – Koruma Seviyesi

IECEx sisteminde zorunludur:

- Ga: En yüksek güvenlik → Zone 0

- Gb: Zone 1
- Gc: Zone 2
- Da/Db/Dc: Toz ortamları için

Örnek Kodun Açılımı

Örnek ile II 2G Ex d IIB T4 Gb tipik bir ex-proof işaretini açıklamak gerekirse;

Kod	Açıklama
II	Endüstriyel ortam (Petrokimya, rafineri vb.)
2G	Zone 1 için uygun – Gaz ortamı
Ex	Patlayıcı atmosferde kullanım için onaylı
d	Alevsızdırmaz koruma tipi
IIB	Gaz grubu → Etilen sınıfı
T4	Maksimum yüzey sıcaklığı 135°C
Gb	EPL → Zone 1

Bu kodun tamamı ekipmanın nerede, hangi gaz grubunda, hangi koruma yöntemiyle, hangi sıcaklık limitlerinde, hangi güvenlik seviyesinde kullanılabileceğini gösterir.

IEC 60079-10-1'e Göre Tehlikeli Alan Sınıflandırması

IEC 60079 standardı, patlayıcı gaz atmosferlerinin ortaya çıkma olasılığına göre çalışma alanlarını Zone 0, Zone 1 ve Zone 2 olarak sınıflandırır. Bu sınıflandırma; gazın ortamda ne kadar süre bulunduğu, kaçak olasılığı, havalandırma kapasitesi ve ortam akış karakteristikleri dikkate alınarak yapılır.

Zone 0

Zone 0, patlayıcı gaz atmosferinin sürekli, uzun süreli veya çok sık meydana geldiği alanlardır. Bu bölgelerde gaz konsantrasyonu uzun süre LEL seviyesine ulaşabilir veya bu seviyeye yakın kalabilir. Zone 0 için kullanılan ekipman en yüksek koruma seviyesine sahip olmalı ve cihaz yüzey sıcaklığı gazı tutuşturmayacak seviyede olmalıdır.

Zone 1

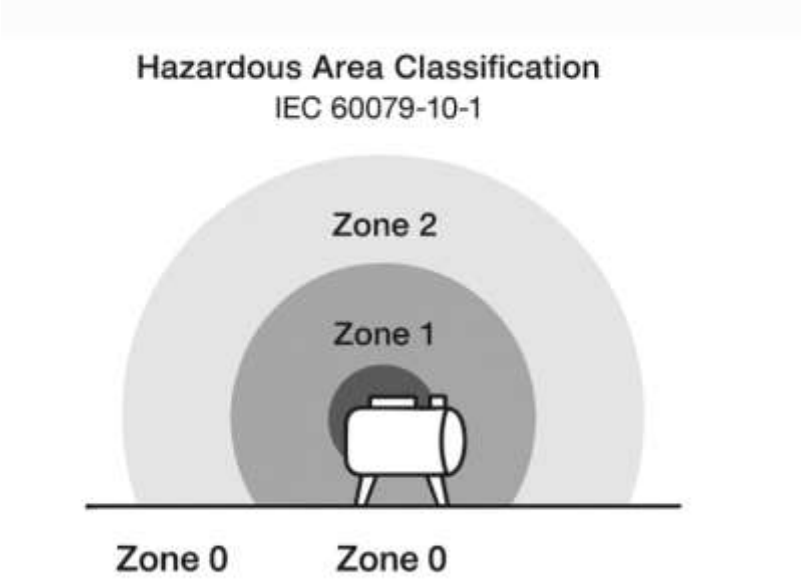
Zone 1, normal çalışma koşullarında patlayıcı gaz atmosferinin zaman zaman oluşabileceği alanlardır. Bu ortamlarda gaz sızıntısı kısa süreli ancak tekrarlayan niteliktedir. Havalandırma Zone 0'a göre daha etkilidir, ancak gaz birikmesi hâlâ mümkündür. EPL seviyesi Gb olan ekipmanlar kullanılır.

Zone 2

Zone 2, normal çalışma sırasında patlayıcı gaz atmosferinin oluşmasının beklenmediği, oluşsa bile kısa süreli olacağı alanlardır. İyi havalandırma sayesinde gaz birikimi genellikle engellenir.

Zone 2NE – Havalandırma ile Güvenli Alan

Zone 2NE Yeterli havalandırma debisi sayesinde ortamdaki gaz konsantrasyonu sürekli olarak LEL seviyesinin çok altında tutulur. Bu durumda bölge pratikte tehlikesiz kabul edilir.



Patlayıcı gaz atmosferi bulunan endüstriyel tesislerde, bir hacmin tehlike sınıfının belirlenmesinde gazın türü, kaçak karakteri, proses koşulları ve ekipman özellikleri kadar, o ortamda sağlanan havalandırma performansı da belirleyici bir mühendislik parametresidir. IEC 60079-10-1 standardı, gazların tehlike yaratma potansiyelinin yalnızca kaçağın varlığıyla değil, bu kaçağın ortamda hangi konsantrasyona kadar yükselebildiği ile ilişkili olduğunu vurgular. Dolayısıyla iyi tasarlanmış bir havalandırma sistemi, gazın birikmesini engelleyerek patlayıcı atmosfer oluşmadan önce gazı ortamdan uzaklaştırabilir ve böylece tehlikeli alanın derecesini düşürür. Böyle bir yaklaşımda HVAC sistemi, konfor amacıyla kullanılan pasif bir mekanik düzenek değil; atlamayı önleyici aktif bir güvenlik fonksiyonu haline gelir.

Grade of release	Ventilation						
	Degree						
	High			Medium			Low
	Availability						
	Good	Fair	Poor	Good	Fair	Poor	Good, fair or poor
Continuous	(Zone 0 NE) Non-hazardous[a]	(Zone 0 NE) Zone 2[a]	(Zone 0 NE) Zone 1[a]	Zone 0	Zone 0 + Zone 2	Zone 0 + Zone 1	Zone 0
Primary	(Zone 1 NE) Non-hazardous[a]	(Zone 1 NE) Zone 2[a]	(Zone 1 NE) Zone 2[a]	Zone 1	Zone 1 + Zone 2	Zone 1 + Zone 2	Zone 1 or Zone 0[c]
Secondary[b]	(Zone 2 NE) Non-hazardous[a]	(Zone 2 NE) Non-hazardous[a]	Zone 2	Zone 2	Zone 2	Zone 2	Zone 1 and even Zone 0[c]

NOTE "+" signifies "surrounded by".

[a] Zone 0 NE, 1 NE or 2 NE indicates a theoretical zone which would be of negligible extent under normal conditions.

[b] The zone 2 area created by a secondary grade of release may exceed that attributable to a primary or continuous grade of release; in this case, the greater distance should be taken.

[c] Will be zone 0 if the ventilation is so weak and the release is such that in practice an explosive gas atmosphere exists virtually continuously (i.e. approaching a "no ventilation" condition).

Patlayıcı atmosferin tanımlanmasında en temel parametre, gazın havadaki konsantrasyonudur. Her yanıcı gazın "tutuşabileceği" bir aralık vardır. Bu aralığın alt sınırı LEL (Lower Explosion Level) olarak adlandırılır ve gazın en düşük hangi konsantrasyonda yanma veya patlama oluşturabileceğini gösterir. Örneğin hidrojen (H_2) için LEL yaklaşık %4 hacimsel oranındadır. Gazın konsantrasyonu bu değerin altındaysa, tutuşma olasılığı pratik olarak yoktur. Aralığın üst sınırı ise UEL (Upper Explosion Level) olarak tanımlanır ve gazın aşırı yüksek konsantrasyonda oksijenle karışmadığı için tutuşamayacağı noktayı ifade eder. Dolayısıyla bir gazın patlayabilmesi için havadaki oranının LEL ile UEL arasında bir yerde bulunması gerekir. Havalandırma sistemlerinin güvenlik açısından önemi tam da bu noktada ortaya çıkar: Gaz kaçağı oluşsa bile ortamın sürekli tazelenmesiyle gaz oranı LEL'in çok altında tutulur ve böylece patlayıcı atmosfer hiç oluşmaz.

Seyreltme kavramı, standardın merkezindeki mühendislik düşüncesidir. Bir hacimde gaz konsantrasyonunu belirleyen temel fiziksel ilişki, gazın kaçak debisi ile havalandırma debisi arasındaki orandır. Kaçak debisi Q_l ile gösterilir ve prosesin doğası gereği kontrol edilmesi zor bir parametredir; flanş bağlantıları, valfler, motor gövdeleri veya proses ekipmanları zaman zaman kaçak yapabilir. Buna karşılık havalandırma debisi Q_v tamamen tasarımcının kontrolündedir. Q_v büyüdükçe, ortamda oluşan gazın birikme süresi azalır, gaz hızlıca uzaklaştırılır ve konsantrasyon LEL seviyesinin çok altına çekilir. Basit bir ifade ile:

Gaz Konsantrasyonu ≈ Kaçak Debisi / Havalandırma Debisi

Bu ilişki, seyreltmenin neden tehlikeli alan sınıfını düşürmede etkili olduğunu matematiksel bir açık seçiklikle gösterir. Havalandırma kapasitesi yeterince yüksekse, herhangi bir anda oluşabilecek gaz kaçağı ortamdan uzaklaştırılacağı için gazın LEL seviyesine ulaşması fiziksel olarak mümkün değildir.

IEC 60079-10-1, havalandırmayı yalnızca bir taze hava miktarı olarak değerlendirmez; üç boyutlu bir performans parametresi olarak ele alır. Bunlar: seyreltme kapasitesi, havalandırmanın sürekliliği ve havalandırma etkinliğidir. Seyreltme kapasitesi gazın tehlikeli seviyelere ulaşmadan dağıtılabilmesi için gereken hava miktarını ifade eder. Süreklilik ise havalandırmanın kesintisiz çalışması anlamına gelir; aralıklı çalışan bir fan, riskin sürekli olduğu proseslerde yeterli kabul edilmez. Etkinlik ise havanın akış düzeninin hacimde ölü noktalar bırakmaması ve gazın birikme eğilimi gösterdiği bölgelerin (örneğin tavan köşeleri veya ekipman arka yüzleri) süpürülmesi anlamına gelir. Bu üç kriter iyi seviyedeyse, havalandırma “good ventilation” olarak sınıflandırılır ve bu durumda bölgenin tehlike sınıfı önemli ölçüde düşürülebilir.

Havalandırmanın tehlikeli alanı azaltması pratikte özellikle Zone 2 bölgeleri üzerinde etkili olur. Zone 2, normalde patlayıcı atmosfer oluşması beklenmeyen ancak bir arıza halinde kısa süreli gaz birikmesinin mümkün olduğu alanlardır. Eğer bu alanlarda havalandırma kapasitesi artırılır ve gaz kaçağı oluştuğunda konsantrasyon LEL'e ulaşamayacak hızda seyreltilebiliyorsa, bölge artık fiilen patlayıcı atmosfer barındırmıyor demektir. Standardın resmi terminolojisinde bu durum “non-hazardous due to ventilation” şeklinde tanımlanır; endüstride ise sıkça Zone 2NE olarak adlandırılır. Bu, bölgenin hukuken hâlâ gözetim altında olduğu ancak fiilen patlayıcı atmosfer oluşturma ihtimalinin ihmal edilebilir seviyeye indiği anlamına gelir.

Bu yaklaşımın mühendislik karşılığı, havalandırma debisinin artırılmasıdır. Örneğin bir Gas Engine Generator odasında 50 ACH (Air Changes per Hour), yani saatte 50 kez komple taze hava ile yenilenen bir hacim, gazın birikmesini fiziksel olarak imkânsız kılar. Böyle bir hava değişim oranında gaz molekülleri odada kalıcı olamaz; daha henüz yayılmaya başlamadan temiz hava akımıyla ortamdan uzaklaştırılır. Bu nedenle birçok projede 50 ACH, Zone 2’nin Zone 2NE’ye indirilmesi için kullanılan pratik bir mühendislik eşiği hâline gelmiştir. Bu seyreltme seviyesinde, gazın LEL seviyesine ulaşması için gereken süre, havalandırmanın gazı uzaklaştırma süresinden çok daha uzundur; bu da gazın tehlikeli konsantrasyonlara ulaşmasını teknik olarak imkânsızlaştırır.

Benzer bir durum batarya odaları için geçerlidir. Batarya şarjı sırasında oluşan hidrojen gazı, düşük yoğunluğu nedeniyle tavanda birikme eğilimi gösterir ve LEL'i çok düşük olan bir gazdır. Bu nedenle hidrojenin ortamda birikmesini engellemek için tavan bölgesinde hassas H_2 dedektörleri kullanılır ve bu dedektörler genellikle LEL'in %25'i olan yaklaşık %1 hidrojen seviyesinde alarm verir. Bu eşik bilimsel olarak anlamlıdır çünkü LEL'in altında kalan bu seviyede yakalama yapılması, patlayıcı atmosfer oluşmadan önce önlem alınmasını sağlar. Bu mekanizmanın etkin olabilmesi için odada sürekli çalışan bir taze hava debisi ve acil durumda devreye giren bir yedek fan bulunur. Böylece hidrojen konsantrasyonu hiçbir zaman patlayıcı aralığa taşımaz; UEL de dikkate alındığında hidrojen ancak %4–75 aralığında yanabilir ve bu aralığa girmeden seyreltildiği sürece herhangi bir tutuşma ihtimali doğmaz.

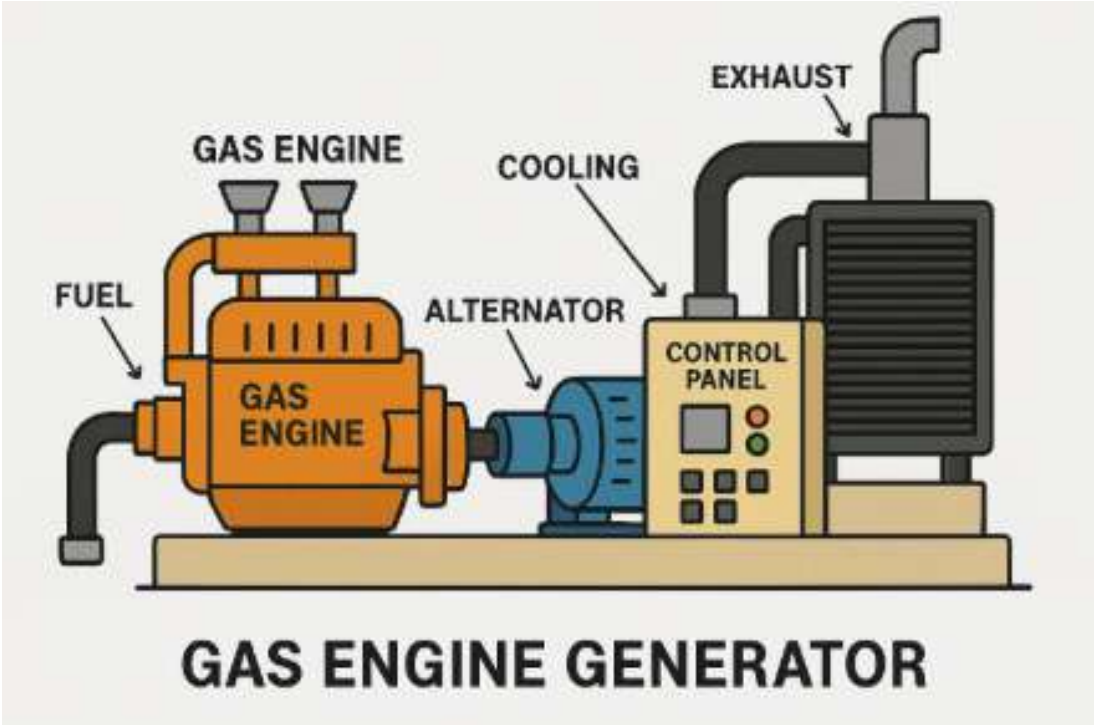
Sonuç olarak, IEC 60079-10-1'in yaklaşımı, tehlikeli alan sınıflandırmasında havalandırmayı yalnızca destekleyici bir unsur olarak değil, tehlike seviyesini aktif biçimde düşüren bir mühendislik aracı olarak konumlandırır. Kaçak debisinin genellikle kontrol edilemediği proseslerde, havalandırma debisi tasarımcının elindeki en güçlü parametredir. Havalandırmanın artırılmasıyla gaz konsantrasyonunun LEL'in altında tutulması, patlayıcı atmosferin oluşmasını engeller ve bölgeyi Zone 2'den Zone 2NE seviyesine, yani pratik olarak güvenli sayılabilecek bir sınıfa indirger. Bu nedenle ex-proof tasarım felsefesi içinde HVAC sistemleri, güvenli çalışma ortamının sürdürülebilirliği açısından kritik birincil bariyerlerden biri olarak değerlendirilmelidir.

ENDÜSTRİ TESİSLERİNDE ÖRNEK UYGULAMALAR

Gas Engine Genarator ekipmanı hakkında genel bilgiler

Gas Engine Generator doğal gaz veya biyogaz gibi gaz yakıtları kullanarak elektrik üreten bir ekipmandır. Temel olarak şu şekilde çalışır:

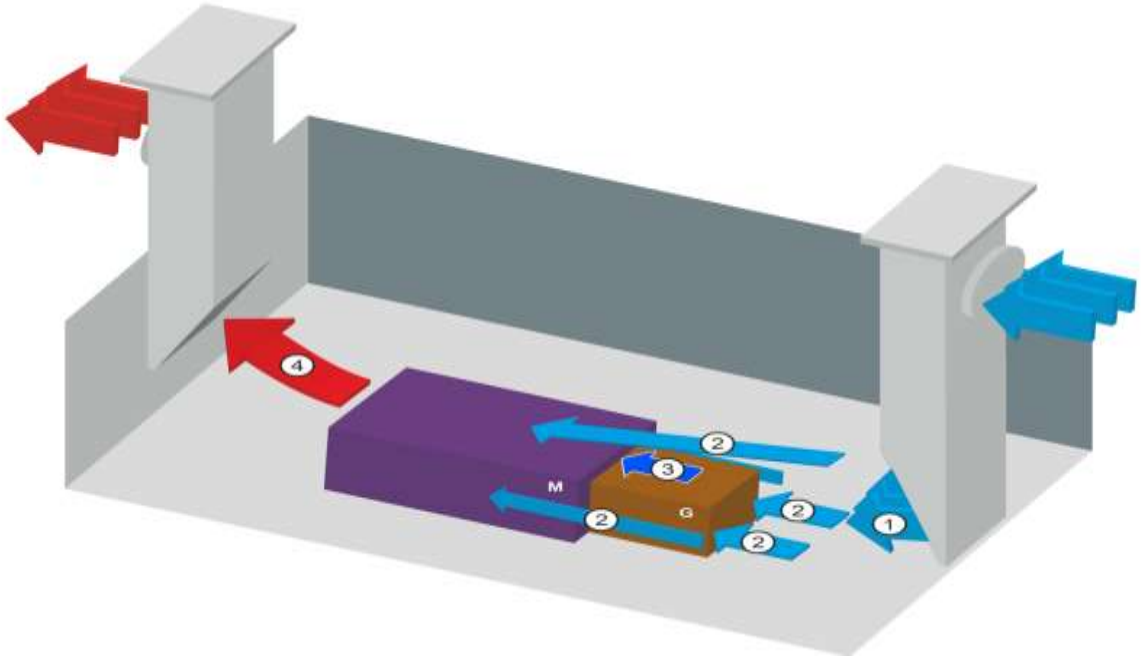
1. Gaz Motoru: İçten yanmalı bir motor, gaz yakıtını hava ile karıştırıp yanma işlemi gerçekleştirir. Bu yanma, mekanik enerji üretir.
2. Alternatör: Motorun ürettiği mekanik enerji, alternatör aracılığıyla elektrik enerjisine dönüştürülür.
3. Kontrol Sistemi: Motorun devri, yakıt beslemesi ve elektrik çıkışı kontrol edilir. Ayrıca güvenlik ve verimlilik için izleme yapılır.
4. Soğutma ve Egzoz Sistemleri: Motorun ısısını düşürmek ve yanma gazlarını tahliye etmek için kullanılır



.

Gas Engine Generator firması teknik şartnamelerini incelediğimizde gerekli minimum hava değişimi tüm çalışma süresi boyunca (motor çalıştırma ve durdurma dahil) bir NE bölgesinin (IEC 60079-10-1:2015 uyarınca) yeterli önlemlerle sağlamaktan sorumlu olduğu belirtilmektedir.Minimum hava değişim oranının ise minimum saatte 50 hava değişimi olması gerektiği belirtilmektedir.

$$\text{Minimum air exchange rate (Cmin.)} = \frac{\text{(Intake air – combustion air)}}{\text{Free volume in the room}} = 50\ h^{-1}$$



Gaz Engine Jeneratör Binası İçin Havalandırma, Isı Yükü ve ACH Hesabı

Bu bölümde, 6 adet gaz motorlu jeneratörün (GEG) yerleştirildiği hayali bir Bina için ısı yükü, havalandırma gereksinimleri, taze hava ve egzoz debileri ile yaz–kış iç ortam sıcaklıklarının kontrolü değerlendirilmiştir. Jeneratör üreticisi tarafından talep edilen minimum 50 ACH şartı ve proje dış hava koşulları olan –11 °C (kış) ve +37 °C (yaz) değerleri esas alınmıştır. GEG odasında hedeflenen iç ortam koşulları minimum 10 °C ve maksimum 47 °C'dir.

Oda Yapısı ve Hacim Hesabı

6 adet GEG'in yerleşimi yapılacak bina ölçüleri aşağıdaki gibidir:

Uzunluk: 42 m

Genişlik: 14 m

Yükseklik: 6 m

Toplam hacim:

$V = 42 \times 14 \times 6 = 3528\ \text{m}^3$

İç Isı Yükü (Heat Dissipation)

Her bir gaz engine jeneratörün kabin dışına yayılan ısı yükü (gövde radyasyonu + mekanik kayıplar) tipik olarak ~200 kW'tır. Egzoz hattı, jacket water ve intercooler devreleri odanın ısı yüküne dahil edilmemiştir.

Toplam iç ısı yükü:

$Q_{\text{internal}} = 6 \times 200\ \text{kW} = 1{,}2\ \text{MW}$

Bu değer, havalandırma tasarımı için kullanılan net iç ısı yayılımıdır.

Minimum 50 ACH Gereksinimine Göre Debi Hesapları

Gas Engine generatör Üreticisi tarafından belirlenen gerekli seyreltmeyi sağlayabilmek adına yapılması gereken minimum havalandırma gereksinimi:

$ACH_{\text{min}} = 50\ \text{h}^{-1}$

Gerekli toplam taze hava debisi:

$Q = ACH \times V = 50 \times 3528 = 176\,400\ \text{m}^3/\text{h}$

6 taze hava + 6 egzoz fanı konfigürasyonunda:

$Q_{\text{fan}} = \frac{176\,400}{6} \approx 29\,400\ \text{m}^3/\text{h}$

Yaz Şartlarında (37 °C) Sıcaklık Kontrolü

Toplam debi 176.400 m³/h iken (50 ACH), iç ısı yükünün oluşturduğu sıcaklık artışı:

$\dot{m}$=1,2 kg/m3×49 m3/s=58,8 kg/s

$\Delta T = \frac{Q_{\text{internal}}}{\dot{m} c_p} \approx \frac{1{,}2 \times 10^6}{58{,}8 \times 1005} \approx 20°C$

Yaz dış hava sıcaklığı:

$T_{\text{oda}} = 37 + 20 = 57\ ^\circ C$

Bu değer, hedeflenen 47 °C maksimum sıcaklığı sağlamaz.

Yaz İçin Gerekli Havalandırma Debisi (47 °C Limitini Sağlamak İçin)

Hedef sıcaklık artışı:

$\Delta T_{\text{izin}} = 47 - 37 = 10\ ^\circ C$

Gerekli taze hava debisi:

$Q_{\text{yaz}} \approx 358\,000\ \text{m}^3/\text{h}$

Buna karşılık gelen havalandırma:

$ACH_{\text{yaz}} = \frac{388\,000}{3528} \approx 102\ \text{h}^{-1}$

6 fan için yaz modunda fan başı debi:

$Q_{\text{fan, yaz}} \approx 61\,500\ \text{m}^3/\text{h}$

Yazın maksimum sıcaklık limitini sağlayabilmek için fanların yaklaşık 100–105 ACH kapasitesinde seçilmesi önerilir.VFD ile kışın düşük devirlere geçilerek 50 ACH'e inilmesi mümkündür.

Kış Şartlarında (–11 °C) Sıcaklık ve Isıtma Gereksinimi

50 ACH ile dış hava sıcaklığı –11 °C iken, 1,2 MW iç ısı nedeniyle oda sıcaklığı yaklaşık:

$T_{\text{oda}} \approx -11 + 20{,}3 = 9{,}3\ ^\circ C$

Bu değer hedef olan 10 °C'nin biraz altındadır.

Gerekli ek ısıtma:

$Q_{\text{toplam}} = \dot{m} c_p \Delta T = 1{,}24$ MW

$Q_{\text{heater}} = 1{,}24 - 1{,}20 = 40$ kW

Yani 50 ACH'de, motorlar tam yükteyken odanın minimum sıcaklığını sağlamak için yaklaşık 40 kW ek ısıtma yeterlidir.

Motorlar devre dışı olduğunda daha yüksek ısıtma ihtiyacı oluşacaktır; gerçek projede fan hızının büyük ölçüde azaltılması ve bağımsız ısıtıcıların devreye alınması tavsiye edilir.

Sonuç ve Önerilen Fan Konfigürasyonu

Soğutma – Yaz:

Toplam taze hava: ≈ 350.000–370.000 m³/h

ACH: 100–105

Fan başı debi: ≈ 60.000–62.000 m³/h

Minimum havalandırma – Üretici şartı (50 ACH):

Toplam debi: ≈176.000 m³/h

Fan başı: ≈ 29.000–30.000 m³/h

Kış – Minimum 10 °C için:

50 ACH + 1,2 MW iç ısı

Ek ısıtma gereksinimi: ≈ 40 kW

Bu sonuçlar, GEG üreticisinin minimum taze hava şartlarını sağlayacak, aynı zamanda yaz-kış sıcaklık limitlerini karşılayabilecek bir havalandırma sisteminin seçimi için temel mühendislik altyapısını oluşturur.

DEĞERLENDİRME VE SONUÇ

Gas Engine Generator binası için doğru mühendislik tasarımı yapabilmek adına Hem Emniyet koşulları hem de Isıtma soğutma gereksinimleri göz önünde bulundurulmalıdır. Ekipman için firmanın belirlediği minimum ve maksimum sıcaklıkların yanında bina içinde gaz salınımının LEL değerinden aşağıda tutmak için minimm 50 ACH havalandırma talep edilmektedir. Yaz mevsiminde Fan debimizi maksimum sıcaklığa göre seçmemiz , Kışın ise emniyet koşullaır nedeniyle 50 ACH havalandırma yapmamız ve iç ortamı bu havalandırma debisine göre minimum 10 derece sıcaklıkta tutmaya yetecek ısıtıcı kullanmamız gerekecektir. Böylece hem

Gas engine generator firmasının taleplerini yerine getirmiş hem de ex-proof iç ortam koşullarından kurtulmuş oluyoruz.

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AKILLI KODLAMA EĞİTİM PLATFORMLARINDA HATA TAHMİNİ İÇİN ALGORİTMA TASARIMI

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ÖZET

Dijital öğrenme ortamlarının yaygınlaşmasıyla birlikte kodlama eğitimi, öğrencilerin etkileşim verilerine dayalı olarak şekillenen veri temelli ve uyarlanabilir öğrenme sistemleriyle desteklenmeye başlamıştır. Programlama öğrenme sürecinde yapılan hatalar öğrenmenin doğal bir parçası olmakla birlikte, bu hataların oluşmadan önce tahmin edilmesi, öğrencinin öğrenme sürecini daha etkili ve kesintisiz biçimde sürdürebilmesi açısından önem taşımaktadır. Bu araştırmanın amacı, akıllı kodlama eğitim platformlarında öğrencilerin programlama görevleri sırasında hata yapma olasılığını tahmin edebilen makine öğrenimi tabanlı bir algoritma tasarlamak ve farklı sınıflandırma yöntemlerinin tahmin performanslarını karşılaştırmaktır.

Araştırma, özel bir üniversitede Algoritma ve Programlama dersini alan 80 öğrencinin web tabanlı bir kodlama platformundaki etkileşimlerinden elde edilen log verileri üzerinde yürütülmüştür. Veri seti; deneme sayısı, hata türleri, görev süresi, görev tamamlama durumu ve sistem geri bildirimlerini içermektedir. Nicel araştırma yaklaşımı benimsenen çalışmada, ilişkisel tarama modeli kullanılmış; veri analizi sürecinde betimsel istatistiklerin yanı sıra lojistik regresyon, karar ağacı ve rastgele orman (Random Forest) algoritmalarından yararlanılmıştır. Modeller, doğruluk (accuracy), kesinlik (precision), duyarlılık (recall), F1-skoru ve ROC-AUC ölçütleri üzerinden değerlendirilmiştir.

Elde edilen bulgular, rastgele orman algoritmasının diğer modellere kıyasla daha yüksek doğruluk ve ayırt edicilik sunduğunu göstermiştir. Deneme sayısının hata yapma olasılığını yordamada en güçlü değişken olduğu, öğrencilerin önceki görevlerde yaptıkları hata türlerinin sonraki görevlerdeki hata eğilimlerini anlamlı biçimde etkilediği belirlenmiştir. Ayrıca görev süresi uzadıkça hata yapma olasılığının arttığı tespit edilmiştir. Araştırma sonuçları, hata tahminine dayalı algoritmaların uyarlanabilir geri bildirim mekanizmalarının geliştirilmesine katkı sağlayarak kodlama eğitiminde kişiselleştirilmiş öğrenme deneyimlerini destekleyebileceğini ortaya koymaktadır.

Anahtar Kelimeler: Kodlama eğitimi, makine öğrenimi, hata tahmini, öğrenme analitiği, uyarlanabilir öğrenme ortamları

DESIGNING AN ERROR PREDICTION ALGORITHM FOR INTELLIGENT CODING EDUCATION PLATFORMS

ABSTRACT

With the widespread use of digital learning environments, coding education has evolved into a data-driven and adaptive structure supported by learners' interaction data. Although errors are an inherent part of the programming learning process, predicting potential errors before they occur is critical for supporting students' learning continuity and effectiveness. The aim of this study is to design a machine learning–based algorithm capable of predicting students' likelihood of making errors in intelligent coding education platforms and to compare the predictive performance of different classification methods.

The study was conducted using log data obtained from the interactions of 80 undergraduate students enrolled in an Algorithm and Programming course at a private university. The dataset included variables such as the number of attempts, types of errors, task completion time, task success status, and system feedback. Adopting a quantitative research approach, a correlational survey design was employed. Data analysis involved both descriptive statistics and machine learning techniques, including logistic regression, decision tree, and random forest algorithms. Model performance was evaluated using accuracy, precision, recall, F1-score, and ROC-AUC metrics.

The findings revealed that the random forest algorithm outperformed the other models in terms of prediction accuracy and discriminative power. The number of attempts was identified as the strongest predictor of error occurrence, while error types from previous tasks significantly influenced students' error tendencies in subsequent tasks. Additionally, longer task completion times were associated with a higher probability of making errors. The results indicate that error prediction algorithms can play a crucial role in developing adaptive feedback mechanisms and supporting personalized learning experiences in coding education environments.

Keywords: Coding education, machine learning, error prediction, learning analytics, adaptive learning environments

1. GİRİŞ

Son yıllarda dijital öğrenme ortamlarının yaygınlaşmasıyla birlikte kodlama eğitimi, yalnızca sözdizimsel bilgi aktarımına dayalı geleneksel yaklaşımlardan uzaklaşarak öğrenen etkileşimlerini merkeze alan veri temelli sistemlere doğru evrilmiştir. Özellikle programlama öğrenme süreci, yoğun bilişsel yük, soyut düşünme gereksinimi ve hata yapma sıklığı nedeniyle öğrenciler açısından zorlayıcı bir yapıya sahiptir (Robins, Rountree & Rountree, 2003). Bu

bağlamda öğrencilerin kodlama sürecinde karşılaştıkları hataların erken tespit edilmesi ve anlamlandırılması, öğrenme sürecinin sürdürülebilirliği açısından kritik önem taşımaktadır.

Kodlama eğitiminde yapılan hatalar yalnızca başarısızlık göstergesi değil, aynı zamanda öğrenme sürecinin doğal ve gerekli bir parçası olarak değerlendirilmektedir (Spohrer & Soloway, 1986). Ancak hataların zamanında fark edilmemesi, öğrencilerin motivasyon kaybı yaşamasına, bilişsel yüklerinin artmasına ve dersten kopmalarına yol açabilmektedir. Bu nedenle güncel araştırmalar, hata oluştuktan sonra geri bildirim sunan sistemlerden ziyade, hata oluşmadan önce tahmin ve önleme odaklı akıllı öğrenme ortamlarına yönelmektedir (Baker & Inventado, 2014).

Bu noktada öğrenme analitikleri (learning analytics) ve eğitsel veri madenciliği (educational data mining) yaklaşımları ön plana çıkmaktadır. Öğrencilerin platform üzerindeki etkileşimlerinden elde edilen log verileri; deneme sayısı, süre, hata türleri ve başarı durumları gibi değişkenler üzerinden analiz edilerek öğrenen davranışları modellenebilmektedir (Siemens & Long, 2011). Makine öğrenimi tabanlı modeller ise bu büyük veri kümelerinden anlamlı örüntüler çıkararak öğrencinin gelecekteki performansını tahmin etmeye olanak tanımaktadır.

Bu çalışma, akıllı kodlama eğitim platformlarında öğrencilerin hata yapma olasılığını önceden tahmin edebilen bir algoritma tasarlayarak, kişiselleştirilmiş ve uyarlanabilir öğrenme ortamlarının geliştirilmesine katkı sunmayı amaçlamaktadır. Böylece öğrenme süreci reaktif değil, proaktif bir yaklaşımla desteklenmektedir.

Bu araştırmanın temel amacı, akıllı kodlama eğitim platformlarında öğrencilerin programlama görevleri sırasında hata yapma olasılığını tahmin edebilen makine öğrenimi tabanlı bir algoritma geliştirmektir. Bu genel amaç doğrultusunda aşağıdaki alt amaçlar belirlenmiştir:

- Öğrencilerin platform etkileşimlerinden elde edilen log verilerini analiz ederek hata örüntülerini ortaya koymak
- Farklı makine öğrenimi sınıflandırma algoritmalarının hata tahmin performanslarını karşılaştırmak
- Hata yapma olasılığını yordayan temel değişkenleri belirlemek
- Geliştirilen modelin uyarlanabilir öğrenme ortamlarında kullanılabilirliğini değerlendirmek

Bu yönüyle çalışma, kodlama eğitiminde öğrenme analitiği temelli erken uyarı sistemlerinin geliştirilmesine yönelik uygulamalı bir çerçeve sunmaktadır

Bu çalışmanın literatüre sağladığı özgün katkılar aşağıda özetlenmiştir:

- Öngörücü hata analizi yaklaşımı

Literatürde birçok çalışma hata analizi üzerine yoğunlaşmakla birlikte, hata oluştuktan sonra yapılan değerlendirmeler ağırlıktadır. Bu araştırma, hatayı gerçekleşmeden önce tahmin etmeye odaklanarak proaktif bir öğrenme destek modeli önermektedir.

- Gerçek öğrenme ortamından elde edilen log verileri

Simülasyon veya yapay veri setleri yerine, öğrencilerin gerçek platform etkileşimlerinden elde edilen verilerin kullanılması, çalışmanın ekolojik geçerliğini artırmaktadır.

- Algoritmalar arası performans karşılaştırması

Lojistik regresyon, karar ağacı ve rastgele orman algoritmalarının sistematik biçimde karşılaştırılması, eğitim bağlamında hangi modelin daha etkili sonuç verdiğine ilişkin ampirik kanıt sunmaktadır.

- Uyarlanabilir öğrenme sistemleri için altyapı sunması

Geliştirilen algoritma; ipucu sunma, görev yönlendirme ve kişiselleştirilmiş öğrenme yolları oluşturma gibi sistem bileşenleri için temel teşkil etmektedir

2. YÖNTEM

2.1. Araştırma Modeli

Araştırmada nicel araştırma yöntemlerinden ilişkisel tarama modeli kullanılmıştır. Öğrencilerin platform etkileşimleri ile hata yapma durumları arasındaki ilişkiler incelenmiş; elde edilen veriler üzerinden öngörücü modeller geliştirilmiştir.

2.2. Çalışma Grubu

Araştırmanın çalışma grubunu, bir üniversitenin meslek yüksekokulu ve lisans düzeyinde öğrenim gören ve “Programlama Temelleri” dersini alan toplam 80 öğrenci oluşturmaktadır. Katılımcılar gönüllülük esasına göre çalışmaya dahil edilmiştir.

2.3. Veri Toplama Süreci

Araştırma sürecinde öğrenciler, akıllı kodlama eğitim platformu üzerinden altı farklı programlama görevini tamamlamıştır. Platform, öğrencilerin tüm etkileşimlerini otomatik olarak kayıt altına almıştır. Toplanan veriler şunlardır:

- Yazılan kod satırları
- Sözdizimsel ve mantıksal hata türleri
- Deneme sayıları
- Her deneme için harcanan süre
- Görev başarı durumu

- Sistem tarafından sunulan geri bildirimler

Bu veriler analiz öncesinde anonimleştirilmiş ve dışa aktarılmıştır

2.4. Verilerin Analizi

Veri analizi iki aşamada gerçekleştirilmiştir:

Aşama 1: Betimsel ve İlişkisel Analiz (SPSS)

- Ortalama deneme sayıları
- Hata türlerinin dağılımı
- Görev bazlı başarı oranları
- Değişkenler arası korelasyon analizleri

Aşama 2: Makine Öğrenimi Analizi (Python / R)

Hata tahmini amacıyla aşağıdaki sınıflandırma algoritmaları kullanılmıştır:

- Lojistik Regresyon
- Karar Ağacı (CART)
- Rastgele Orman (Random Forest)

Modeller; **Accuracy, Precision, Recall, F1-Skoru ve ROC-AUC** ölçütleri üzerinden karşılaştırılmıştır.

3. BULGULAR

Bu bölümde, akıllı kodlama eğitim platformundan elde edilen log verileri doğrultusunda gerçekleştirilen betimsel analizler ve makine öğrenimi tabanlı hata tahmin modellerine ilişkin bulgular sunulmaktadır. Bulgular, hem öğrencilerin hata yapma eğilimlerini ortaya koymakta hem de geliştirilen algoritmanın tahmin başarısını değerlendirmeye olanak sağlamaktadır.

3.1. Betimsel Bulgular

Betimsel analiz sonuçlarına göre öğrencilerin görevler boyunca ortalama deneme sayısının arttıkça hata yapma oranının da yükseldiği belirlenmiştir. Özellikle ilk üç görevde deneme sayılarının daha yüksek olduğu, ilerleyen görevlerde ise öğrencilerin deneyim kazandıkça deneme sayılarının azaldığı gözlemlenmiştir. Bu durum, öğrencilerin platforma ve problem türlerine alışma süreciyle ilişkilendirilmektedir.

Hata türleri incelendiğinde, öğrencilerin en sık karşılaştığı hataların sözdizimsel (syntax) hatalar olduğu, bunu sırasıyla mantıksal (logic) hatalar ve çalışma zamanı (runtime) hatalarının izlediği belirlenmiştir. Sözdizimsel hataların özellikle programlama öğreniminin erken aşamalarında yoğunlaştığı görülmüştür.

Süre değişkeni açısından bakıldığında, görev başına harcanan sürenin artmasıyla hata yapma olasılığı arasında pozitif yönlü anlamlı bir ilişki olduğu tespit edilmiştir. Uzun süreli kod yazma süreçlerinin, öğrencinin problem çözme sürecinde zorlandığını ve hata yapma riskinin yükseldiğini gösterdiği söylenebilir.

Korelasyon analizleri sonucunda;

- Deneme sayısı ile hata yapma durumu,
- Görev süresi ile hata yapma durumu arasında **orta düzeyde ve anlamlı ilişkiler** olduğu belirlenmiştir ($p < .05$).

3. 2 Makine Öğrenimi Tabanlı Hata Tahmin Bulguları

Hata tahmini amacıyla geliştirilen modellerin performans sonuçları karşılaştırıldığında, **rastgele orman (Random Forest) algoritmasının** diğer modellere kıyasla daha yüksek doğruluk ve ayırt edicilik sunduğu görülmüştür.

Lojistik regresyon modeli, hata yapma olasılığını belirli değişkenler üzerinden anlamlı şekilde yordamakla birlikte, karmaşık etkileşimleri modellemede sınırlı kalmıştır. Karar ağacı modeli ise yorumlanabilirlik açısından avantaj sağlasa da, bazı görevlerde aşırı öğrenme (overfitting) eğilimi göstermiştir.

Rastgele orman algoritması;

- **Accuracy**,
- **Precision**,
- **Recall**,
- **F1-Skoru**

ve özellikle **ROC-AUC** değerleri açısından en yüksek performansı sergilemiştir. Bu durum, birden fazla karar ağacının birleşik yapısının, öğrencilerin hata davranışlarını daha başarılı biçimde yakalayabildiğini göstermektedir.

Özellik önem analizleri incelendiğinde;

- Deneme sayısı,
- Önceki görevlerde yapılan hata türleri,
- Görev süresi

değişkenlerinin hata tahmininde en güçlü yordayıcılar olduğu belirlenmiştir.

Bu bulgular, öğrencinin geçmiş öğrenme davranışlarının ve süreç verilerinin, gelecekteki hata eğilimlerini tahmin etmede kritik rol oynadığını ortaya koymaktadır.

TARTIŞMA VE SONUÇ

Bu araştırmada elde edilen bulgular, kodlama eğitiminde öğrenme analitiği ve makine öğrenimi tabanlı hata tahmin yaklaşımlarının etkinliğini destekleyen literatürle büyük ölçüde örtüşmektedir.

Araştırma sonuçlarına göre deneme sayısı ve görev süresinin hata yapma olasılığını anlamlı biçimde yordaması, programlama öğrenme sürecinin doğasıyla ilişkilidir. Robins, Rountree ve Rountree (2003), programlama öğreniminin yoğun bilişsel işlem gerektirdiğini ve öğrencilerin deneme–yanılma yoluyla öğrenme sürecini sürdürdüğünü vurgulamaktadır. Bu çalışmada elde edilen bulgular da, artan deneme sayılarının bilişsel zorlanma ve hata eğilimiyle ilişkili olduğunu göstermektedir.

Öğrencilerin özellikle erken görevlerde daha fazla sözdizimsel hata yapmaları, Spohrer ve Soloway'in (1986) programlama hatalarını "öğrenme sürecinin doğal çıktıları" olarak tanımlayan görüşleriyle örtüşmektedir. Sözdizimsel hataların zamanla azalması, öğrencilerin dil yapısına aşinalık kazandığını ve öğrenmenin kademeli olarak gerçekleştiğini ortaya koymaktadır.

Makine öğrenimi modelleri açısından elde edilen bulgular incelendiğinde, rastgele orman algoritmasının en yüksek tahmin performansını göstermesi, eğitim verilerinin çoğunlukla karmaşık ve doğrusal olmayan yapılara sahip olmasıyla açıklanabilir. Baker ve Inventado (2014), eğitsel veri madenciliği çalışmalarında ensemble tabanlı yöntemlerin öğrenci davranışlarını daha doğru tahmin ettiğini belirtmektedir. Bu çalışmada rastgele orman algoritmasının öne çıkması, söz konusu bulgularla birebir uyumludur.

Ayrıca, geçmiş hata türlerinin gelecekteki hata eğilimlerini yordaması, öğrenme analitiği literatüründe vurgulanan öğrenen izleme (learner tracing) yaklaşımlarıyla paralellik göstermektedir (Siemens & Long, 2011). Öğrencinin önceki etkileşimlerinin, sonraki performansını anlamlandırmada güçlü bir gösterge olduğu bu çalışma kapsamında da doğrulanmıştır.

Bu sonuçlar, hata tahmin algoritmalarının yalnızca teknik bir başarı değil, aynı zamanda pedagojik açıdan anlamlı çıktılar sunduğunu göstermektedir. Erken uyarı sistemleri sayesinde öğrenci henüz hata yapmadan desteklenebilir; bu durum öğrenme sürecinin kesintisiz ve motive edici biçimde sürdürülmesine katkı sağlayabilir.

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REKLAMLARDA KONTROL VE GÖZETİM METAFORU: APPLE REKLAM KAMPANYASI ÜZERİNDEN PANOPTİKON KAVRAMININ İNCELENMESİ

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ÖZET

Panoptikon, İngiliz filozof Jeremy Bentham tarafından mahkûmların yaşam alanlarının merkezine kontrol edici bir gardiyan kulesi yerleştirilmiş hapishane inşa modelidir. Bu model hayata geçirilmemekle birlikte; cezaevleri, okullar ve diğer kurumlar gibi toplumsal yapılar için minimum müdahale ile maksimum gözetime olanak tanıyarak tarihin en önemli kontrol ve gözetim örneklerinden biri olmuştur. Foucault bu kavrama "Hapishanenin Doğuşu" adlı kitabında yer vermiş ve Panopticon kavramını bir gözetim mekanizması olarak ele almıştır. Michael Foucault'ya göre, iktidarın modern işleyişinin temelinde Panoptikon sistemiyle ilişkilendirilen öz denetim mekanizması bulunur. Foucault, Panoptikon'u nihai bir iktidar aracı olarak tanımlar; bu sistemde gözaltında tutulan her birey, üzerlerinde uygulanan gözetimin sürekliliği sayesinde, iktidarın işlevini kendi davranışlarında içselleştirir ve kendi kendini disipline eder. Kavramın sanata yansıması, özellikle fotoğrafçılık ve video sanatında sıkça görülür. Bu üretimlerde, izleyicilerin gözlemlendiği bir alan yaratılır ve izleyicinin kendisini izlenen bir konumda hissetmesi amaçlanmaktadır. Görsel sanatlarda, gözetleme kameralarının kullanıldığı, izleyicinin hareketlerini takip eden veya yansıtan enstalasyonlar; Dijital sanatlarda ise internet üzerindeki ayak izlerimizi, algoritmaların bizi nasıl profillediğini ve manipüle ettiğini gösteren interaktif eserler Panoptikon'un sanatsal yansımalarına örneklerdir. Bu bağlamda çalışmanın amacı, Panoptikon'un sanata yansıma biçimlerinin bir devamı olarak, Apple markasının 2024 yılı reklam kampanyası örneği üzerinden, kurumsal gözetimin ve teknoloji kullanımının yarattığı öz denetim kültürünün reklamlarda nasıl ele alındığını veya kullanıldığını analiz etmektir. Kuramsal bir kavramın güncel bir medya ürünü üzerindeki etkilerini ve işleyişini çözümlemeyi hedefleyen çalışmada belirlenen reklam örneği, nitel yaklaşımlardan biri olan göstergebilim verilerinden yararlanılarak gösteren ve gösterilen ilişkisi bağlamında incelenmiştir.

Anahtar Kelimeler: Panoptikon, Grafik Tasarım, Reklam, Göstergebilim.

THE METAPHOR OF CONTROL AND SURVEILLANCE IN ADVERTISEMENTS: AN EXAMINATION OF THE PANOPTICON CONCEPT THROUGH APPLE'S ADVERTISING CAMPAIGN

ABSTRACT

The Panopticon is a prison construction model devised by the English philosopher Jeremy Bentham, featuring a central guard tower from which prisoners' living quarters can be monitored. Although this model was never implemented, it has become one of history's most significant examples of control and surveillance, enabling maximum oversight with minimal intervention in social structures such as prisons, schools, and other institutions. Foucault addressed this concept in his book The Birth of the Prison and treated the Panopticon concept as a surveillance mechanism. According to Michael Foucault, the mechanism of self-control associated with the Panopticon system lies at the heart of the modern functioning of power. Foucault defines the Panopticon as the ultimate instrument of power; in this system, each individual under surveillance internalizes the function of power in their own behavior and disciplines themselves through the continuity of the surveillance imposed upon them. The reflection of this concept in art is frequently seen, particularly in photography and video art. In these works, a space is created where viewers are observed, and the aim is for the viewer to feel like they are being watched. In visual arts, installations that use surveillance cameras to track or reflect the movements of viewers; in digital art, interactive works that show our digital footprints on the internet and how algorithms profile and manipulate us are examples of artistic reflections of the Panopticon. In this context, the aim of this study is to analyze how corporate surveillance and the culture of self-censorship created by the use of technology are addressed or utilized in advertisements, using Apple's 2024 advertising campaign as an example, as a continuation of the Panopticon's reflections in art. The advertising example identified in this study, which aims to analyze the effects and functioning of a theoretical concept on a contemporary media product, was examined in the context of the relationship between the signifier and the signified, using data from semiotics, one of the qualitative approaches.

Keywords: Panopticon, Graphic Design, Advertising, Semiotics.

1. GİRİŞ

“Öz/iç denetim” fikri, çoğu zaman “gözün üzerimizde olması” metaforu üzerinden açıklanabilir. Bu metafor, bireylerin gözetim altında doğup ölen varlıklar olarak, sürekli izlendikleri duygusuyla yaşamalarını ifade etmektedir. Yaratıcıya atfedilen, dünyada bizi bir yerlerden gözetleyen bir varlık düşüncesi; çoğu zaman davranışlarımızı, iç sesimizi ve

vicdanımızı kontrol eden bir iç kontrol mekanizmasını oluşturmaktadır. Öte yandan, aile büyüklerinin normları, kültürel değerler ve toplumsal beklentiler benzer şekilde bu mekanizmayı çalıştırmaktadır. Birey 18 yaşını doldurduğunda, ait olduğu toplumun kanunları çerçevesinde hak, yükümlülük ve sorumlulukları belirlenmiş toplumsal bir özne olur; yasalar, kurumlar ve normlar içinde yaşamını sürdüren birey, bu yapıların oluşturduğu denetim ile gündelik davranışlarını yönlendirir. İnsan, sosyal bir varlık olarak bu "gözetlenme" hissini neredeyse her zaman üzerinde hisseder. Belki de insanı kontrol altında tutan en güçlü unsur tam olarak budur. İnsanlık tarihini en başından ele alan Yuval Noah Harari'nin eserlerinde ya da Claude Lévi-Strauss'un ilkel topluluklara ilişkin yazılarında olduğu gibi George Orwell'ın Big Brother metaforunda somutlaşan bu yapı, gözetimin sürekliliğini ve bireyin her an izleniyor olma duygusunu temsil eder. İnsanlık tarihinin başından itibaren varlığını sürdüren bu yapılar, farklı dönemlerde ve toplumsal biçimlerde değişen araçlar ve söylemlerle yeniden üretilmiş olsa da özünde bireyin davranışlarını düzenleme, yönlendirme ve kontrol etme işlevini hep korumuştur.

İç ve dış denetim ilk bakışta birbirinden farklı mekanizmalar olarak görünse de, toplumsal düzenin sürekliliği açısından birbirini tamamlayan ve iç içe geçen yapılar olarak değerlendirilmelidir. Bir açıdan öz denetimimizi sağlayan ilk etken dış denetim yasalarıdır. Bu yasalar kurumlar, cezalar ve açık gözetim biçimleri ile bireylerin davranışlarını sınırlandırırken, iç denetim bu sınırların bireyin zihninde ve vicdanında kimi zaman içselleştirilmiş olarak yer almasını sağlamaktadır. Öyle ki zamanla dış denetim, genellikle bireyin kendi kendini denetlemesine dönüşmekte ve kaçınılmaz olarak iktidar, artık görünür olmaktan çıkarak bireyin iç dünyasında etkisini sürdürmeye devam etmektedir (Foucault, 1992:256-257).

İnsanoğlu toplu yaşama geçerken, bu birlikteliği nasıl sürdürebilecekleri sorusuyla karşı karşıya kalmıştır. Kalabalıklar büyüdükçe, düzeni sağlama ve davranışları kontrol etme ihtiyacı da bir o kadar artmıştır. Bu noktada dış denetim mekanizmaları, bulunduğu dönemin şartlarına göre toplu yaşamın devamlılığı için vazgeçilmez bir araç olarak ortaya çıkmıştır. Tarih boyunca yöneticiler ve dini otoriteler, toplumu bir arada tutan ve yönlendiren "tek bir el" olma arzusunu farklı yöntemlerle işlemiş ve düzenin temel dayanağı haline getirmiştir. Tek kontrol merkezi olma arzusu fikri hiç değişmeden ama form değiştirerek varlığını devam ettirmiştir.

Jeremy Bentham'ın Panopticon modeli, bu süreci en açık ve sistematik biçimde ortaya koyan temel örneklerden biridir. İngiliz filozof ve toplum kuramcısı Bentham'ın mimari olarak tasarladığı ve sonrasında Michael Foucault'nun kuramsal çerçevesiyle genişlettiği bu model

günümüz denetim sisteminin başta görünür, sonrasında görünmez yapısını oluşturmaktadır. Bu fikirden hareketle Panoptikon algısı ve modeli çerçevesinde ele alınan bu çalışma, günümüz dijital dünyasında gözetimle kurulan ilişkiyi Apple'ın 2024 yılında yayımladığı "Flock" adlı reklam filmi üzerinden irdelemektedir. Reklam ve grafik tasarım ürünlerinin, gözetim olgusunu hangi görsel araçlarla görünür kıldığı ve izleyicide nasıl bir algı yarattığı, görsel anlatı temelinde değerlendirilmektedir.

2. ARAŞTIRMA VE BULGULAR

2.1. Panoptikon ve Gözetim

Panoptikon'un kökeni, Jeremy Bentham'ın kardeşi Samuel Bentham'ın Rusya'daki çalışmalarına dayanmaktadır. 1780'lerde Prens Potemkin için çalışan Jeremy'nin kardeşi Samuel Bentham, çok sayıda işçiyi merkezden denetlemeyi sağlayan bir sistem tasarlamıştır, Jeremy Bentham'da, 1786'da kardeşini ziyareti sırasında bu fikirden etkilenerek Panoptikon'u hapishane, okul, hastane gibi kurumlara uyarlanabilecek mimari bir model olarak geliştirmiştir (Watkin, vd., 2016:78). Geliştirdiği bu projeyi şu sözleriyle kamuoyuna ve yetkililere yönelik yazdığı mektuplarında dile getirmiştir;

> *"… insanın gözetim altında tutulmasının amaçlandığı… geniş mekâna sahip olmayan, istisnasız bütün kurumlara uygulanabilir olduğu…, bina, endüstrinin her alanındaki iş kollarındaki ıslah edilemeyenlerin cezalandırılması, delilerin denetim altında tutulması, ahlaksızların ıslah edilmesi, şüphelilerin hapsedilmesi, tembellerin çalıştırılması, acizlerin bakılması, hastaların tedavi edilmesi, gönüllülerin yönlendirilmesi, ya da eğitim alanında yeni neslin eğitilmesinde… uygulanabilir." (Bentham, vd., 2016:12).*

Dairesel bir plana sahip olan yapının merkezinde, etrafındaki hücrelerin tamamını görebilen bir gözetleme kulesi bulunmaktadır. Bu proje, kuledeki denetçinin tüm hücreleri sürekli ve tek yönlü bir şekilde izlemesine olanak tanımaktadır (Marshall, 1999:574). Bu hücrelerde içe bakan bir pencere (kuleye dönük) ve dışa bakan bir pencere bulunmaktadır. Dışarıdan gelen güçlü ışık sayesinde hücredeki mahkûmun silueti kuledeki gözetleyen tarafından iç pencereden net bir şekilde görülebilmektedir. Bu plan, mahkûmun her hareketinin görülebilmesini sağlarken, gözetleyenin kendisinin görünmez kalmasını sağlamaktadır. Bu durum hücre içerisinde bulunanların her an izlendiği hissine kapılmasına yol açarak davranışlarını sürekli kontrol etmeye ve kendi kendilerini disipline etmeye itmektedir (Foucault, 1992:253). Böylece, fiziksel şiddete gerek kalmadan, yalnızca gözetim algısıyla etkili bir denetim gerçekleşmektedir. Bu sistem, minimum fiziksel müdahale ile maksimum psikolojik kontrol imkânı sunarak, tarihin en etkili gözetim mekanizmalarından biri haline gelmiştir. Ne var ki Bentham, projesini hayata

geçirmek için 20 yılı aşkın çaba göstermesine rağmen, yaşamı sırasında mali, teknik ve siyasi engeller nedeniyle tam anlamıyla uygulanabilir bir yapıya dönüşmemiştir (Werret, vd., 2016:88). Fakat 1877'de Rennes Hapishanesi ve 20. yüzyıl başlarında Stateville'deki ABD Federal Islahevi gibi kurumlarda kullanılmıştır (Sennett; 2021: 74).

Bentham'ın projesi, sonrası için ona yakın planlarda yapılsa da Bentham (2016:9)'ın "*gözetim altında tutulması istenen her tür insanın bulunduğu*" mekanlar şeklinde tanımladığı kurumsal yapı, sonrasında modern toplumun iktidar anlayışının temellerini oluşturmuştur. Bu anlayışı en derin ve kapsamlı biçimde "Hapishanenin Doğuşu" adlı eserinde analiz eden Michael Foucault'dur. "Bütünü gözetlemek" anlamına gelen Panoptikon kavramına kuramsal bir yaklaşımla eğilen Foucault, bu modeli modern toplumdaki disiplin mekanizmalarının işleyişini açıklamak üzere eleştirel bir analizle yeniden yorumlamıştır. Foucault'nun bu eleştirisi, bu modeli XIV. Louis döneminde yapılan "Versailles Hayvanat Bahçesi" projesine benzetmesi ile anlaşılmaktadır. Ona göre "Panopticon, bir krallık hayvanat bahçesidir", "hayvanın yerine insan ve kralın yerine de kaçamak bir iktidar makinesi geçmiştir" "görünmez ve her an orada olabilen bir iktidar makinesi" (Foucault, 1992:255). Versailles'ın bahçesindeki kraliyet gösterisi, böylece modern çağın sessiz, ama her yeri kuşatan gözetim toplumuna evrilmiştir. Bu gösteriyi en iyi tanımlayan filozof Guy Debord'dur. Aslında Debord'un genel anlamda gösteri ile ilgili anlatmak istediği bir bireyin tecrit içinde tutulduğu ve her an gözetlendiği varsayımıyla kendi davranışını düzenlediği Panoptikon mimarisinin tüm toplumu kapsayan bir tahakküm sistemi haline gelişidir (Bauman ve Lyon, 2016:24).

Güncel koşullar altında panoptik gözetim, iktidarın veya kapitalistlerin tek taraflı uyguladığı bir sistem olmaktan büyük ölçüde ayrışmıştır. Bu nedenle günümüz toplumunda iktidar tek bir kule değildir ya da kulenin içinde tek bir gözetleyen yoktur (Foucault, 1992: 222). Modern kontrol mekanizması içerisinde şirketler, sivil toplum kuruluşları, uluslararası örgütler, dijital platformlar ve hatta bireyin kendisi de iktidarın dağınık ağı içinde birer "kontrol aktörü" haline gelmiştir. Dolayısıyla günümüzde kontrol; Weber (2005:46)'in rasyonel yasal otoritesine dayalı hiyerarşik ve merkezi bürokrasisindeki gibi tek bir merkezden yönetilmez. Bu yönetim biçimi çoklu ve birbiriyle bağlantılı aktörler ve kurumlar arasındaki etkileşimlerden oluşan bir ağ olarak işlemektedir. Çoklu kontrol ağları Foucault'nun anonim iktidarı ya da insansız iktidar anlayışı tek bir merkeze bağlı değildir (Foucault, 1992:276). Tıpkı mitolojideki her şeyi gören

Hera'nın hizmetkârı Argos[1]'un yüz gözü gibi günümüzdeki çoklu odaklara dağılmış bir kontrol sistemine karşılık gelmektedir (Can, 1994:78). Günümüzdeki dijital dönüşüm, yeni kontrol modelleri ile gözetim biçimlerinin ortaya çıkmasına yol açmıştır. Dijitalleşme ve teknolojik araçların ulaştığı nokta, Orwell'in distopyasının ötesine geçmiştir. Toplumu ve bireyi izleyen "MOBESE" (Mobil Elektronik Sistem Entegrasyonu), K.K.M. (Komuta Kontrol Merkezi), "A.T.S" (Araç Takip Sistemi) gibi sayısız denetim mekanizması gündelik hayattın doğal ve olağan birer unsuru olarak toplumsal kabule dönüşmüştür (Çoban vd., 2016:127). Çağın gerekliliği olarak dayatılan bu söylem ile bireyler, elektronik medya sistemleri aracılığıyla şirketler, medya platformları, sivil toplum örgütleri vb. gibi iktidarlar tarafından hem gözlemlenmekte hem de kendi ideolojik söylemini yayma kapasitesini genişletmektedir. Bu durum Bauman ve Lyon (2016:24)'a göre, modern gözetim olan akışkan gözetim, bireylerin her gün kendi istekleriyle ve gönüllü olarak gerçekleştirdiği cep telefonu kullanımı, alışveriş merkezleri, seyahat, internette gezinme, eğlence vb. eylemler aracılığıyla kendiliğinden hayatın olağan akışında gerçekleşmektedir. İktidar tıpkı konakçı bedende metastaz yapmış hastalık gibi, gündelik pratikler aracılığıyla kendi meşruiyetini, değerlerini, normlarını kesintisiz olarak bu ağlar içinde sürdürmektedir (Baudrillard, 2011:147).

2.2. Reklamlarda Kontrol ve Gözetim Metaforu: Sanat ve Panoptikon

Sanat, tarih boyunca toplumsal gerçekliğin kolektif ifadesi olarak, düşünsel, duygusal ve kültürel yapıların oluşumunda çoğunlukla belirleyici olmuştur. Zamanın ruhunu görünür kılan ve kayda geçiren bu üretim alanı, kimi zaman salt bir güzellikle, kimi zaman bir mesaj iletme isteği ile ya da sıradan olana direnme veya sıra dışı olma arzusuyla, toplumsal yaşamın hem bir parçası hem de eleştirisi olmuştur. Yaşamın her alanında varlığını sürdüren sanat, Homo sapiens'in mağara resimlerinden ilkel toplulukların ritüellerine, Antik Yunan'da taklitçi rolden, Orta Çağ'ın dini temsillerine, Rönesans'ta ideale ulaşma arayışından, Modernizm'de biçimsel özerkliğe ve özgürlüğüne, Postmodernizm'in parçalı yapısına kadar köklü bir dönüşüm yaşamıştır. Bu tarihsel dönüşüm süreci, sanatın yalnızca estetik biçimlerle değil, aynı zamanda iktidar ve denetim ile ilişki kurmaya başladığını göstermektedir. Özellikle modern ve postmodern dönemlerde, sanat üretimi gözetim olgusunu merkeze alan yeni temsil biçimlerine yönelmiş ve bu bağlamda Panoptikon düşüncesi sanatsal imgelerde belirginleşmiştir.

[1] Argos Panoptis, Yunan efsanesinde çeşitli kaynaklarda İnachus, Agenor veya Arestor'un oğlu ya da yerli bir kahraman (autochthon) olarak tanımlanan bir figürdür. Lakabı, başındaki veya vücudunun her yerindeki yüz gözünden gelmektedir (www.britannica.com, [10.12.2025]).

Panoptikonun sanattaki en büyük göstergesi göz imgesidir. Nitekim gözetim toplumunda "göz" imgesi, gözetleyenin önemli bir iktidar organına, temel denetim biçimlerinden birisine dönüşmüştür. Bu paralelde ikonlar arasında göz imgesi ise, Tanrı'nın sınırsız bilgisi ve gücünün fiziksel bir uzantısı ve gösterimi olarak yer alır (Weret, vd., 2016:102). Horus'un gözü gibi kutsal doğanının her şeyi gören gözüdür, kuvveti, bütünlüğü ve mükemmeliyeti simgeler ve onun kötülüğe karşı koruyucu gücü olduğuna inanılır (Gibson, 2023:59). Göz imgesi sanatta genellikle bu perspektiften değerlendirilmiştir.

Panoptikon, modern sanat bağlamında değerlendirildiğinde; özellikle fotoğrafçılık ve video sanatı alanlarında izleyiciyi pasif bir alıcı konumundan çıkartarak hem gören özne hem de görülen nesne haline getirir. Bu tarz enstalasyonlarda izleyici fiziksel ve algısal olarak eserin içine dahil olmaktadır. Bu durumun en somut örneğini İngiliz sanatçı Steve McQueen'in "Ashes" (küller) adlı video enstalasyonun da görülmektedir (Görsel 1), (www.icaboston.org, [18.02.2024]).



Görsel 1. Steve McQueen'in "Ashes" (küller) video enstalasyonu

Eserde, izleyicilerin gözleri, bir kişinin yakılma törenini belgeleyen bir video ekranına sabitlenir. Bu odaklanma, izleyicilerin kendilerini gözetlenen bir konumda hissetmelerini sağlarken, ekranın çevresine yerleştirilmiş aynalar aracılığıyla da kendilerini gözlemlediklerini fark etmeleri beklenir. Böylece sanatın içine dahil edilen bu metafor pasif bir sembol olmaktan uzaklaşır etkileşimli, eleştirel ve çoğu zaman rahatsız edici bir sorgulama gerçekleşir. Shu Lea Cheang'ın 2019 Venedik Bienali için hazırladığı multimedya enstalasyonun da ise, tipik bir hapishane hücresinin 3x3 m² boyutlarına gönderme yapılır (www.icaboston.org, [20.02.2024]). Burada panoptikon, imgesel olmaktan çıkarak kendi fiziksel gerçekliğinde yer alır. Bu multimedya enstalasyonu, tarihi ve çağdaş cinsel suçların biyografilerini keşfetmek ve günümüzün her yerde var olan dijital gözetiminin etkileri üzerine düşündürür. Bu sanat enstalasyonlarının arasında en dikkat çekici ve ilginç olanı Hasan Elahi "Tracking Transience The Orwell" projesi; sanatçı Hasan Elahi'nin bir FBI soruşturması deneyiminden yola çıkarak geliştirdiği bir öz-gözetim çalışmasıdır (http://trackingtransience.net, http://elahi.org/, [28.02.2024]. Sanatçı bu performansıyla sürekli gözetim altında yaşamanın sonuçlarını

sorgulamaktadır. Hasan Elahi'nin öz- gözetim temelli bu sanatsal çalışması, panoptik denetimin birey tarafından içselleştirilmesini eleştirirken, benzer bir gözetim sorununu görsel kültür ve reklam dili üzerinden ele alan çağdaş örneklerden biri de Apple'ın "Privacy. That's iPhone" kampanyasıdır.

2.3. Apple iPhone "Flock" Reklamı

Günümüzde küresel bir sorun hâline gelen "dijital gizlilik ve güvenlik" konularını işleyen "Privacy. That's iPhone" reklam kampanyası, Apple tarafından ilk kez 2019 yılında başlatılmıştır. Bu kampanya kapsamında üretilen seri reklam filmlerinden biri olan ve Temmuz 2024'te yayınlanan "Flock" başlıklı reklam filmi, konuyu etik temellerde ele alarak dijital gözetim olgusunu panoptik bir yaklaşımla işlemektedir. Gizliliği bir ürün özelliği olarak konumlandıran kampanyanın devamı niteliğindeki bu filmde, tüm Apple cihazlarında yer alan Safari web tarayıcısının gizlilik odaklı özellikleri tanıtılmaktadır. "Safari. Gerçekten gizli bir tarayıcı" sloganıyla yürütülen kampanyada, "Akıllı Takip Önleme" gibi gelişmiş güvenlik vaatleri öne çıkarılarak tarayıcının kişisel verileri korumadaki üstün yeteneği vurgulanmaktadır. Sektör lideri konumundaki Apple, bu reklamla dijital gözetimin panoptik işleyişini ve tüketicilerin sürekli izlenme kaygısını ele alarak, bu çalışmanın temel dayanak noktası olan panoptikon olgusunu, somut ve analiz edilebilir bir görünürlükte görsel bir alegoriye dönüştürmektedir.

Reklam, akıllı telefonlarını internette gezinmek için kullanan insanların, aniden kanatlı güvenlik kameralarından oluşan tehditkâr bir "sürü" tarafından takip edilmesini konu almaktadır. Bu uçan kamera kuşlar, insanların çevrimiçi etkinliklerini gözetleyip veri toplayan dronlar olarak tasvir edilmiştir. Apple, bu metaforla kullanıcıların "her an izlenebileceği" gerçeğine dikkat çeker; nitekim reklamda "Your browsing is being watched"-"Gezinti geçmişiniz izleniyor" uyarısı doğrudan bu mesajı vurgular niteliktedir. Apple'ın son dönemde üstlendiği bu misyon, aslında günümüz dijital toplumunda yeni araçlar ve teknolojik altyapının yarattığı "gözetim toplumu"nu bu reklamla eleştirmesidir. Söz konusu eleştirel yaklaşımın somut bir örneğini oluşturan bu reklam filminin teknik ve içerik özellikleri aşağıdaki tabloda özetlenmiştir.

Tablo 1. Apple iPhone "Flock" (2024) reklam filmine ilişkin künye bilgileri

Bilgi Alanı	Detaylar
Reklamın Adı	Flock (Sürü)
Kampanya Adı	Privacy. That's iPhone.
Orijinal Çıkış Zamanı	Temmuz 2024
Reklam Ajansı	TBWA\Media Arts Lab
Yönetmen	Ivan Zacharias
Çekim Yeri	Santiago, Şili
Reklam Müziği	Björn J:son Lindh - Billathi Askara.
Temel Mesaj	Taramanız izleniyor. Safari bunu durdurmaya yardım eder.

Reklam, görsel iletişimin güçlü araçları kanalıyla pazarlama ve tanıtım stratejilerinin somutlaştığı temel alanlardan biridir. Grafik tasarımın sunduğu görsel düzenleme ve mesaj iletme becerisi, ürün veya hizmetin hedef kitleye aktarılmasında en etkili yöntemlerden birini oluşturmaktadır. Reklam filminin ilk sahnesinde, elindeki telefona bakan bir kişi olağan işleri ile meşguldür (Görsel 2). Kent yaşamının yoğun akışı içinde birey, dinlenmek amacıyla bir yere oturmaktadır. Sahnenin ardında, kentin soğuk mimarisinde olağan gibi duran kameralar ona yönelir ve takibe başlar (Görsel 3), (Görsel 4).



Görsel 2. İlk sahne



Görsel 3. Kuş kameralar



Görsel 4. Kuş kamera

Bu her iki görselde gösteren, gündelik hayatımızda her yerde karşımıza çıkan sıradan güvenlik kameralarıdır. Ancak bu kameraların çok sayıda olması, yüksekte konumlandırılması çağımızın panoptik gözetiminin sürekliliğini ve her an izlenebilir olduğumuz gerçeğini yansıtmaktadır. Bu yönüyle, gözetimin her yere dağılmış teknolojik ağlara dayandığını açıkça ortaya koymaktadır. Bu iki kare birlikte okunduğunda, özgürlük ile gözetim arasındaki çelişkiyi açık biçimde kurgulamaktadır. Çatıya dizilmiş kameralar, gösteren düzeyinde teknik güvenlik araçları, gösterilen düzeyinde panoptik bir denetim rejimini temsil etmektedir. Mimari çevrenin insansız ve soğuk tasviri, gözetimin artık modern kent yaşamında sorgusuz sualsiz kabul edilen, içselleştirilmiş bir denetim biçimine dönüştüğünü anlatmaktadır.



Görsel 5. Telefon kullanan karakter, iç mekân



Görsel 6. Telefon kullanan karakter, dış mekân



Görsel 7. Telefon kullanan karakter, iç mekân



Görsel 8. Telefon kullanan karakter, dış mekân

Reklam filminin diğer sahnelerinde (Görsel 5,6,7,8), iç ve dış mekân karşıtlığı, kadrajdaki tüm bireylerin aynı biçimde telefona odaklanması, gözetimin mekândan bağımsız, süreklilik taşıyan bir kontrol rejimine dönüştüğünü göstermektedir. Gösteren düzeyinde sıradan telefon kullanımı olarak sunulan eylemler, gösterilen düzeyinde bireyin kendi davranışlarını dijital sistemlere göre düzenlediği çağdaş panoptik yapıyı temsil etmektedir.



Görsel 9. Telefon kullanan karakter, korku sahnesi



Görsel 10. Telefon kullanan karakter, korku sahnesi

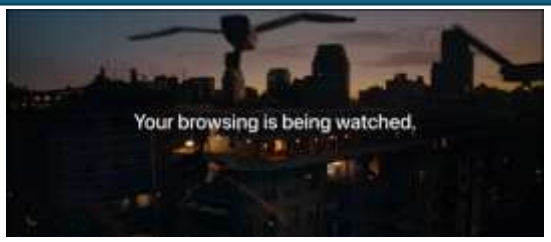


Görsel 11. Telefon kullanan karakter, korku sahnesi



Görsel 12. Telefon kullanan karakter, korku sahnesi

Görsel 9,10,11,12'de görülen sahneler bir bütün olarak ele alındığında, gözetimin özel yaşamdan kamusal alana doğru genişlediği, bireysel bir deneyim olarak başlayan tedirginliğin giderek kitlesel bir korku haline dönüştüğü görülmektedir. Bu karelerde gösteren, günlük hayata ait sıradan kesitler; gösterilen ise dijital gözetimin mekân tanımaz, aralıksız ve insan üzerinde psikolojik bir yük oluşturan doğasıdır. Bu sahnelerde kullanılan dronlardan üretilmiş kuşlar, geleneksel izleme mekanizmalarının yerini alan yeni teknolojik iktidar biçimlerini simgelemektedir. İnsanların yaşadığı korku, panik ve kaçış çabaları ise bu iktidarın artık içselleştirilmiş, gündelik bir tehdit olarak algılandığını göstermektedir. Böylelikle görsel kurgu, modern panoptik düzenin bireysel ve toplumsal boyutta yarattığı baskıyı, birbirini takip eden sahnelerle adeta görünür hale getirir. Böylece korku, dijital gözetim ve veri takibiyle ilişkilendirilmektedir.



Görsel 13. İzleniyor yazının yer aldığı sahne



Görsel 14. İnternette gezinme sahnesi

Görsel 13'te gösteren, alacakaranlık saatlerindeki şehir silueti, kentsel yaşamın sakin ve eve dönüş vaktini yansıtan görüntüsü ile "Your browsing is being watched."- "Gezinmeleriniz izleniyor" sloganın okunmasını kolaylaştıran bir fon oluşturur. Dilbilimsel bağlamda yapısına baktığımızda doğrudan "Seni" ya da "Sizi" hedef alan, edilgen bir tehdit cümlesiyle eylemi kimin yaptığı (kim tarafından?) belirsizliği vurgulanmaktadır. Gösterilen, belirsizlik, tekinsiz korku, mahremiyetin ihlali ve güvensizlik kavramlarıdır. "Browsing" (gezinme) kelimesi normalde tek başına özgür bir eylemi ifade ederken "watched" (izleniyor) kelimesiyle yan yana gelerek bir hapis veya takip edilme kavramına dönüşmektedir.

Görsel 14'te ise gösteren, evinin sakin ortamında gelen tehlikenin farkına varmadan elinde telefonla kadraja yer alan figürdür. Gösterilen, modern dünyada gece vakti ekranla kurulan bireysel bağdır.



Görsel 15. Pusula ikon sahne



Görsel 16. Kuşların patlaması



Görsel 17. Kuşların patlaması



Görsel 18. Kuşların patlaması

Reklamın son sahnelerinde Görsel 15'te gösteren; akıllı cep telefonun ekranında Apple firmasının safari uygulamasının pusula ikonudur. Bu sahnenin gösterileni ise; internete erişim, bilgi arama, güvenli dijital dünyaya giriş kapısı olarak Safari tarayıcısının sunduğu imkân ve vaattir. Sonraki sahne olan Görsel 16'da ise bu uygulamaya giriş yaptıktan sonra şimdiye kadar her anı izleyen panoptik kuşların infilak eden görüntüleri gösteren olurken, gösterilen bu patlamaların arkasındaki baskıcı denetim mekanizmalarının çöküşünün mesajdır. Görsel 17 ve Görsel 18'de yakın plan panoptik kuşun patlama görüntüsü arka plan olurken yine aynı estetik

minimalist tipografik öge ile gösteren, görüntü üzerine binen "Safari. A browser that's actually private" – "Safari. Gerçekten özel olan tarayıcı." metni yer almaktadır. Görsellerin göstereni Foucault'nun bahsettiği her anı izleyen "görünmez otorite" gözünün sembolik olarak kör edilmesi, dijital bir sığınak vaadidir. Reklam metniyle birleşen patlama görüntüsü, Lyon'un "Elektronik Göz" olarak tanımladığı izleme mekanizmalarına karşı bir zafer mesajı vermektedir. Bu zafer, gerçekliğin bizzat zihnin özerk üreticiliğiyle kurulan bir sembol dünyası olarak ortaya çıkar. Ütopik görüntü ile fikir arasındaki ayrım kaybolur, çünkü gözlemlenen ve sahip olunan "gerçeklik", yalnızca bu sembolik dünyaların içinde var olur (Cassirer, 2005:69).



Görsel 19. Mahremiyet sahnesi



Görsel 20. Güvenlik ve mahremiyet sahnesi

141 saniye süren bu reklam filminin Görsel 19'da yer alan son sahnesinin ilk karesindeki gösteren, elinde iPhone marka cep telefonu tutan bir kadın görseli, firmanın elma şeklinde logosu ve bu görselin üst kısmında "Privacy. That's iPhone."- "Gizlilik. İşte bu, iPhone." İfadesidir. Gösterilen, teknolojik bir aygıtla özdeşleştirilen mahremiyeti temsil etmektedir. "Privacy" metni bir ürün özelliği olarak sunulmaktadır. Kadının yüzünün telefonla kapatılması, öznenin gizliliğinin cihazın korumasıyla sağlandığı fikrini pekiştirmektedir. Sloganın kısa ve kesin yapısı değerlendirildiğinde sistemsel bir gözetim sorunundan doğan hak ihlalinin, yine teknolojik bir ürünle çözülebileceğini düşündürmektedir. Bu yaklaşım, mahremiyeti satın alınabilir bir özelliğe dönüştürerek temel bir toplumsal hak olmaktan çıkarmaktadır. Baudrillard (2011:131) 'ın belirttiği gibi, reklamın "tutkusu" günlük yaşantımıza giren teknolojik araçlarla birlikte minyatürleştirilmiş bir enformatiğe doğru kaymıştır. İşte bu "minyatürleşmiş enformatik" ortamında, mahremiyet gibi temel kavramlar da birer ürün özelliğine dönüşerek öznenin temel hak ve özgürlüklerini metalaştırmaktadır. Görsel 20'de yer alan son sahne firmanın logosu ile tamamlanır. Bu sahnede gösteren, arka planda sıradan kent silueti ve şehir dokusunun üzerinde beliren kilit formundaki Apple logosudur. İlk olarak ön plana çıkarılan logo dikkat çekmektedir. Gösterilen, güvenlik duygusudur. Firma logosunun kilit formu bireyin güvenliği, şehrin üzerinde konumlanan bu sembolik merkeze emanet edilmiş duygusunu uyandırmaktadır.

Apple iPhone için 2024 yılında yayımlanan Flock reklam filmi, mitsel içeriğini Alfred Hitchcock'un 1963 yapımı The Birds (Kuşlar) filmine gönderme yapmaktadır. Hitchcock'un filminde kuşlar, nedensiz ve açıklanamaz biçimde insanlara saldırarak modern bireyin güvenlik duygusunu sarsan bir tehdit olarak görülür. Bu benzer anlatı Apple'ın Flock reklamında farklı düzlemde tekrarlanır. Bu kaotik tehdit, doğadan değil teknoloji aracılığıyla üretilmiş mekanik kuşlar üzerinden temsil edilmektedir. Tarih boyunca kuş imgesi farklı anlam katmanları ile mitsel hikâyeye her zaman dahil olmuştur. Kuşa yüklenen en belirgin nitelik ise uçma yeteneğidir bu açıdan genellikle yücelik kudret ve özgürlüğün temsili figürüdür. Birçok kültürde tanrının temsilcisi ve koruyucusu olarak görülmüştür. Bununla birlikte, Orta Çağ Hristiyan ikonografisinde kuşlar hem kurtuluşu hem de ilahi gözetimi temsil eden simgeler olarak değerlendirilir. İşte burada ilahi göz ya da ilahi gözetim metaforuyla en belirgin sahneleri kuşlar üzerinden temsil edilen güvenlik kameralarıdır. Uçma yetisi kazandırılan kameralar her zaman her yerde olabilme yeteniyle gözetim toplumunun özellikle dijital panoptik anlatının temsilleridir.

Reklamın genel yapısı değerlendirildiğinde, sıradan teknolojik bir ürünün tanıtımından çok, sinematik bir gerilim filminin fragmanını anımsatmaktadır. Bu kurgu yapısıyla, bireyin kent içindeki gündelik yaşamında ve bu yaşamın olağan akışında gizlilik konusuna yeterli kadar önem vermemesi konu alınmıştır. Reklam filminin hikâye kurgusundaki genel yapı incelendiğinde, kent toplumunda sıklıkla rastlanan gündelik hayatın olağan akışı vurgulanır. Yaşamın koşturmacasını yansıtan her sahne tamamlandığında, panoptik kuşlar birer avcı gibi kadraja girmektedir. Bu çekim planlarında kuşların doğal hareketleri özenle taklit edilmiştir. Bu sahneler Baudrillard'ın "doğal simülark" kavramıyla örtüşür, Tanrı'nın yarattığı ideal doğanın bir benzerini veya kopyasını oluşturmayı hedefleyen bu imgeleme ve taklit, reklamın görsel kurgusunun temelini oluşturmaktadır (Baudrillard; 2011:168). Panoptik kuşlar doğal ve olağan hareketleri ile kimsenin fark etmediği, her biri birer gözetleme unsuru olarak görünmeyen iktidarın bekçileri gibi hareket etmektedir. Öyle ki insanların telefonlarında neye baktığını, ne satın aldığını ve nerede olduğunu izleyen rahatsız edici takipçilere dönüşmüştür. Sokaktaki her insan, pencerelerden sızan ya da omuzlarının üzerinden bakan bu metalik sürünün tacizi altındadır; sessiz ama ürkütücü bir kuşatılmışlık hissi tüm atmosfere hakimdir.

SONUÇ

Her dönem, kendi koşulları içinde toplumu kontrol etmeye yönelik farklı yöntemler üretmiştir. Kimi zaman yasa, kimi zaman inanç, kimi zaman da korku bu düzenin taşıyıcısı olmuştur. İşte

tam bu süreçlerde, yalnızca bugünü değil, geleceğin toplumunu da şekillendirmeyi amaçlayan otorite merkezli yapıların ilk örnekleri ortaya çıkmıştır. Bu yapılar, iktidarın nasıl görünür ya da görünmez olabileceğine dair güçlü birer metafor olarak günümüze kadar etkisini sürdürmüştür. Panoptikon'un hücrelerinde sıkışıp kaldığımızı fark etmeden yaşıyoruz. Gün geçtikçe, hiç kimseden saklanamayacağımız bu tek odalı dünyada, yaşamlarımızın özelde ama genel yapı üzerinden kontrol edildiğini dijital çağın getirdiği hezeyanlar içinde bilişsel olarak görmezden geliyoruz. Telefonlarda, dijital saatlerde, sokaklarda, alışveriş merkezlerinde, okullarda, yollarda, trafikte her yerdeyiz, ama her yerde gözetlenen mahkûmlarız. Saklanacak hiçbir yerin kalmadığı bu tek kişilik hücrede, büyük bir gözetim altında olduğumuzu hissediyor, ancak bunu umursamıyoruz. Foucault Panoptikon'u, modern disiplin toplumunun bir metaforu olarak değerlendirmiştir. Debord ise bu disiplinin, tüketim toplumunda bir "gösteri"ye, yani imajlar ve temsiller sistemi haline dönüştüğünü sorgulamıştır. Günümüzde teknolojinin gelişmesiyle birlikte, gözetim ve denetim mekanizmalarına dayalı ağ sistemleri tüm toplumsal sınıflar üzerindeki baskıyı da artırmıştır. Jean Baudrillard'ın ileri sürdüğü gibi zaman içerisinde artık her şey muğlaklaşmaktadır ve günümüz dijital toplumunda kesin bir bilgi ve anlayış yoktur. Nitekim antik dönemde denetim olgusunu erdem ve akıl temsil ederken; modern dönemde Hobbes ve Rousseau tarafından, toplumsal düzenin otorite ve sözleşme yoluyla sağlandığı savunulmuştur. Öte yandan Michael Foucault bu süreci, bireyin gözetimi içselleştirdiği disiplin ve denetim mekanizmaları üzerinden yeniden yorumlamıştır. Günümüz toplumunda Zygmunt Bauman ve Shoshana Zuboff gibi düşünürler, gözetimin dijitalleştiğini, bireyin artık dışsal baskıdan çok algoritmalar, veri akışı ve gönüllü şeffaflık yoluyla kontrol edildiğini ortaya koymaktadır. İnsan, doğası gereği sosyal bir varlık olarak bu "gözetlenme" hissini çoğu zaman bilinçli ya da bilinçdışı düzeyde taşımaktadır. Bu durum, bireyin yalnızca dış yaptırımlardan kaçınmak için değil, aynı zamanda toplumsal kabul ve ahlaki tutarlılık arayışıyla davranışlarını düzenlemesine neden olur. Bu bağlamda öz denetim, bireyi kontrol altında tutan tek unsur olmamakla birlikte, insan davranışlarını şekillendiren en güçlü ve süreklilik gösteren mekanizmalardan biri olarak değerlendirilebilir. İncelenen reklamda kuş sürüsü, görünmez, her yerde hazır ve sürekli izleyen bir gücü temsil eder; bu tam olarak panoptik gözetimin işleyişidir.

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VİDEO OYUNLARI VE ŞİDDET İLİŞKİSİNİN "PLAYING COLUMBINE" VE "ELEPHANT" FİLMLERİ ÜZERİNDEN KARŞILAŞTIRMALI ANALİZİ

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ÖZET

ABD'nin Colorado eyaletindeki Columbine Lisesi'nde, 1999 yılında iki öğrenci tarafından gerçekleştirilen silahlı saldırı, gençlerdeki şiddetinin sorgulanması açısından önemli bir olay olarak tarihe geçmiştir. Columbine Lisesi saldırısı aynı zamanda video oyunları ve şiddet ilişkisi üzerine daha fazla araştırma yapılmasına sebep olan ilk olay olmasıyla da anılmaktadır. Nitekim bu olayın, sadece medyada uzunca bir süre gündem teşkil etmekle kalmadığı gibi kitaplara, filmlere ve bir oyuna konu olduğu da bilinmektedir. Öyle ki, şiddet ve suç haberlerinin sunumunda medyanın rating kaygısıyla haber anlatısını "görece" daha ilgi çekici hale dönüştürmeye çalışması, istedikleri sürece gündemde tutması, hatta yeri geldiğinde de "ısıtıp" yeniden kamuoyunun önüne çıkarması yapısı gereğidir. Bu bağlamda medyada yaygın gündem oluşturmasından ötürü "Columbine Lisesi olayı" için saldırıyı gerçekleştiren gençlerin şiddet içerikli video oyunlarına olan düşkünlüklerinin ve yaşamlarında oyun-gerçek arasındaki sınırları zihinlerinde muğlaklaştırmalarının bu tür eylemlere kalkışmalarına etki ettiğine yönelik iddialar söz konusudur. Buna karşın eylemin video oyunu temelli bir şiddet yansıması olmadığını iddia eden görüşler de bulunmaktadır. Dolayısıyla bu çalışma kapsamında şiddet ve oyun bağlantısının Columbine Lisesi katliamını yorumlayan iki birbirinden farklı anlatıdaki "Playing Columbine" ve "Elephant" filmlerinde nasıl kurulduğu tanımlanmaktadır. Dahası örnekleme konu olan filmlerde, video oyunları ve şiddet arasında doğrudan bir ilişki olup olmadığının sorgulanması amaçlanmaktadır. "Playing Columbine" bu ilişkiyi "Super Columbine Massacre RPG!" oyununa gelen eleştirilerle tartışmaktadır. "Elephant" filminde ise şiddet sahnesi seyirciye sessizce yansıtılmaktadır.

Anahtar Kelimeler: Video Oyunları, Şiddet, Playing Columbine, Elephant, Super Columbine Massacre RPG!

THE RELATIONSHIP BETWEEN VIDEO GAMES AND VIOLENCE: A COMPARATIVE ANALYSIS OF THE MOVIES “PLAYING COLUMBINE” AND “ELEPHANT”

ABSTRACT

In terms of questioning adolescent violence, the 1999 shooting at Columbine High School in Colorado, USA, can be considered a significant event. The Columbine High School shooting is also remembered for being the first event to spark more research into the relationship between video games and violence. Indeed, this event not only dominated the media headlines for a considerable period, but it has also been the subject of books, films, and a game. Thus, in the presentation of news about violence and crime, the media's concern for ratings leads them to try to make the news narrative "relatively" more engaging, to keep it on the agenda for as long as they want, and even to "recycle the same story" and bring it back to the public when the opportunity arises; this is inherent in their nature. In this context, due to the widespread media attention surrounding the "Columbine High School incident," there are claims that the perpetrators' frequent use of violent video games and the blurring of lines between gaming and reality in their minds influenced their tendency to commit such acts. However, there are also views that argue the incident was not a reflection of video game-based violence. Therefore, within the scope of this study, the ways in which the relationship between violence and games is constructed in the two distinct narratives interpreting the Columbine High School massacre “Playing Columbine” and “Elephant” are examined. Furthermore, the aim of the sampled films is to investigate whether there is a direct link between video games and violence. “Playing Columbine” discusses this relationship with the criticisms leveled against the game “Super Columbine Massacre RPG!”, while in the film “Elephant,” the violent scene is conveyed to the audience silently.

Keywords: Video Games, Violence, Playing Columbine, Elephant, Super Columbine Massacre RPG!

1.GİRİŞ

Dünya geneline bakıldığında gençlerdeki şiddet eğiliminin ve özellikle de gençlerin gerçekleştirdiği okul saldırılarının, silah erişiminin kolay olduğu ABD’de diğer ülkelere kıyasla daha yaygın olduğu görülmektedir.[2] (CNN US, 2018) Gençlerin şiddete başvurmalarının nedenleri ise her zaman bir tartışma konusu olmuş ve medyaya düşen her yeni haberle de tekrar

[2]https://edition.cnn.com/2018/05/21/us/school-shooting-us-versus-world-trnd/index.html

tekrar gündeme gelmektedir. ABD'nin bünyesindeki Gençlik Adaleti ve Suçluluğu Önleme Ofisi'nin (Juvenile Justice Bulletin, 2000)[3] yayınlamış olduğu bir bültene göre gençlerdeki şiddetin bireysel-ailevi durumlar, akran ilişkileri, okul ortamı, toplum ve çevreyle kurulan iletişim gibi çok çeşitli faktörlere dayandığı düşünülmektedir.

Geçmişten günümüze pek çok kez dünyanın farklı coğrafyalarında okul saldırılarının gerçekleştirildiği bilinmektedir. Bu saldırılar öğrenciler, yetişkinler, hatta devlet güçleri tarafından gerçekleştirilmiştir. ABD'nin köklü ve saygın üniversiteleri arasında yer alan Kent State Üniversite'sindeki 1970 yılındaki saldırı[4] (Kent State University, 1998) devlet güçleri tarafından gerçekleşen saldırılar arasında sayılabilir. Nitekim bu eylem Ulusal Muhafızların Vietnam Savaşını protesto eden gençlere karşı ateş açmaları şeklinde gerçekleştirilmiştir. Buna karşın yakın geçmişte (2025) yaşanmış olan, Evergreen Lisesi[5] (The Colorado Sun, 2025) ve Antioch Lisesi'ndeki[6] (Tennessee Lookout, 2025) saldırılar ise öğrenciler tarafından gerçekleştirilen saldırılara birer örnektir.

Columbine Lisesi Katliamı:

Okul saldırısı olaylarındaki ölü sayısının artmasıyla medyanın konuyu daha çok gündemde tuttuğu, hatta sansasyonel bir durum haline getirebildiği de görülmektedir. Can kaybının yüksek olmasından ötürü medya gündemindeki yerini uzunca bir süre koruyan okul saldırılarının en bilinen örneklerinden biri Columbine Lisesi katliamıdır. Medyada büyük ilgi görmüş ve şiddetin video oyunları ile bağlantısının en çok tartışılmaya başlandığı saldırı olarak da anılmıştır.

Columbine Lisesi katliamı olarak anılan olaya ilişkin olarak yaşları 18-17 olan Eric ve Dylan isimli iki genç kendi liselerinden 12'si öğrenci, 1'i öğretmen olmak üzere 13 kişiyi öldürmüş ve 23 kişiyi de yaralamışlardır.[7] (History.com, 2009) Bu olay sonrasında video oyunlarının gerçek şiddeti etkileyip etkilemediği yönünde birçok araştırma yapılmış ve günümüzde de yapılmaya devam etmektedir. Yakın geçmişte (2019) Teksas ve Ohio'da gerçekleşen silahlı

[3] https://books.google.com.tr/books?hl=tr&lr=&id=15zaAAAAMAAJ&oi=fnd&pg=PT1&dq=youth+violence&ots=f0JdFf4YVi&sig=cfMDwN9l1FWuNt0Y61LWzPWBWwA&redir_esc=y#v=onepage&q=youth%20violence&f=false
[4] https://www.kent.edu/may-4-historical-accuracy
[5] https://coloradosun.com/2025/09/17/how-the-evergreen-high-school-shooting-unfolded-moment-by-moment/
[6] https://tennesseelookout.com/2025/01/22/two-students-dead-one-injured-after-shooting-at-nashville-high-school/

[7] https://www.history.com/this-day-in-history/april-20/a-massacre-at-columbine-high-school

saldırılar[8] (NBC News, 2019) sonucunda ABD Başkanı Donald Trump video oyunları ve şiddet ilişkisini tekrar gündeme getirmiştir.

"Playing Columbine" ve "Elephant":

Columbine Lisesi saldırısı, film, kitap, oyun gibi pek çok farklı mecralarda konu olarak işlenmiştir. Nitekim saldırı sonrasında 2005 yılında "Super Columbine Massacre RPG!"[9] (Ledonne, columbinegame.com, 2005, web sitesi erişime açık değil) adlı oyun geliştirilmiştir. Oyunun yayınlanmasının hemen ardından birçok eleştiriye maruz kalması, oyunun geliştiricisi Danny Ledonne'ı "Playing Columbine" (2008) isimli bir belgesel filmini çekmeye teşvik etmiştir. Columbine saldırısını konu alan bir diğer örnek ise Cannes Film Festivalinden "Altın Palmiye" ve "En İyi Yönetmen" ödüllü film olan "Elephant"tır. (2003) Dolayısıyla Columbine Lisesi saldırısını temsil eden "Playing Columbine" ve "Elephant" filmleri çalışmanın örneklemini oluşturmaktadır. Anlatım tarzları tamamen karşıt diyebileceğimiz bu iki filmden biri röportajların olduğu belgesel türündedir. Diğeri ise amatör oyuncularla[10] çekilen silahlı saldırının kurgulanmış halidir. Bu bağlamda video oyunları ve şiddet arasındaki ilişkinin filmlerde nasıl kurulduğunun sorgulanması amaçlanmaktadır.

2.YÖNTEM

Araştırmaya örneklem olan iki film anlam odaklı tematik film analiziyle karşılaştırmalı olarak, nitel araştırma yöntemiyle incelenmiştir. Filmler çözümlenirken betimlemelerden faydalanılmıştır. Filmler tematik yapıları, anlatı perspektifi, izleyici ile kurulan etkileşimleri yönünden değerlendirilmiştir.

3.BULGULAR

3.1. Medyada "Columbine Lisesi Saldırısı" ve Video Oyunları:

Columbine Lisesindeki saldırının medyada çokça tartışmalar yarattığını ve farklı yorumlara sebep olduğunu görmekteyiz. Saldırı hakkında video oyunlarının suçlu olduğunu savunan ve video oyunlarının gerçek-kurgu arasındaki çizgiyi silikleştirdiğini düşünen iddialar olmuştur. Buna karşın video oyunlarının saldırıya etki etmeyeceğine ve suçlanmaması gerektiğine yönelik haberler de gündeme gelmiştir. Bu görüşler arasında yer alan "gerçek-kurgu" ilişkisini

[8] https://www.nbcnews.com/politics/donald-trump/fact-check-trump-suggests-video-games-blame-mass-shootings-n1039411
[9] (Web sitesinin arşivlenmiş hali) https://web.archive.org/web/20200129093500/https://www.columbinegame.com/
[10] https://emanuellevy.com/interviews/gus-van-sant-on-elephant-2/

değerlendirirken Fransız Sosyolog Jean Baudrillard'ın simülasyon[11] kuramından da faydalanmamız mümkündür.

Simülasyon Kuramı: Bu kuramdan yola çıkarak oyunu gerçeğin bir temsili yani bir "simülasyon"u olarak düşündüğümüzde "gerçek" ile "simüle edilmiş gerçek: taklit" arasındaki anlam farkının yok olduğu sonucuna varabilmemiz mümkündür. Oyunlardaki şiddetin gerçek hayattaki şiddete bağlı olan sonuçları doğurmaması sebebiyle buradaki şiddet bir "simülakr"dır. Nitekim oyunda acı çekmek yerine tam aksine öldürülen karakterler üzerinden puan toplanmaktadır. Dolayısıyla buna göre şiddet içerikli video oyunları oynayan gençlerin bir zaman sonra zihinlerindeki şiddet kavramı anlamını yitirmekte ve gerçek hayattaki şiddet sıradan bir eyleme dönüşmektedir. Çünkü kurgu gerçeğin yerini almıştır.

ABC News[12], "20/20", 2000: Video oyunlarının artık çok gerçekçi olması ve şiddeti etkileyip etkilemediği farklı görüşler üzerinden tartışılmıştır.

The York Dispatch[13], 1999: Haberde saldırının gerçekleşmesine neden olabilecek tehlike belirtilerinin aileler tarafından fark edilmemesini eleştirmektedir. Bu belirtiler arasında gençlerin Hitler'e olan hayranlıkları, video oyunlarına olan bağımlılıkları ve Eric'in internetten yaydığı sınıf arkadaşını öldürmeye yönelik mesajları gösterilmektedir. Aynı zamanda silah ve el bombaları gibi cephanelik stoklamaların da ailelerin dikkatinden kaçmasına dikkat çekilmiştir.

The Guardian[14], 2000: Gazetede yayınlanan bir haberde ABD'li iki psikolog C.A.Anderson ve K.E.Dill'in makalesine[15] yer verilmiştir. Makalede video oyunlarının gençlerdeki saldırgan davranışları artırabileceği sonucuna varılmıştır.

"The Guardian"[16] bir başka haberde daha bu makaleye değinmiştir. Video oyunlarının televizyon ve filmlerden daha zararlı olduğu çünkü daha sürükleyici olduğundan bahsedilmiştir.

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[11] **Simülakr:** Bir gerçeklik olarak algılanmak isteyen görünüm. **Simüle etmek:** Gerçek olmayan bir şeyi gerçekmiş gibi sunmak, göstermeye çalışmak. (Baudrillard, 2025, s.9) **Simülasyon:** Bir köken ya da bir gerçeklikten yoksun gerçeğin modeller aracılığıyla türetilmesine hipergerçek yani simülasyon denilmektedir. (Baudrillard, 2025, s. 15-16)
Simülasyon kuramı: Çağdaş yaşamda hiçbir şeyin aslının olmadığını belirten Jean Baudrillard "simülasyon" kavramı üzerinde duruyor. Ona göre herşey bir simülasyondan ibaret ve yaşanan evren bir "gibi"ler evreni. (Öker, 2005, s.211) Gerçeğin yok edilmesinin döngüsü olarak çalışan hipergerçeklik yoluyla gerçek farklı bir boyut kazanmıştır. (Öker, 2005, s.213)

[12] https://www.youtube.com/watch?v=gGOefW-7mp4&t=131s

[13] https://archive.org/details/the-york-dispatch-1999-04-26-7

[14] https://www.theguardian.com/uk/2000/apr/24/timradford

[15] https://ocw.metu.edu.tr/pluginfile.php/2357/mod_resource/content/2/optional_AndersonDill_Video%20Games%20and%20Aggressive%20Thoughts.pdf

[16] https://www.theguardian.com/uk/2000/apr/23/tracymcveigh.theobserver

"Quake" ve "Doom" oyunları şiddet içeren oyunlara örnek olarak verilmiştir. Aynı zamanda Columbine saldırısını gerçekleştiren gençlerin planladıkları katliamın "Doom" oyununa benzeyeceğini söyledikleri video kayıtları bulunmuştur.

The Guardian[17]**, 2001:** Haberde Columbine saldırısında kurban olan ailelerin şiddet içerikli video oyunları ve cinsel içerikli web siteleri geliştiren şirketlere dava açtığı gösterilmektedir. Polisin soruşturmada bulduğu video kaydında Eric'in av tüfeğine "Doom"daki bir karakter olan "Arlene" diye seslendiğini fark ettiği de haberde ayrıca belirtilmektedir.

Los Angeles Times[18]**, 1999:** Gazete haberinde "Mortal Kombat", "Killer Instinct" ve "Doom" oyunlarının Columbine'daki saldırıya katkıda bulunduğunu düşünen ABD başkanı Clinton'ın sözlerine yer verilmiştir. Clinton hem ebeveynleri hem de oyun üreticilerini oyunların içeriklerine dikkat etmeleri konusunda uyarmıştır. Aynı zamanda Clinton gençlerin silaha erişimlerini kısıtlayan yasa teklifi de sunmuştur.

The New York Times[19]**, 1999:** Haberde Yale Üniversitesi Çocuk Çalışmaları Merkezi direktörü Donald Cohen'in ve Harvard Üniversitesi'nde psikiyatri doçenti olan Gordon Harper'ın görüşleri yer almıştır. Cohen, silahlı saldırganların, öldürmenin ne olduğunu kavrayacak kadar büyük yaşta olduklarını ancak iki öğrencinin de gerçeklik ve kurgu algısının gelişmemiş olabileceğini söylemiştir. Dahası Harper, hayal ve gerçeklik arasındaki dengenin herkesin hayatının bir parçası olduğunu fakat saldırgan gençlerde bunları dengeleyen bir gücün olmadığını söylemiştir.

EBSCO Research Starters[20]**, 2023:** *"Video oyunlarına olan takıntılarının, gerçeklik ve fantezi arasındaki ayrımı bulanıklaştırmalarına yol açmış olabileceği öne sürüldü. Katliamdan sonra bulunan günlükleri ve videoları bu argümanı doğrular nitelikteydi. Katiller, bir uçağı kaçırıp New York şehrinin merkezine çarpmayı hayal ediyorlardı. Ayrıca 1995'teki Oklahoma City bombalamasından daha büyük bir saldırı düzenleme arzusunu da dile getirmişlerdi."*

Brown, B., & Merritt, R., 2002, No Easy Answers: The Truth Behind Death at Columbine[21]**:** Kitapta video oyunu oynayan iki farklı tipte insan olduğundan bahsedilmektedir. Bunlardan birincisi "gerçeklikle bağını koparmayanlar kişiler", ikincisi ise "hayal-gerçek

[17] https://www.theguardian.com/technology/2001/apr/24/internetnews1
[18] https://www.latimes.com/archives/la-xpm-1999-apr-25-mn-30999-story.html
[19] https://archive.nytimes.com/www.nytimes.com/library/national/042599colo-school-psychology.html

[20] https://www.ebsco.com/research-starters/history/columbine-high-school-massacre
[21] https://archive.org/details/pdfy-pC_WzWbOzxls5ms1/mode/2up

arasındaki ayrımı kaybeden kişiler". Eric ve Dylan'ın ikinci kategoriye dahil oldukları ifade edilmektedir. Video oyunları saldırıya sebep olan bir suçlu olarak görülmemiştir, onlar gençlerin hayat sıkıntılarından ve öfkelerinden kaçtıkları bir alan olarak değerlendirilmiştir. Gençlerin kendi gerçeklikleri yerine alternatif bir gerçeklik seçtikleri düşünülmektedir.

The Free Lance-Star[22]**, 2000:** Gazete haberinde bilgisayar teknolojilerinin gelişmesinin kurgu olan şeyleri çok daha gerçekçi kılması tartışılmıştır. Eric ve Dylan'ın akranlarından izole olup "Doom" oynayarak gerçeklikten kopup alternatif gerçekliğin içine girdikleri düşünülmektedir. Bu sanal gerçekliğin insanları birbirinden uzaklaştırdığından söz edilmektedir.

Richmond Free Press[23]**, 2001:** Gazete haberinde internet çağının gençlerin birbirleriyle ağ kurarken "gerçeklik" ve "gençlerin öfkeli fantezileri" arasındaki çizginin silikleşmesine yol açmakta olduğunu söylemektedir.

Time[24]**, 1999, s.31:** Dergideki Columbine saldırısına ayrılan "special report" bölümünde saldırıda hayatta kalan kişilerin katiller hakkında video oyunu oynar gibi saldırıyı gerçekleştirdiklerini ve hiç acımalarının olmadığını söyleyen yorumları bulunmaktadır.

Time[25]**, 2025:** Haberde, video oyunlarının evlere girmesinin bahane edilmesini ve silahlı saldırıların tekrarlamasında "video oyunları"nın suçlu gösterilmesini anlatılmaktadır. Çünkü en kolay ve en somut seçeneğin o olduğunu anlatılmaktadır. Columbine saldırısı için de çoğu kişinin "Doom"u suçlamasına dikkat çekilmiştir.

Summit Daily News[26]**, 1999:** Gazetedeki haberde, medyanın saldırılardan sorumlu tutulmaması gerektiğinden, onun yerine ailelerin çocuklarından sorumlu olması gerektiği düşünülmektedir. Ailelerin çocuklarının ne izleyip, nelere baktığına, nereye gittiğine veya kimlerle görüştüğüne kadar her şeyden haberdar olması gerektiğinden söz etmektedir. Aynı zamanda eğer aile çocuğuna gerçek ve kurgu arasındaki farkı öğretemediyse sorunun şiddette değil ebeveynlikte olduğu savunulmaktadır.

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[22] https://books.google.com.tr/books?id=hfEyAAAAIBAJ&pg=PA5&dq=columbine+video+game+reality&article_id=6768,632178&hl=tr&sa=X&ved=2ahUKEwixovb0sZ2RAxVBBNsEHcWDE2oQ6AF6BAgKEAM#v=onepage&q=columbine%20video%20game%20reality&f=false

[23] https://www.virginiachronicle.com/?a=d&d=RFP20010906.1.10&srpos=1&e=-------en-20--1--txt-txIN-columbine+blur+reality

[24] https://archive.org/details/time-1999-05-03-remastered

[25] https://time.com/7320700/video-games-violence-history/

[26] https://www.coloradohistoricnewspapers.org/?a=d&d=SDN19990508-01.2.45&srpos=1&e=-------en-20--1--img-txIN%7CtxCO%7CtxTA-columbine+video+game+reality-------0------

Video oyunları ve psikoloji: Video oyunları ve etkileri psikoloji alanının da araştırma konusu olmuştur. Psikologlar GTP (Game transfer phenomena) olarak adlandırılan bir kavram tanımlamışlardır. GTP, video oyunundaki deneyimleri istemsiz bir şekilde gerçek hayata aktarmak anlamına gelmektedir. GTP ile ilgili yapılan yeni bir araştırma makalesine[27] göre (Llamas-Alonso ve ark., 2025) pozitif şizotipi (olağandışı algı ve inançlara sahip bireyler[28]) ve yoğun zihinsel deneyim yaşamanın internet oyun bağımlılığı ve GTP arasındaki ilişkiye aracılık ettiğini göstermiştir.

3.2. Film Özeti:

3.2.1. Playing Columbine[29], 2008:

Columbine Lisesi katliamının olduğu sene 10. sınıf lise öğrencisi olan Danny Ledonne bu olaydan çok etkilenmiş ve "Super Columbine Massacre RPG!" oyununu geliştirmiştir. Oyununa gelen tartışmalı yorumları derleyerek bu filmi kurgulamıştır. İnsanlar oyunun başlığında "Columbine"ı görünce önyargıyla yaklaşmış ve bunun ikinci bir saldırıya karşı özendirme olduğunu düşünmüşlerdir. Oyunun kaldırılması ve kamuoyundan özür dilenmesi adına Ledonne'a büyük bir baskı yapılmıştır. Ledonne filminde video oyunları ve şiddet ilişkisini röportajlarla ve haberlerle karşıt görüşleri de dahil ederek tartışmıştır.

3.2.2. Elephant[30] [31], 2003:

Gus Van Sant'ın yönetmenliğindeki film Columbine saldırısından ilham alınarak farklı karakterler, mekânlar ve yorumlamalarla yeniden canlandırılmıştır. Filmde genç saldırganların saldırıyı gerçekleştirdikleri günü izlemekteyiz. Saldırganlarla kurbanların günlük deneyimleri iç içe geçmiş olarak görülmektedir. Saldırgan iki genç bir gün evde beraberlerken Eric'in video oyun oynadığı gösterilmekte ve sonrasında Alex'in internetten silah araştırıp sipariş etmesine tanık olmaktayız. Ellerinde bombaların olduğu spor çantalarıyla sakin bir şekilde okula gitmişlerdir. Okula girmeden Alex arkadaşları John'u birazdan kötü şeylerin olacağı ve oradan uzaklaşması gerektiği konusunda uyarmıştır. John da gördüğü diğer kişilere binaya girmemelerini söylemiştir. Benny isimli karakter, bir öğrencinin kaçmasına yardım etmiştir fakat tam öğretmenini de kurtaracakken vurulmuştur. Alex sonlara doğru Eric'i de öldürmüştür.

[27] https://doi.org/10.1016/j.entcom.2025.100964
[28] https://www.ovid.com/journals/pdtrt/abstract/10.1037/per0000407~positive-schizotypy-maladaptive-openness-and-openness-facets?redirectionsource=fulltextview
[29] https://www.youtube.com/watch?v=VXp3ZcEq9Fg&t=4032s
[30] https://www.youtube.com/watch?v=qgd1n2Oq48s&t=2996s
[31] https://tribecafilm.com/news/elephant-gus-van-sant-gun-violence-mass-shootings-analysis-michael-moore-nra

Film okulun popüler çifti olan Carrie ve Nathan'ın, Alex tarafından kafeteryada sıkıştırmasıyla sona ermiştir.

Elephant Filminin Başlığı[32] [33]:

Van Sant, filminde Alan Clarke'ın filmi olan "Elephant" ile aynı başlığı kullanmayı tercih etmiştir. "Elephant" ismini "elephant in the room" deyimiyle bağdaştırmış ve bir metafor olarak "herkesin bildiği ama konuşmaktan kaçındığı, görmezden gelmek istediği ama gelemediği derecede büyük olan bir problem" anlamında kullanmıştır.

3.3. Temalar

- **Video oyunları ve şiddet:** "Playing Columbine" filmindeki bir görüşe göre oyunların trajediyi etkileyen ve saldırıya teşvik eden bir yönü olduğu savunulmaktadır. Oyunların faillere öldürmek konusunda beceri, teknik ve senaryolar kazandırmakta olduğu düşünülmektedir. Buna katılmayan bir görüşe göre, video oyunları her ne kadar askerlerde de koordinasyonu geliştirmek için kullanılmış olsalar da insanları saldırı gerçekleştirmeye itmemektedir.
- **Video oyunları ve kültür:** "Playing Columbine" filminde oyunların çoğu zaman yalnızca eğlence aracı olarak görüldüğü ifade edilmiştir. Halbuki onların bilgi edinme, başkasının hayatını deneyimleme amaçlı da kullanabileceğini düşünülmektedir.
- **Video oyunlarını suçlama:** "Playing Columbine" filmindeki bir görüşte, bazı kesimin silahlara sahip ve gotik tarzda birini gördüklerinde eğer o kişi daha önce video oyunu oynamışsa hemen video oyunlarının suçlanmasından yakınmaktadır. Ülkede yolunda gitmeyen bir şeyler olduğunda oyunların öğretmenler, polisler ve ebeveynler tarafından seçilen en kolay hedef olduğu düşünülmektedir.
- **Toplum korkusu:** "Playing Columbine" filminde toplumun zor bir konuyla bir oyunda veya alışılmışın dışında bir platformda rastladığı zaman bunun üzerini örtme çabasına girdiği anlatılmaktadır. Halbuki bu konuları göz önünden silmenin değil konuşmanın ve bilgi sahibi olmanın çözüm için faydalı olabileceği düşünülmektedir.

[32] https://www.theguardian.com/film/2009/jan/19/guardian-interview-gus-van-sant

[33] https://www.the-independent.com/arts-entertainment/films/features/gus-van-sant-my-own-private-idiom-74368.html

- **Şöhret olma isteği:** "Playing Columbine" filminde gençlerin şöhretle ölmek arzularının olabileceği fikri de düşünülmüştür. Çünkü kimsenin görüp dinlemediği bu gençlere, yeterince dikkat çekici bir şeyler yaparlarsa medya tarafından ünlü olacaklarının garantisi verilmektedir. Nitekim Eric ve Dylan saldırıdan sonra "Time" dergisinin kapağına çıkmışladır.
- **Zorbalık:** "Elephant" filminde hem saldırgan kişi hem de kurbanlardan biri zorbalığa maruz kalmaktadır. Alex'le (saldırgan) birkaç öğrenci alay etmiş ve derste üzerine buruşturulmuş kâğıt atmışlardır. Michelle (kurban) de hocaları ve arkadaşları tarafından tarzı ve giydikleri yüzünden zorbalanmaktadır. Kurban rolündeki karakter saldırgandan daha az zorbalanmaz fakat o, Alex gibi şiddete yönelmeyi seçmemiştir.

3.4. Görsel Benzerlikler:

Bir sahnede gerçek silah ile oyundaki silahın (Figure 1-2. görsel)[34] aynı açılarda olması dikkat çekmektedir. Bu sahne, yukarıda incelemiş olduğumuz Time dergisindeki (1999) Columbine saldırısında hayatta kalanların saldırganlar hakkındaki yorumlarını hatırlatmaktadır. Olaya oyun oynar gibi yaklaştıklarını ve acımasızca davrandıklarını düşünmektedirler. Dolayısıyla şiddetin robotik, soğuk ve sıradan bir olay gibi yansıtılmak istenmiş olması mümkündür.



Figure 1



Figure 2



Figure3

3.5. Karşılaştırmalı Analiz

"Elephant" şiddeti sessizce göstermeyi "Playing Columbine" ise konuşmayı seçmiştir. "Elephant" zamanı hem ileri hem geriye sararak, çoğunlukla tek bir mekânda olayı bize yaşatırken "Playing Columbine" medya arşivleri, röportajlar ve politik tartışmalardan faydalanmıştır. "Elephant"ta aynı diyalogları farklı karakterlerin perspektifinden tekrar izlerken "Playing Columbine"da farklı görüşteki kişilerin ayrı ortamlardan çekilmiş videolarını görmekteyiz. "Elephant" şiddete herhangi bir duygu katmadan nötr anlatırken "Playing Columbine"daki her konuşmacı fikrini coşkuyla söylemektedir. "Elephant" filminde

[34] https://quod.lib.umich.edu/f/fc/13761232.0041.108/--mood-of-dissonance-unpinning-ambiguity-in-gus-van-sants?rgn=main;view=fulltext

diyalogların az olduğu görülmektedir. Aynı zamanda karakterlerin iç dünyaları da yansıtılmamaktadır.[35] Böylelikle gençler arası yabancılaşmaya ve iletişimsizliğe gönderme yapılmış olması mümkündür. "Elephant" filminde karakterler uzun takip çekimleriyle arka profillerinden izlenmektedir. Bu da olaya sadece seyirci kalabildiğimizi[36], müdahale edemediğimizi ya da kişileri kimliksizleştirip olayın genelleştirildiğini bize düşündürmektedir. "Playing Columbine" filminde ise kamera sabittir ama konuşmacılar değişmektedir. "Elephant" izleyiciyi sessiz bir tanık yaparken "Playing Columbine" izleyiciyi düşündürmeye çalışmakta ve tartışmaya davet etmektedir. "Playing Columbine" medya, oyun geliştiricileri ve politik figürlerle şiddeti nasıl etiketlediğimizi anlatırken "Elephant" bu şiddete neyin sebep olduğunu sorgulamamızı sağlamaktadır. Her iki filmde de net bir sonuca ulaşılmamasını, filmlerin şiddeti çok yönlü sebeplerle ilişkilendirmeleri yüzünden olması mümkündür. "Playing Columbine" şiddetin anlamının medya tarafından istenildiği şekilde inşa edildiğini göstermektedir. "Elephant"ta da sahnelerin sessiz ilerlemesi, durumun belirsiz veya zor anlamlandırıldığını bize gösteriyor olması mümkündür. Medya, Hollywood senaryolarındaki şiddeti, video oyunlarını, popüler müziği, ateşli silahlara kolay erişimi, okul zorbalığını ve buna benzer pek çok şeyi şiddete neden olarak saymış fakat yine de asıl sebep belirsiz kalmıştır. Bu karşılaştırmada bir filmde anlam fazlalığı diğerinde ise anlam eksikliği olduğunu görmekteyiz. Birinde insanların aşırı yorum ve tanımlamalar yapmasından bahsedilirken diğerinde konuya dair hiçbir ipucu bulamamaktayız.

4.SONUÇ

Her iki film de net bir kanıya varmaktan kaçınmaktadır. İkisinin de şiddet hakkındaki derinliği olmayan yorumları eleştirmekte ve seyircinin de sorgulamasını istemekte olduğunu söylememiz mümkündür. Bu yüzden de mesaj açık uçlu ve belirsiz bırakılmaktadır. Her ne kadar net bir sonuca varılmasa bile "Playing Columbine"ın savunduğu mesajı az çok anlamaktayız. "Playing Columbine" karşıt iki görüşü de röportajlarla göstermekte ve tarafsız gibi görünmektedir. Bir müzakere havasında olan filmde video oyunlarının suçlanmaması gerektiği yönündeki görüşlerin daha baskın olduğunu görmekteyiz. Dolayısıyla film, şiddetin sebebi olarak video oyunlarının gösterilmemesi gerektiğini ve şiddet sebeplerinin bundan daha derin olabileceğini savunmaktadır. "Elephant" filminde de video oyunları, gençlerin Hitler'i

[35] https://www.rogerebert.com/reviews/elephant-2003

[36] https://www.sensesofcinema.com/2005/the-metaphysics-of-violence/elephant-2/

seyretmeleri, sosyal izolasyon gibi suça sebep olarak medyanın gösterdiği bütün faktörler filmde kısa sahnelerle yer almaktadır. Bu faktörler aşağı yukarı aynı sürelerle filmde yer almıştır. Hiyerarşik olarak hiçbirine filmde daha uzun süre tanınarak daha üstün bir sebep olarak gösterilmemiştir. Buradan vardığımız sonuçta "Elephant"ın şiddetin nedeninin belirsiz olduğunu ve tek bir sonuca varmanın yanlış olduğunu bize gösterdiğini söylememiz mümkündür.

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YÜKSEK YAPILARDA FARKLI İKLİM BÖLGELERİNE GÖRE DOĞAL HAVALANDIRMA YÖNTEMLERİNİN KARŞILAŞTIRILMASI

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ÖZET

Artan nüfus ve kentleşmeye bağlı olarak şehirlerin dikey yönde büyümesi, yapılarda doğal havalandırmanın sağlanmasını zorlaştırmış ve güvenlik riskleri nedeniyle mekanik havalandırma sistemlerinin kullanımını büyük ölçüde kaçınılmaz hale getirmiştir. Bununla birlikte, mekanik sistemlerin yüksek enerji tüketimi ve işletme maliyetleri dikkate alındığında, doğal havalandırmanın tek başına yeterli olmadığı yapılarda doğal ve mekanik havalandırmanın birlikte kullanıldığı karma (hibrit) havalandırma sistemleri, doğal havalandırma ilkelerini uygulayan binalar için pratik ve güvenilir bir çözüm olarak değerlendirilmektedir. Bu çalışmada, yüksek yapılarda doğal havalandırma stratejilerinin belirlenmesinde iklim türü ve coğrafi konumun etkisi incelenmiştir. Köppen–Geiger iklim sınıflandırmasına göre ılıman (C) ve tropikal (A) iklim bölgelerinde yer alan ve 0–300 m yükseklik aralığında bulunan ikişer yüksek yapı seçilmiş; bu yapıların doğal havalandırma stratejileri, içinde bulundukları iklimsel ve konumsal koşullar doğrultusunda karşılaştırmalı olarak analiz edilmiştir. Bulgular, ılıman (C) iklim bölgesinde gök bahçe ve çift kabuk cephe sistemlerinin, yapıların konumundan bağımsız olarak doğal havalandırma açısından yeterli performans sergileyebildiğini göstermektedir. Buna karşılık, tropikal (A) iklim bölgesinde doğal havalandırma performansının yapı konumuna bağlı olarak değiştiği ve bu nedenle farklı stratejilerin uygulanmasını gerektirdiği belirlenmiştir. Bu durum, tropikal iklimlerde hâkim rüzgâr yönü ve yüksek nem oranı gibi iklimsel parametrelerin doğal havalandırma stratejileri üzerinde belirleyici olduğunu ortaya koymaktadır. Sonuç olarak, yüksek yapılarda doğal havalandırma stratejilerinin seçiminde iklim türünün temel bir belirleyici olduğu ve özellikle tropikal iklim bölgelerinde konuma özgü, iklimle uyumlu çözümlerin geliştirilmesinin sürdürülebilir yapı tasarımı ile enerji verimliliği açısından kritik önem taşıdığı sonucuna ulaşılmıştır.

Anahtar Kelimeler: Yüksek Yapılar, Doğal Havalandırma, Enerji Etkin Tasarım, Ilıman İklim (C), Tropikal İklim (A)

COMPARISON OF NATURAL VENTILATION METHODS ACCORDING TO DIFFERENT CLIMATE ZONES IN HIGH-RISE BUILDINGS

ABSTRACT

The vertical growth of cities driven by population increase and urbanization has made natural ventilation difficult to achieve, while safety concerns have rendered the use of mechanical ventilation systems largely inevitable. However, considering the high energy consumption and operating costs of mechanical systems, hybrid (mixed mode) ventilation systems that combine natural and mechanical ventilation are regarded as practical and reliable solutions for buildings that apply natural ventilation principles where natural ventilation alone is insufficient. This study examines the influence of climate type and geographical location on determining natural ventilation strategies in high-rise buildings. Two high-rise buildings located in temperate (C) and tropical (A) climate zones according to the Köppen–Geiger classification, and within the height range of 0–300 m, were selected. The natural ventilation strategies of these buildings were comparatively analyzed with respect to their climatic and locational conditions. The findings show that in temperate (C) climates, sky gardens and double-skin façade systems can provide adequate natural ventilation performance regardless of building location. In contrast, in tropical (A) climates, natural ventilation performance varies depending on building location, thereby requiring the implementation of different strategies. This indicates that climatic parameters such as prevailing wind direction and high humidity levels play a decisive role in shaping natural ventilation strategies in tropical regions. In conclusion, the study demonstrates that climate type is a fundamental determinant in the selection of natural ventilation strategies in high-rise buildings, and that developing site-specific and climate-responsive solutions, particularly in tropical climates, is critically important for sustainable building design and energy efficiency.

Keywords: High-Rise Buildings, Natural Ventilation, Energy-Efficient Design, Temperate Climate (C), Tropical Climate (A)

1. INTRODUCTION

Architectural space has transformed throughout history in parallel with changing human needs and the social meanings attributed to it. The tendency to build upward first appeared for religious, defensive, and surveillance purposes. The emergence of modern high-rise buildings, however, became possible after the Industrial Revolution with advances in structural materials and construction technologies. Over time, rapid urbanization and increasing density have

encouraged the vertical growth of cities, making high-rise construction a prevalent architectural solution. This vertical development has generated new responsibilities for architects, particularly in relation to energy performance, indoor environmental quality, and environmental impact. Designing buildings so that lighting, ventilation, and thermal comfort are achieved through strategies responsive to climate and context is defined as passive design design (Ç. B. Dikmen, 2011; Eşmen, 2023). Within this framework, natural ventilation (NV) constitutes a primary passive design strategy that contributes to reduced energy consumption, improved user comfort, and healthier interior spaces. NV systems are especially effective in lowering the energy demand associated with heating, cooling, and ventilation (Chen et al., 2017a).

Heating, ventilation, and lighting represent major components of building energy use, accounting for about 46% of total consumption (Department of Energy, 2015). According to the U.S. Energy Information Administration (EIA), buildings account for approximately 41% of national energy demand. In commercial buildings, a substantial share of this demand results from lighting (20%), space heating (16%), and space cooling (14%) (Sawyer, 2014; Tuğrul Okbaz et al., 2024). These figures underline the architectural importance of reducing energy demand through passive design strategies (R. A. Ali et al., 2023). Natural ventilation creates indoor airflow by using outdoor drivers such as wind and temperature-induced buoyancy. In high-rise buildings, NV strategies vary according to spatial organization, building form, orientation, façade configuration, and the architectural elements integrated into the building envelope. In general, NV is classified into four main strategies: single-sided ventilation, cross ventilation, stack-effect ventilation, and night ventilation (Eşmen, 2023; Küçüker, 2019; Yüksek & Esin, 2011).

Single-sided ventilation provides limited airflow through openings on a single façade. Cross ventilation increases air exchange by using openings placed on opposite façades. Stack-effect ventilation relies on buoyancy forces, where warm air rises and cooler air is drawn from lower levels. Night ventilation uses diurnal temperature differences and the thermal mass of structural components to release accumulated heat at night, improving performance in buildings with high thermal capacity (M. Dikmen & Limoncu, 2016 a). The success of these strategies depends on how effectively they are integrated into architectural form. Elements such as atriums, sky gardens, double-skin façades, and wind towers can significantly enhance natural ventilation performance.

Atriums, as multi-storey interior voids, enable deep daylight penetration and support stack-driven airflow, while establishing intermediate pathways for cross ventilation. Sky gardens and green roofs contribute to airflow and improve the microclimate through vegetation. Double-skin façades consist of inner and outer façade layers separated by an air cavity that acts as a buffer zone, moderating heat transfer and allowing controlled natural airflow. When combined with operable components, these systems can also support night ventilation (Çakır, 2012; Z Yilmaz , 2006). Wind towers, derived from traditional climatic architecture and adapted in contemporary design, capture wind at higher elevations, direct cooler air indoors, and discharge warm air through buoyancy-driven movement (C. Ali & Say Özer, 2012).

The performance of NV strategies is closely related to climate. Parameters such as air temperature, humidity, prevailing wind direction, and wind speed directly influence ventilation potential and user comfort. Therefore, natural ventilation strategies differ across climate zones, and architectural decisions regarding building form, façade configuration, and openings must be reconsidered within climatic context (Aflaki et al., 2015a; Raji et al., 2016).To enhance NV, architects frequently employ devices such as solar chimneys, wind towers, and double-skin façades to support wind-driven and buoyancy-driven airflow. However, NV alone is not always feasible. Hybrid (mixed mode) ventilation systems**,** which use natural ventilation when outdoor conditions are suitable and mechanical ventilation otherwise, provide a practical and reliable architectural solution (Brager & De Dear, 2000) . In high-rise buildings, increased height and complex geometries can alter airflow around the façade and reduce NV performance (Tong et al., 2017). Evaluating NV potential in high-rise buildings therefore requires explicit attention to climate. Climatic variables such as temperature, humidity ratio, prevailing wind direction, and wind intensity determine ventilation effectiveness, and the suitability of strategies varies by climate type.

The Köppen–Geiger classification identifies five main climate groups, subdivided by precipitation and temperature. These types appear across different latitudes and continents. Tropical (A) climates exhibit year-round high temperatures and humidity; while NV is necessary, moisture may limit comfort. Arid (B) climates combine high temperatures with low humidity and strong solar radiation, requiring NV to be considered together with cooling measures. Temperate (C) climates generally offer favorable conditions for NV because of moderate temperatures and balanced humidity. Continental (D) climates experience large seasonal fluctuations, and NV may increase heat loss. Polar (E) climates maintain very low

temperatures and are typically unsuitable for naturally ventilated occupied (Aflaki et al., 2015b; Ayoobi et al., 2024; Chen et al., 2017b; Kottek et al., 2006a).

The literature shows that most research on NV focuses on low-rise buildings or regional housing. Systematic comparisons of NV strategies in high-rise buildings across different climate zones remain limited (Aflaki et al., 2015a; Chen et al., 2017a; Tong et al., 2017). This study aims to address this gap by comparatively analyzing NV strategies in high-rise buildings located in temperate and tropical climates. The objective is to explain how climate type influences the selection of ventilation strategies and to emphasize the role of climate-responsive architectural design. For this purpose, representative high-rise buildings from two climate regions, classified according to Köppen–Geiger, were examined and their natural ventilation approaches evaluated.

2. MATERIAL AND METHODS

This study focuses on the comparative analysis of natural ventilation strategies used in high-rise buildings located in different climatic regions. Within the scope of the analysis, only buildings situated in temperate (C) and tropical (A) climate zones according to the Köppen-Geiger climate classification (Kottek et al., 2006b) were evaluated. Arid (B), continental (D), and polar (E) climate zones were excluded from the study due to the low effectiveness of natural ventilation in these regions and/or the limited high-rise building stock (Aflaki et al., 2015c; Tong et al., 2017).

To minimize the impact of building height on natural ventilation potential, structures in the super-tall (300–600 m) and mega-tall (above 600 m) categories were also excluded; only high-rise buildings with a height of 0–300 meters were selected. In this way, it was ensured that the analyzed buildings were comparable with one another. In the selection of the case study buildings, criteria such as the clear definability of the building's climate zone, the availability of sufficient data in the literature regarding the use of natural ventilation strategies, and accessibility to technical documentation—such as plans, sections, and facade details—were considered. Additionally, the diversity of functional types of the selected buildings (residential, office, mixed-use) was considered. Based on these criteria, the Sapphire Tower (Istanbul) and Commerzbank Tower (Frankfurt) representing the C climate, and The Met Tower (Bangkok) and CapitaGreen (Singapore) representing the A climate, were examined (Table 1).

Table 1. Selected case study buildings

Building Name	Location	Climate Type	Construction Year	Height (m)	Usage Type
Sapphire Tower	Istanbul, Turkey	C (Temperate)	2010	261	Office+ Residential
Commerzbank Tower	Frankfurt, Germany	C (Temperate)	2010	155	Office
The Met Tower	Bangkok, Thailand	A (Tropical))	2009	230	Residential
CapitaGreen	Singapore	A (Tropical)	2014	242	Office

Each selected building was analyzed in detail in terms of natural ventilation strategies, building form, height effect, and the architectural elements employed (double-skin facades, sky gardens, atriums, etc.). The data were compiled from literature sources, technical project documents, and published scientific articles related to the buildings. A qualitative comparative analysis method was adopted for this study. The design approaches of the buildings toward natural ventilation were correlated with their respective climatic conditions, and the effects of climatic variables (temperature, humidity, prevailing wind direction) on ventilation performance were evaluated specifically for each building.

3. RESULTS AND DISCUSSION

The four high-rise buildings analyzed in this study were evaluated in terms of their natural ventilation strategies according to the climatic regions in which they are located. The structures were examined specifically based on design decisions, architectural ventilation elements, and the use of passive systems; subsequently, the strategies were interpreted comparatively in line with the acquired data. The findings reveal how natural ventilation systems diversify through parameters such as building form, height, and function, as well as their relationship with the climate.

3.1. Sapphire Tower, Istanbul, Türkiye (C Climate Type)

Located in Istanbul and completed in 2010 as a mixed-use high-rise building, Sapphire Tower is one of the early examples in Turkey designed with a sustainability-oriented approach. The building reaches a height of 261 m and employs a double-skin façade system composed of a transparent outer layer and an inner façade. The controlled buffer zone formed between these two layers improves indoor comfort and contributes to energy efficiency. The air cavity formed between the outer and inner facades, as shown in **Hata! Başvuru kaynağı bulunamadı.**,

continues vertically throughout the structure and is divided by sky gardens placed at three-story intervals to prevent overheating on the upper floors. These gardens ensure that vertical air circulation occurs in a controlled manner; fresh air is drawn into the building through vents located in each sky garden, while the heated indoor air is expelled through outlet openings integrated into the garden above (Fig. 2). This system of the building makes the stack effect controllable while simultaneously providing a hybrid solution in which natural ventilation and mechanical ventilation systems operate together.



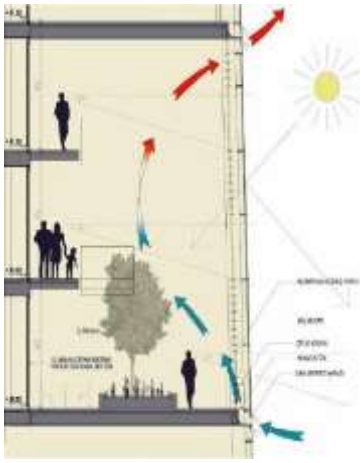


Fig. 1. Schematic section of the Sapphire Tower and the operating principle of the sky gardens (Url-2,2025)



Fig. 2. Building modeling and facade vents (Url-2,2025)

3.2. Commerzbank Tower, Frankfurt, Germany (C Climate Type)

The Commerzbank Tower, constructed in 1997 in Frankfurt, Germany, stands out as Europe's first naturally ventilated high-rise office building, with a height of 259 meters. As illustrated in Fig. 3, the structure is designed with a triangular plan scheme and consists of zones divided by service cores positioned at each of the three corners, a central rising atrium, and sky gardens located every 12 floors. The atrium facilitates natural lighting and air circulation within the interior spaces; however, it has been controlled by zoning with steel-glass diaphragms to prevent overheating that could occur due to the stack effect. User-controlled natural ventilation is provided through bottom-hung (vasistas) type openable windows integrated into the facade system (Fig. 4). This solution enables single-sided ventilation in offices near the exterior facade, while airflow is also maintained in the inner office areas through the atrium and sky gardens.

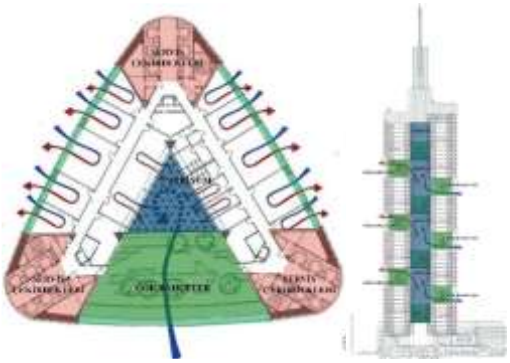


Fig. 3. Plan and section scheme of the Commerzbank Tower (Kılınç, 2015)

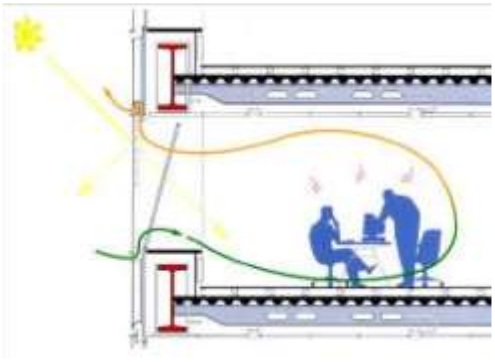


Fig. 4. Natural ventilation scheme of the Commerzbank Tower double-skin facade (Kılınç, 2015)

3.3. The Met Tower, Bangkok, Thailand (A Climate Type)

The Met Tower, located in Bangkok, Thailand, is a residential high-rise completed in 2009 with a height of 230 meters. The structure consists of three main towers connected by sky gardens at certain levels (Fig. **5**.) and is oriented in the north-south direction. This orientation was determined in accordance with the prevailing wind direction of the tropical climate in which the building is situated. The ventilation voids located between the towers operate in conjunction with the sky gardens, triggering the stack effect by allowing the heated air to rise and be expelled from the structure. The staggered layout of the residential floor plans allows the units to receive air from four sides, thereby enhancing the potential for cross ventilation (Fig. 6). The relationship between the ventilation voids and the sky gardens increases air circulation on the upper floors; the evacuation of warm air through the sky gardens prevents overheating at higher levels. The ventilation scheme of the building can be evaluated as a passive design strategy adapted to humid and hot tropical climate conditions, which ensures less internal heating through natural ventilation and minimizes the cooling demand.

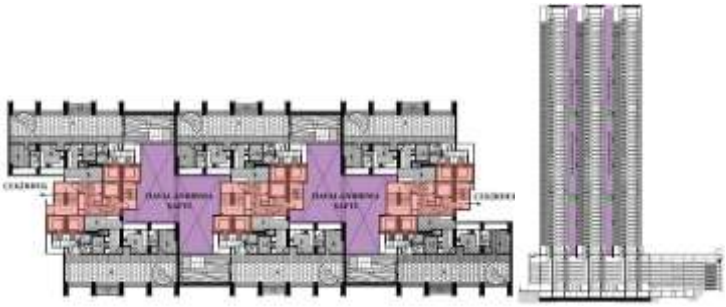


Fig. 5. Plan and schematic section of The Met Tower (Kılınç, 2015)

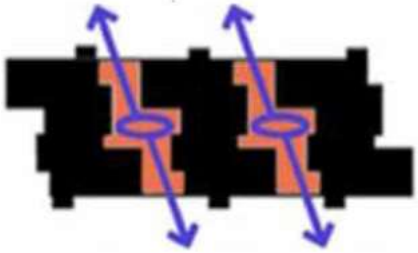


Fig. 6. Schematic representation of cross ventilation (M. Dikmen & Limoncu, 2016b)

3.4. CapitaGreen, Singapore (A Climate Type)

The CapitaGreen building, located in Singapore and completed in 2014, is an office high-rise with a height of 242 meters. This structure presents an innovative example in terms of natural ventilation strategies; the 45-meter-high wind scoop positioned on the roof, as seen in Fig. 7, is oriented according to the prevailing wind direction to capture high-altitude winds and direct the cool air found at the upper levels into the interior spaces (Fig. 8). Thus, both ventilation and partial cooling are provided through passive methods. The building's facade features a double-skin system consisting of full glass panels on the interior and narrow glass panels on the exterior; fresh air is drawn between the two shells thanks to the air-permeable outer skin, while the vegetated areas in between contribute to thermal performance (Fig. 9). Apart from this, there are no active applications of cross ventilation, the stack effect, or the double-skin system within the structure. Although the vegetated facade surfaces serve aesthetic and shading functions, they do not directly contribute to natural air circulation.



Fig. 7. Wind catcher (Wind scoop) (Url-7)



Fig. 8. Schematic diagram of the wind catcher and ventilation system (Url-5, Url-6)



Fig. 9. Schematic section model of CapitaGreen (Url-6)

In line with the comparative analysis of these structures, the natural ventilation strategies employed are summarized in Table 2.

Table 2. Natural ventilation strategies implemented in the case study buildings

	Building Name (Climate Type)	Single-Sided Ventilation	Cross-Ventilation	Double-Skin (Facade)	Stack Effect	Atrium	Sky Garden	Wind Scoop
1	Sapphire Tower (C)			X			X	
2	Commerzbank Tower	X		X		X	X	
3	The Met Tower (A)		X		X		X	
4	Capita Green (A)							X

The natural ventilation strategies of the analyzed buildings exhibit significant differences in line with both climatic data and structural design decisions. In terms of climate sensitivity, the ventilation systems of structures in temperate and tropical regions have different priorities. In the temperate (C) climate type, despite the buildings being in different geographical positions, the common preference for double-skin facade and sky garden methods demonstrates that these strategies can adapt to climatic conditions independently of location. The Commerzbank Tower stands out as an example that implements natural ventilation as an integrated system and incorporates passive solutions into the building's form. Thanks to both facade openings and atrium zoning, single-sided and cross ventilation are provided simultaneously. In contrast, it is observed that ventilation systems are implemented only at a limited level in the Sapphire Tower; despite the aesthetic and comfort contributions of the double-skin facade and sky gardens, they do not transform into an effective natural ventilation system.

The Met Tower, located in a tropical climate region, can be evaluated as a successful example where the stack effect and cross ventilation are used in combination. The orientation and void design of the structure provide significant contributions in terms of directing the wind and ensuring the continuity of indoor air circulation. While the stack effect supports air circulation, windows opening into the stack area can lead to thermal comfort issues on the upper floors; however, the pressure differences created in conjunction with the sky gardens ensure the continuity of airflow.

CapitaGreen, on the other hand, stands out with its innovative wind scoop application; capturing the faster and cooler wind at an altitude of approximately 300 meters and directing it into the structure supports both natural ventilation and air conditioning. However, it does not utilize

other classical strategies of natural ventilation, which indicates that the system relies on a singular solution.

When evaluated in general, it is understood that natural ventilation systems are implemented in a more complex and layered manner in buildings located in temperate climates; whereas in tropical climates, no single common method stands out, and more permeable design approaches that provide direct air passage are preferred.

However, this situation also reveals that each structure is customized according to its own design context and that there is no standard strategy in question. It can be stated that factors such as building height, functional use, facade openings, and volume organization, alongside climatic conditions, directly affect the success of natural ventilation strategies.

The findings obtained demonstrate that multi-layered parameters must be taken into consideration when evaluating the feasibility of natural ventilation systems in high-rise buildings. In design approaches to be developed accordingly, the formal organization of the structure, the level of permeability allowing for airflow, and the way user control is provided play as critical a role as climate sensitivity.

4. CONCLUSIONS AND RECOMMENDATIONS

This study aimed to comparatively analyze natural ventilation strategies through high-rise building examples located in different climatic conditions. The evaluations reveal that natural ventilation systems differentiate significantly depending not only on climatic conditions but also on architectural parameters such as building form, height, function, and facade design.

According to the findings obtained, natural ventilation strategies in buildings located in temperate climates are implemented in a more systematic, layered, and controlled manner. It is observed that integrated systems—where single-sided and cross ventilation systems are supported by atriums and sky gardens, and where the stack effect is regulated through zoning, as in the example of the Commerzbank Tower—can be successfully implemented. In contrast, in buildings located in tropical climates, directing airflow comes to the fore depending on factors such as temperature and humidity; strategies such as the stack effect, permeability, and wind directioning are more commonly utilized. In this context, although The Met Tower and CapitaGreen are distinct from one another, they provide remarkable examples of generating climate-specific solutions.

In this context, the success of natural ventilation strategies in high-rise buildings is possible not merely through the existence of a system, but through its holistic design in accordance with

climatic conditions and structural characteristics. There is no standard solution applicable to every climate type; natural ventilation strategies are shaped according to contextual and customized decisions at the building scale.

Based on the findings of the study, the following recommendations can be presented:

- To utilize natural ventilation effectively in high-rise buildings, the analysis of climatic data must be taken as a basis during the early stages of the design process.
- Architectural elements such as atriums, sky gardens, and facade openings should be configured not only as aesthetic or social spaces but in a manner that contributes to air circulation.
- Permeability and volumetric voids in tropical climates, and zoned controlled systems in temperate climates, should be considered as priority design parameters.
- Wind direction and airflow patterns should be analyzed using digital simulation tools, and the performance of passive systems should be tested during the design phase.

Among the limitations of this study are the restriction of the analyzed structures to four examples and the fact that the evaluations are primarily based on literature and visual documentation. Future studies with a broader sample will enable a more in-depth analysis of natural ventilation strategies. Furthermore, conducting simulation-based performance analyses (e.g., CFD – Computational Fluid Dynamics) for the selected buildings would be beneficial in revealing the behavior of these systems against actual environmental effects.

In conclusion, natural ventilation is a critical component in high-rise buildings, not only in terms of energy efficiency but also in the context of creating occupant comfort and healthy indoor spaces. In this regard, climate-sensitive ventilation strategies, addressed holistically at the building scale, are significant design tools that will contribute to the goals of sustainable urbanization.

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TEBRİZ MİNYATÜR OKULU'NDA KIZILBAŞLIK SEMBOLİZMİ VE ESTETİK ANLAYIŞI

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ÖZET

Tebriz Minyatür Okulu, XVI. yüzyıl ortalarından itibaren Safevî sarayının himayesinde gelişmiş ve Doğu resim sanatının önemli merkezlerinden biri olmuştur. Bu okul, yalnız teknik ustalık ve estetik zenginlik sunmakla kalmamış, aynı zamanda Safevî ideolojisinin görsel bir tercümanı olarak da işlev görmüştür. Kızılbaşlık, Tebriz minyatürlerinde yalnız bir betimsel unsur değil, derin bir ideolojik ve estetik sistemin taşıyıcısıdır.

Makalede, minyatürlerdeki Kızılbaş figürleri, başlıklar, giysiler, renk kullanımı ve jestlerle sembolik bir dil oluşturduğu gösterilmiştir. Kırmızı, beyaz, mavi ve altın tonları, Kızılbaşlık ideolojisinin güç, iman ve cüret gibi değerlerini temsil eder. Başlık ve kıyafetler, siyasi hiyerarşi ve dini aidiyetin görsel kodlarını sunarken, el hareketleri ve bakış yönleri dini ve ideolojik mesajları güçlendirir. Ayrıca, ritüel sahneler ve savaş tasvirleri, Kızılbaşların hem manevi hem de siyasi rollerini vurgular ve Tebriz minyatürlerinde ideolojik merkeziyetin estetik olarak ifade edilmesini sağlar.

Kızılbaşlık, yalnızca Safevî devletinin askerî-siyasî dayanağı olmayıp, aynı zamanda Şiîliği millî-dinî bir ideoloji düzeyine yükselten bir hareket olarak görsel kültürde de derin izler bırakmıştır. Tebriz minyatürlerinde Kızılbaşlık motiflerinin, ikonalarının ve sembollerinin incelenmesi, bu geleneğin sanata nasıl nüfuz ettiğini anlamaya imkân sağlar. Bu makalenin amacı, Tebriz Minyatür Okulu'nun görsel dilinde Kızılbaşlığın estetik ve sembolik tezahürlerini araştırmak ve bu sanat örneklerinin ideolojik yükünü tahlil etmektir.

Sonuç olarak, Tebriz minyatürleri, sanat ile ideoloji arasında sıkı bir ilişki kurar; sanat, yalnızca estetik bir deneyim değil, aynı zamanda Safevî devletinin ideolojik ve siyasi mesajlarını aktaran bir araç hâline gelir. Bu minyatürler, hem sanat tarihi hem de ideoloji çalışmaları açısından çözümlemeye açık, çok katmanlı ve zengin bir kültürel miras sunmaktadır.

Anahtar Kelimeler: Tebriz Minyatür Okulu, Kızılbaşlık, Safevîler, Görsel ideolojik temsil, sembolizm

SYMBOLISM AND AESTHETIC PERCEPTION OF QIZILBASH IN THE TABRIZ SCHOOL OF MINIATURE PAINTING

ABSTRACT

The Tabriz Miniature School, which emerged under the patronage of the Safavid court in the mid-16th century, represents one of the most significant branches of Eastern painting. This school not only demonstrates technical mastery and aesthetic richness but also functions as a visual manifestation of Safavid ideology**.** Kizilbash identity, as depicted in Tabriz miniatures, serves not merely as a descriptive element but as a carrier of a complex ideological and aesthetic system**.**

The study highlights how Kizilbash figures, headgear, costumes, color schemes, and gestures create a symbolic language within these miniatures. The use of red, white, blue, and gold conveys Safavid ideals such as courage, faith, and martyrdom. Headpieces and clothing visually encode political hierarchy and religious affiliation, while hand movements and gaze directions reinforce spiritual and ideological messages. Furthermore, ritual scenes and battle depictions emphasize both the spiritual and political roles of the Kizilbash**,** illustrating the ideological centrality of these figures through compositional strategies and symbolic representation.

Ultimately, Tabriz miniatures establish a close relationship between art and ideology. They demonstrate that art functions not only as an aesthetic experience but also as a medium for transmitting the Safavid state's ideological and political messages**.** These miniatures constitute a multi-layered cultural heritage, offering rich material for both art historical and ideological analysis, and revealing the intricate interplay of visual aesthetics, religious symbolism, and political legitimacy in Safavid Azerbaijan.

Keywords: Tabriz Miniature School, Kizilbash, Safavids, Visual ideological representation, symbolism

SYMBIOGENISIS; EVOLUTION THROUGH SYMBIOSIS: CONCEPTUALIZING A THIRD SPACE FOR EMPLOYEE WELL-BEING

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Abstract

"DHA Employee Nexus" proposes an innovative workplace intervention that redefines the conventional employee environment by integrating a purposeful third space (proposed by Edward Soja) within the existing building fabric. Grounded in the biological concept of symbiogenesis—a mutually beneficial interaction between two symbionts—the project conceptualizes the new architectural intervention and the existing structure as co-evolving entities. Together, they generate a unified, healthier, and more adaptive work ecosystem.

Emerging from post-pandemic shifts, where employees faced heightened stress, social disconnection, and rigid workplace cultures, this third space serves as a transitional zone bridging traditional and contemporary work environments. The design emphasizes employee wellness and well-being, employing a spatial programming strategy inspired by the chakra system, where each spatial zone corresponds to a specific chakra's emotional, psychological, and physical attributes. This alignment promotes balance, harmony, and holistic restoration for users.

The third space supports social interaction and community-building among employees from diverse departments, reducing isolation and improving collaborative energy. Future-focused amenities—such as art therapy studios, gaming zones, and yoga and fitness areas—address mental, emotional, and physical health needs, reinforcing the project's commitment to comprehensive well-being.

In short, the symbiogenesis-driven integration of the new intervention with the existing building, combined with chakra-informed spatial programming, establishes a transformative environment that nurtures employee well-being, enhances workplace harmony, and fosters a resilient, interconnected organizational culture.

Keywords: *Chakras, employee well-being, post-pandemic challenges, social isolation, symbiogenesis, third space*

İŞ TATMİNİNİN SANAL KAYTARMA DAVRANIŞLARI ÜZERİNDEKİ ETKİSİNDE İŞE BAĞLILIĞIN ARACI ROLÜ: OTEL ÇALIŞANLARI ÜZERİNE BİR ARAŞTIRMA

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ÖZET

Dijital teknolojilerin çalışma yaşamında yaygınlaşmasıyla birlikte çalışanların mesai saatleri içerisinde iş dışı internet kullanımına yönelmesi, örgütsel verimlilik açısından önemli bir sorun alanı olarak öne çıkmaktadır. Literatürde sanal kaytarma olarak kavramsallaştırılan bu davranışların, çalışanların işlerine yönelik tutumlarıyla yakından ilişkili olduğu görülmektedir. Bu araştırmanın amacı, otel çalışanlarında iş tatmini ile sanal kaytarma davranışları arasındaki ilişkiyi incelemek ve bu ilişkide işe bağlılığın aracı rolünü ortaya koymaktır. Araştırma, nicel araştırma yöntemlerinden korelasyonel desende gerçekleştirilmiştir. Çalışma grubunu Gaziantep ilinde faaliyet gösteren otellerde çalışan 444 kişi oluşturmaktadır. Veriler; Demografik Bilgi Formu, İş Tatmini Ölçeği, Sanal Kaytarma Ölçeği ve İşe Bağlılık Ölçeği aracılığıyla toplanmıştır. Elde edilen veriler SPSS programı kullanılarak analiz edilmiş; betimleyici istatistikler, Pearson korelasyon analizi, bağımsız örneklem t-testi, tek yönlü varyans analizi (ANOVA) ve çoklu regresyon analizi uygulanmış; aracılık analizi ise Hayes tarafından geliştirilen PROCESS Macro (Model 4) aracılığıyla gerçekleştirilmiştir. Araştırma bulguları, iş tatmini ile sanal kaytarma davranışları arasında anlamlı ve negatif yönlü bir ilişki bulunduğunu ($r= -.46$; $p<0.01$) ; iş tatmini ile işe bağlılık arasında ise anlamlı ve pozitif yönlü bir ilişki olduğunu göstermektedir ($r= .62$; $p<0.01$). Ayrıca işe bağlılık ile sanal kaytarma davranışları arasında anlamlı ve negatif yönde bir ilişki olduğu tespit edilmiştir. ($r= -.36$; $p<0.01$). Yapılan aracılık analizi sonuçlarına göre, iş tatmininin sanal kaytarma üzerindeki etkisinde işe bağlılığın anlamlı ve kısmi bir aracı rolü olduğu belirlenmiştir ($b= -.19$, $p<0.01$). Elde edilen bulgular, çalışanların iş tatmini ve işe bağlılık düzeylerinin artırılmasının sanal kaytarma davranışlarını azaltmada önemli bir mekanizma sunduğunu ortaya koymaktadır. Bu çalışma, iş tatmini ile sanal kaytarma arasındaki ilişkide işe bağlılığın aracı rolünü otel çalışanları örnekleminde ortaya koyarak, literatüre özgün bir katkı sunmaktadır.

Anahtar Kelimeler: İş Tatmini, Sanal Kaytarma, İşe Bağlılık

THE MEDIATING ROLE OF JOB COMMITMENT IN THE EFFECT OF JOB SATISFACTION ON CYBERLOAFING BEHAVIORS: A STUDY ON HOTEL EMPLOYEES

ABSTRACT

With the widespread adoption of digital technologies in working life, employees' tendency to use the internet outside of work hours has emerged as a significant problem area in terms of organizational productivity. These behaviors, conceptualized as cyberloafing in the literature, are seen to be closely related to employees' attitudes towards their jobs. The aim of this research is to examine the relationship between job satisfaction and cyberloafing behaviors in hotel employees and to reveal the mediating role of job commitment in this relationship. The research was conducted using a correlational design, one of the quantitative research methods. The study group consisted of 444 people working in hotels operating in Gaziantep province. Data were collected through the Demographic Information Form, Job Satisfaction Scale, Cyberloafing Scale, and Job Commitment Scale. The obtained data were analyzed using the SPSS program; descriptive statistics, Pearson correlation analysis, independent samples t-test, one-way analysis of variance (ANOVA), and multiple regression analysis were applied; Mediation analysis was performed using the PROCESS Macro (Model 4) developed by Hayes. The research findings show a significant and negative relationship between job satisfaction and cyberloafing behavior ($r = -.46$; $p < 0.01$); and a significant and positive relationship between job satisfaction and job commitment ($r = .62$; $p < 0.01$). Furthermore, a significant and negative relationship was found between job commitment and cyberloafing behavior ($r = -.36$; $p < 0.01$). According to the mediation analysis results, job commitment played a significant and partial mediating role in the effect of job satisfaction on cyberloafing ($b = -.19$, $p < 0.01$). These findings indicate that increasing employees' job satisfaction and job commitment levels offers an important mechanism for reducing cyberloafing behavior. This study provides a unique contribution to the literature by demonstrating the mediating role of job commitment in the relationship between job satisfaction and cyberloafing in a sample of hotel employees.

Keywords: Job Satisfaction, Cyberloafing, Job Commitment

KADINLARDA DİKKAT EKSİKLİĞİ VE HİPERAKTİVİTE BOZUKLUĞU BELİRTİLERİ, TIKINIRCASINA YEME DAVRANIŞI VE DUYGU DÜZENLEME GÜÇLÜĞÜ ARASINDAKİ İLİŞKİLERİN İNCELENMESİ

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ÖZET

Güncel araştırmalar, dikkat eksikliği ve hiperaktivite bozukluğu (DEHB) belirtilerinin yalnızca çocuklukla sınırlı kalmayıp yetişkinlik döneminde de yüksek oranda devam ettiğini ortaya koymaktadır. Yetişkin DEHB olgularında komorbiditelerin belirgin biçimde arttığı; özellikle anksiyete ve duygudurum bozukluklarının bu popülasyonda yaygın olarak görüldüğü bilinmektedir. Literatür, DEHB tanısı almış bireylerin yaklaşık %20'sinde yeme bozukluğu eş tanısı bulunduğunu ve bu bireylerin tıkınırcasına yeme davranışı açısından genel popülasyona kıyasla anlamlı düzeyde daha yüksek risk taşıdığını göstermektedir. DEHB'nin temel bileşenleri olan dürtüsellik, hiperaktivite ve dikkat eksikliği; tıkınırcasına yeme davranışının patofizyolojisinde önemli bir rol oynayan dürtü kontrolü sorunlarıyla yakından ilişkilidir. Ayrıca DEHB'li bireylerde duygu düzenleme güçlüğünün yaygın olduğu ve bu güçlüğün olumsuz duygulanım karşısında aşırı yeme eğilimini artırabildiği bilinmektedir.

Bu araştırmanın amacı, kadınlarda DEHB belirtileri, tıkınırcasına yeme davranışı ve duygu düzenleme güçlüğü (DDG) arasındaki ilişkileri incelemektir. Çalışmanın örneklemini 18 yaş üzeri 388 kadın katılımcı oluşturmuştur. Veriler, Erişkin DEHB Kendi Bildirim Ölçeği (ASRS), Tıkınırcasına Yeme Ölçeği (TYÖ) ve Duygu Düzenleme Güçlüğü Ölçeği-Kısa Form (DDGÖ-16) kullanılarak toplanmış; veri analizlerinde SPSS 27 ve LISREL 8.51 programları kullanılmıştır.

Bulgular, DEHB belirtilerinin duygu düzenleme güçlüğü üzerinde güçlü ve anlamlı bir etkiye sahip olduğunu ($\beta = 0.71$) göstermiştir. Ayrıca DEHB'nin tıkınırcasına yeme üzerindeki doğrudan etkisi anlamlı bulunmuştur ($\beta = 0.26$). DDG'nin tıkınırcasına yeme üzerindeki etkisi de anlamlıdır ($\beta = 0.29$). Korelasyonlar, DEHB–DDG ilişkisinin güçlü pozitif ($r = 0.71$), DEHB–tıkınırcasına yeme ve DDG–tıkınırcasına yeme ilişkilerinin ise orta düzeyde pozitif olduğunu göstermektedir ($r = 0.47$). Elde edilen sonuçlar, değişkenler arasında tutarlı ve anlamlı ilişkiler bulunduğuna işaret etmektedir.

Anahtar Kelimeler: dikkat eksikliği ve hiperaktivite bozukluğu, tıkınırcasına yeme, duygu düzenleme güçlüğü

EXAMINING THE RELATIONSHIPS BETWEEN ADHD SYMPTOMS, BINGE EATING BEHAVIOR AND EMOTION REGULATION DIFFICULTIES IN WOMAN

ABSTRACT

Current research demonstrates that symptoms of attention-deficit/hyperactivity disorder (ADHD) are not confined to childhood but frequently persist into adulthood at a substantial rate. In adult ADHD cases, comorbidities markedly increase; in particular, anxiety and mood disorders are widely observed within this population. The literature indicates that approximately 20% of individuals diagnosed with ADHD also meet criteria for an eating disorder, and that these individuals carry a significantly higher risk of engaging in binge-eating behaviors compared to the general population. The core components of ADHD—impulsivity, hyperactivity, and inattention—are closely associated with impulse-control difficulties, which play an important role in the pathophysiology of binge eating. Additionally, emotion regulation difficulties are common among individuals with ADHD, and such difficulties may enhance the tendency to overeat in response to negative affect.

The aim of the present study is to examine the relationships among ADHD symptoms, binge-eating behavior, and emotion regulation difficulties (ERD) in women. The sample consisted of 388 female participants aged 18 years and older. Data were collected using the Adult ADHD Self-Report Scale (ASRS), the Binge Eating Scale (BES), and the Difficulties in Emotion Regulation Scale–Short Form (DERS-16). SPSS 27 and LISREL 8.51 were used for data analyses.

Findings showed that ADHD symptoms had a strong and significant effect on ERD ($\beta = 0.71$). In addition, the direct effect of ADHD on binge eating was significant ($\beta = 0.26$). The effect of ERD on binge eating was also significant ($\beta = 0.29$). Correlations indicated a strong positive relationship between ADHD and ERD ($r = 0.71$), and moderate positive relationships between ADHD and binge eating, as well as between ERD and binge eating ($r = 0.47$). These results suggest consistent and meaningful associations among the variables examined.

Keywords: attention-deficit/hyperactivity disorder, binge eating, emotion regulation difficulties

MİNDFULNESS İLE DÜŞÜNCE EYLEM KAYNAŞMASI ARASINDAKİ İLİŞKİDE BİLİŞSEL ESNEKLİĞİN ARACI ROLÜNÜN İNCELENMESİ

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ÖZET

Bilinçli farkındalık, bilişsel esneklik ve düşünce-eylem kaynaşması (DEK), bireylerin bilişsel süreçleri ve psikolojik iyi oluşları açısından önemli yapılar olarak görülmektedir. Bu çalışmada, yetişkin bir örneklemde bilinçli farkındalık ve bilişsel esneklik düzeylerinin DEK ile ilişkilerinin incelenmesi ve bilinçli farkındalığın DEK üzerindeki etkisinde bilişsel esnekliğin aracı bir rolünün bulunup bulunmadığının değerlendirilmesi amaçlanmıştır. Araştırmanın örneklemini 18–65 yaş aralığında, psikiyatrik tanı bildirmeyen 346 yetişkin oluşturmuştur. Katılımcılara Bilinçli Farkındalık Ölçeği (BİFÖ), Bilişsel Esneklik Envanteri (BEE) ve Düşünce–Eylem Kaynaşması Ölçeği (DEK) uygulanmış, veriler SPSS 27 ile analiz edilmiştir. Tüm ölçeklerin iç tutarlılık katsayıları .82–.93 arasında bulunmuştur. Korelasyon analizlerinde bilinçli farkındalık ile bilişsel esneklik arasında pozitif yönlü orta düzeyde (r = .304), DEK toplam puanı ile negatif yönlü anlamlı bir ilişki (r = –.268) saptanmıştır. Bilinçli farkındalık özellikle DEK Olasılık alt boyutuyla güçlü negatif ilişki göstermiştir (r = –.383). Basit regresyon analizinde bilinçli farkındalığın bilişsel esnekliği anlamlı biçimde yordadığı görülmüş (R^2 = .093), ancak çoklu regresyonda bilişsel esnekliğin DEK'e anlamlı katkı sunmadığı belirlenmiştir. Bilişsel esnekliğin DEK toplam puanı ile anlamlı ilişkisi bulunmadığından aracılık analizi yapılmamış; hiyerarşik regresyonda bilişsel esneklik modele eklendiğinde DEK üzerindeki varyans artışının anlamlı olmadığı görülmüştür (ΔR^2 = .001). Sonuç olarak, bilinçli farkındalık düzeyinin artmasının DEK eğilimini azalttığı, bilişsel esnekliğin ise bu ilişkide aracı rol oynamadığı anlaşılmaktadır. Bulgular, bilinçli farkındalığın DEK üzerindeki koruyucu etkisini desteklemektedir.

Anahtar Kelimeler: Bilinçli farkındalık, bilişsel esneklik, düşünce–eylem kaynaşması, aracılık modeli

EXAMINING THE MEDIATING ROLE OF COGNITIVE FLEXIBILITY IN THE RELATIONSHIP BETWEEN MINDFULNESS AND THOUGHT–ACTION FUSION

ABSTRACT

Mindfulness, cognitive flexibility, and thought–action fusion (TAF) are considered important constructs for understanding individuals' cognitive processes and psychological well-being.

This study aimed to examine the relationships between mindfulness and cognitive flexibility with TAF in an adult sample, and to evaluate whether cognitive flexibility plays a mediating role in the effect of mindfulness on TAF. The sample consisted of 346 adults aged 18–65 who did not report any psychiatric diagnosis. Participants completed the Mindful Attention Awareness Scale (MAAS), the Cognitive Flexibility Inventory (CFI), and the Thought–Action Fusion Scale (TAFS). Data were analyzed using SPSS 27. Internal consistency coefficients for all scales ranged between .82 and .93. Correlation analyses revealed a moderate positive relationship between mindfulness and cognitive flexibility (r = .304), and a significant negative relationship between mindfulness and total TAF scores (r = –.268). Mindfulness showed a stronger negative association with the Likelihood TAF subscale (r = –.383). Simple regression analysis indicated that mindfulness significantly predicted cognitive flexibility (R^2 = .093), whereas multiple regression analysis showed that cognitive flexibility did not make a significant contribution to TAF. Since cognitive flexibility was not significantly associated with total TAF scores, the conditions for testing mediation were not met, and hierarchical regression confirmed that adding cognitive flexibility to the model did not significantly increase the explained variance (ΔR^2 = .001). Overall, the findings indicate that higher mindfulness is associated with lower TAF tendencies, while cognitive flexibility does not mediate this relationship. These results support the protective role of mindfulness in reducing TAF.

Keywords: mindfulness, cognitive flexibility, thought–action fusion, mediation model

GİRİŞ

Son yıllarda psikoloji literatüründe giderek artan ilgi gören mindfulness (bilinçli farkındalık), bireyin düşünce, duygu ve diğer şimdiki an deneyimlerini yargılamadan gözlemleyebilmesini sağlayarak otomatik ve yıkıcı tepkilerden uzaklaşmasına yardımcı olmayı amaçlayan bir süreç olarak tanımlanmaktadır (American Psychological Association Dictionary of Psychology, 2018). Kabat-Zinn'e (2005, 2013, 2015) göre mindfulness, dikkatin bilinçli ve amaçlı biçimde şu ana yöneltilmesi ve yargılamadan sürdürülmesi anlamına gelmekte; meditasyon ise bu dikkati ve farkındalığı geliştirmeyi ve gündelik yaşama entegre etmeyi hedefleyen bir uygulama olarak ele alınmaktadır. Mindfulness'ın psikolojik açıklamalarında farklı modeller geliştirilmiş; Creswell (2017), mindfulness'ı yalnızca geçici bir dikkat durumu değil, bilişsel süreçleri düzenlemeye katkı sağlayan kalıcı bir özellik olarak değerlendirmiştir. Benzer biçimde, mindfulness'ın düşüncelerin yalnızca zihinsel olaylar olarak fark edilmesini desteklediği ve dikkatin şu ana yönlendirilmesini kolaylaştırdığı vurgulanmıştır (Baer, 2003; Brown & Ryan,

2003). Nörobiyolojik düzeyde ise mindfulness uygulamalarının öğrenme, duygu düzenleme ve öz farkındalıkla ilişkili beyin ağlarında yapısal ve işlevsel değişikliklerle ilişkili olabileceği bildirilmiştir (Hölzel ve ark., 2011). Mindfulness'ın dikkat, niyet ve tutum bileşenlerinden oluştuğu; özellikle kabul, yargısızlık, şefkat ve anda kalabilme gibi tutumların uygulamalarda merkezi bir rol oynadığı ifade edilmektedir (Shapiro ve ark., 2006; Atalay, 2019).

Mindfulness temelli müdahalelerin klinik alandaki yaygınlaşması, Kabat-Zinn (1990) tarafından geliştirilen Farkındalık Temelli Stres Azaltma Programı (MBSR) ile başlamış; zamanla bu yaklaşım çeşitli psikoterapi modellerine ve psikopatolojilere uyarlanmıştır. MBSR'nin stres, kaygı ve depresyon düzeylerini azaltabildiği; psikolojik iyilik halini artırabildiği ve bazı çalışmalarda anksiyete üzerinde antidepresan tedavilerle karşılaştırılabilir etkiler gösterebildiği rapor edilmiştir (Goldin ve Gross, 2010; Alzahrani ve ark., 2023; Hoge ve ark., 2023). MBSR ile bilişsel terapi tekniklerinin birleştirilmesiyle geliştirilen Mindfulness Temelli Bilişsel Terapi'nin (MBCT) ise özellikle depresyon nüksünü azaltmada etkili olduğu gösterilmiştir (Segal ve ark., 2002; Ma & Teasdale, 2004; Fennell & Segal, 2013). Güncel meta-analizler, mindfulness temelli müdahalelerin depresyon ve anksiyete bozuklukları başta olmak üzere çeşitli klinik alanlarda kanıta dayalı tedaviler kadar etkili olabileceğini göstermektedir (Goldberg ve ark., 2018; Wielgosz ve ark., 2019; Fortes ve ark., 2025). Bu bulgular, mindfulness'ın yalnızca yargısız farkındalık değil, bilişsel süreçlerin işleyişiyle yakından ilişkili bir yapı olduğunu düşündürmektedir (Dreyfus, 2013).

Bu çalışmada ele alınan bir diğer yapı olan düşünce–eylem kaynaşması (DEK), bireyin zihnine gelen istemsiz düşüncelerin önemini ve sonuçlarını aşırı biçimde değerlendirme eğilimi olarak tanımlanmakta ve bilişsel bir yanılgı olarak ele alınmaktadır (Shafran ve ark., 1996). APA Dictionary of Psychology'ye (2018) göre DEK, rahatsız edici bir olayı düşünmenin ahlaki olarak o eylemi gerçekleştirmeye eşdeğer olduğu inancı (ahlaki DEK) ya da yalnızca düşünmenin olayın gerçekleşme olasılığını artırdığı inancı (olasılık DEK) biçiminde iki boyutta değerlendirilmektedir. DEK, özellikle obsesif kompulsif bozukluk (OKB) literatüründe, takıntılı düşünce ile kompulsif davranış arasında ara bir bilişsel süreç olarak ele alınmakta ve takıntılara atfedilen anlamları yansıtan bir inanç örüntüsü olarak değerlendirilmektedir (Thompson-Hollands ve ark., 2013). DEK'in OKB semptomlarıyla güçlü ilişkiler gösterdiği; ancak anksiyete, depresyon, yeme bozuklukları ve psikotik belirtilerle de ilişkili olabileceği bildirilmiştir (Berle & Starcevic, 2005; Rassin ve ark., 2001; Piri & Kabakçı, 2007). Ayrıca

DEK'in dikkat süreçleri ve varsayılan mod ağıyla ilişkili olabileceğine dair nörobiyolojik bulgular da raporlanmıştır (Jones & Bhattacharya, 2013; Lee ve ark., 2019; Lee ve ark., 2024). Bilişsel esneklik, değişen çevresel taleplere uyum sağlama, alternatifleri değerlendirebilme ve zihinsel setler arasında geçiş yapabilme becerisi olarak tanımlanmakta ve yürütücü işlevlerin temel bileşenlerinden biri olarak görülmektedir (Scott, 1962; Cañas ve ark., 2006; Uddin, 2021). Karar verme literatüründe, bireylerin bilişsel sınırlılıklar nedeniyle sıklıkla sezgisel ve basitleştirici stratejiler kullandıkları vurgulanmakta; bilişsel esnekliğin bu katı örüntüleri esnetme kapasitesiyle ilişkili olduğu belirtilmektedir (Tversky & Kahneman, 1974; Payne ve ark., 1993). Bu yönüyle bilişsel esneklik, Bilişsel Davranışçı Terapi'nin hedefleriyle örtüşmekte ve işlevsel alternatiflerin fark edilmesini destekleyen bir süreç olarak ele alınmaktadır (Johnco ve ark., 2013; Aslan & Türk, 2022). Nörobiyolojik açıdan ise bilişsel esnekliğin frontoparietal ve frontostriatal ağlarla ilişkili olduğu ve bu yapılardaki işlev bozukluklarının bilişsel katılık ile ilişkili olabileceği bildirilmektedir (Uddin, 2021; Kupis & Uddin, 2023; Cole, 2024).

Literatürde mindfulness ile bilişsel esneklik arasında pozitif ilişkiler raporlanmış; farkındalığın dikkat ve üstbilişsel süreçler yoluyla esnekliği destekleyebileceği öne sürülmüştür (Moore & Malinowski, 2009; Zou ve ark., 2020; Arora, 2025). Buna paralel olarak, DEK'in düşünce içeriklerine atfedilen anlamlara dayanan metabilişsel bir inanç örüntüsü olduğu; bilişsel kaynaşma ve tekrarlayıcı bilişsel süreçlerle ilişkili biçimde ele alındığı belirtilmektedir (Reuman ve ark., 2016; Reuman ve ark., 2017). Buna karşılık, mindfulness ile düşüncelerin yalnızca zihinsel olaylar olarak fark edilmesi ve bilişsel kaynaşma arasında anlamlı ilişkiler bildirildiği; bilişsel kaynaşma düzeyleri ile bilişsel esneklik arasında ise ters yönlü ilişkiler bulunduğu bildirilmektedir (Zhang ve ark., 2023; Hajitabar ve ark., 2020; Ji ve ark., 2025; Heppt ve ark., 2025). Klinik ve klinik olmayan örneklemlerde yürütülen çalışmalar, mindfulness temelli müdahalelerin DEK üzerinde azaltıcı etkilere sahip olabileceğini ve iki yapı arasında negatif yönlü ilişkiler bulunduğunu göstermektedir (Hanstede ve ark., 2008; Wilkinson-Zorlu ve ark., 2010; Asgharnezhad ve ark., 2024).

Bu çalışmada, yetişkin bir örneklemde bilinçli farkındalık ve bilişsel esneklik düzeylerinin düşünce–eylem kaynaşması ile ilişkilerinin incelenmesi ve bilinçli farkındalığın DEK üzerindeki etkisinde bilişsel esnekliğin aracı bir rolünün bulunup bulunmadığının değerlendirilmesi amaçlanmıştır.

2. YÖNTEM

2.1. Evren ve Örneklem

Araştırmanın evrenini, Türkiye genelinde yaşayan 18–65 yaş aralığındaki yetişkin bireyler oluşturmaktadır. Araştırmanın örneklemi, kolayda örnekleme yöntemi kullanılarak belirlenmiştir. Bunun yanı sıra veri toplama sürecinde katılımcıların anket bağlantısını kendi çevreleriyle paylaşmaları teşvik edilmiş ve bu doğrultuda kartopu (snowball) örnekleme yönteminden de yararlanılmıştır. Araştırmaya toplam 346 yetişkin birey katılmıştır. Katılımcılara erişim, araştırmacı tarafından hazırlanan çevrim içi anket formu aracılığıyla gerçekleştirilmiştir. Anket bağlantısı Instagram, X, LinkedIn, WhatsApp grupları ve e-posta yoluyla paylaşılmıştır. Bunun yanında araştırmacının doğrudan ulaşabildiği bireylerle elden anket yöntemiyle yüz yüze veri toplama süreci de yürütülmüştür. Böylece veri toplama süreci çevrim içi ve yüz yüze yöntemlerin birlikte kullanıldığı karma bir yaklaşım ile gerçekleştirilmiştir.

Dahil edilme kriterleri, katılımcıların 18–65 yaş aralığında olması, en az ilkokul düzeyinde eğitim almış olması, bilgilendirilmiş onam formunu onaylaması, ölçekleri eksiksiz ve tutarlı biçimde doldurması ve herhangi bir psikiyatrik tanı bildirmemiş olması şeklinde belirlenmiştir. Dışlama kriterleri ise 18 yaş altında veya 65 yaş üzerinde olmak, ilkokul düzeyinin altında eğitim durumuna sahip olmak, bilgilendirilmiş onam formunu onaylamamak, ölçekleri eksik ya da tutarsız biçimde doldurmak ve psikiyatrik tanı bildirmiş olmak olarak belirlenmiştir.

2.2. Veri Toplama Araçları

Araştırmada veri toplamak amacıyla Demografik Bilgi Formu, Bilişsel Esneklik Envanteri, Düşünce–Eylem Kaynaşması Ölçeği ve Bilinçli Farkındalık Ölçeği kullanılmıştır.

2.2.1. Demografik Bilgi Formu

Demografik Bilgi Formu aracılığıyla katılımcıların yaş, cinsiyet, eğitim düzeyi ve psikiyatrik tedavi geçmişlerine ilişkin bilgiler toplanmıştır.

2.2.2. Bilişsel Esneklik Envanteri

Bilişsel Esneklik Envanteri, bireylerin bilişsel esneklik düzeylerini değerlendirmek amacıyla Dennis ve Vander Wal (2010) tarafından geliştirilmiştir. Ölçek 20 maddeden oluşmakta ve "Alternatifler" ile "Kontrol" olmak üzere iki alt boyut içermektedir. Ölçekten elde edilen yüksek puanlar, yüksek bilişsel esneklik düzeyini göstermektedir. Maddeler 1 (Hiç uygun değil) ile 5 (Tamamen uygun) arasında puanlanan 5'li Likert tipi bir derecelendirme ile yanıtlanmaktadır. Ölçeğin Türkçe uyarlaması Gülüm ve Dağ (2012) tarafından yapılmıştır.

Türkçe formun Cronbach alfa katsayısı ölçeğin tamamı için .90, Alternatifler alt boyutu için .89 ve Kontrol alt boyutu için .85 olarak rapor edilmiştir. Ölçek için belirlenmiş bir kesme puanı bulunmamaktadır ve değerlendirmeler örneklem ortalamaları üzerinden yapılmaktadır.

2.2.3. Düşünce–Eylem Kaynaşması Ölçeği

Düşünce–Eylem Kaynaşması Ölçeği, bireylerin düşünce ile eylemler arasında kurdukları bilişsel kaynaşma eğilimini değerlendirmek amacıyla Shafran, Thordarson ve Rachman (1996) tarafından geliştirilmiştir. Bu çalışmada ölçeğin 19 maddeden oluşan yenilenmiş formu kullanılmıştır. Türkçe uyarlaması Yorulmaz, Yılmaz ve Gençöz (2004) tarafından yapılmıştır. Türkçe formda maddeler 1 (Kesinlikle katılmıyorum) ile 5 (Kesinlikle katılıyorum) arasında puanlanmakta ve ölçek iki alt boyuttan oluşmaktadır: Ahlaki DEK ve Olasılıksal DEK. Ölçekten elde edilen toplam puanın artması, bireyin düşünce–eylem kaynaşması eğiliminin arttığını göstermektedir. Türkçe uyarlama çalışmasında ölçeğin alt boyutlarına ilişkin güvenirlik katsayılarının .72 ile .86 arasında değiştiği bildirilmiştir.

2.2.4. Bilinçli Farkındalık Ölçeği

Bilinçli Farkındalık Ölçeği, bireylerin günlük yaşamlarındaki şimdiki an deneyimlerine yönelik farkındalık ve dikkat düzeylerini değerlendirmek amacıyla Brown ve Ryan (2003) tarafından geliştirilmiştir. Ölçek 15 maddeden oluşmakta ve tek boyutlu bir yapı sergilemektedir. Maddeler 6'lı Likert tipi bir derecelendirme ile yanıtlanmakta; yüksek puanlar daha yüksek bilinçli farkındalık düzeyini göstermektedir. Ölçeğin Türkçe uyarlaması Özyeşil, Arslan, Kesici ve Deniz (2011) tarafından yapılmıştır. Türkçe formun Cronbach alfa katsayısı .80, test–tekrar test güvenirlik katsayısı ise .86 olarak rapor edilmiştir. Bulgular, ölçeğin geçerli ve güvenilir bir ölçme aracı olduğunu göstermektedir.

2.3. İşlem

Araştırmaya başlanmadan önce gerekli etik ve idari izinler alınmıştır. Veri toplama sürecinde kullanılan anket formu araştırmacı tarafından Google Forms üzerinden hazırlanmıştır. Veri toplama iki aşamada gerçekleştirilmiştir. İlk aşamada çevrim içi anket bağlantısı sosyal medya platformları ve e-posta yoluyla paylaşılmış, katılımcıların bağlantıyı kendi çevreleriyle paylaşmaları teşvik edilmiştir. İkinci aşamada ise araştırmacının doğrudan ulaşabildiği bireylerle elden anket uygulanmıştır. Elden uygulamada, çevrim içi form ile birebir aynı içeriğe sahip basılı anketler kullanılmıştır. Her iki veri toplama yönteminde de gönüllülük esas alınmış ve tüm katılımcılara Bilgilendirilmiş Onam Formu sunulmuştur. Onamı kabul eden katılımcılar sırasıyla Demografik Bilgi Formu, Bilişsel Esneklik Envanteri, Düşünce–Eylem Kaynaşması

Ölçeği ve Bilinçli Farkındalık Ölçeğini doldurmuşlardır. Uygulama sırası tüm katılımcılar için standartlaştırılmıştır. Veri toplama süreci ortalama 8–10 dakika sürmüştür. Veri toplama tamamlandıktan sonra tüm veriler SPSS 27.0 programına aktarılmıştır. Katılımcılara ait veriler anonim olarak kodlanmış, kişisel kimlik bilgisi toplanmamıştır. Analiz öncesinde eksik veri, uç değer ve dahil edilme kriterlerine uygunluk kontrolleri yapılmış; yalnızca geçerli ve güvenilir veriler analiz sürecine dahil edilmiştir.

3. BULGULAR

3.1.Katılımcılar

Çalışmaya toplam 346 yetişkin katılmıştır. Katılımcıların %68,8'i kadındır; yaş dağılımı 18–25 (%20,8), 26–40 (%35,5) ve 41–65 (%43,6) olarak sınıflandırılmıştır. Katılımcıların %66,2'si lisans, %17,9'u lisansüstü mezunudur.

3.2. Tanımlayıcı istatistikler ve güvenirlik

BİFÖ, BEE ve DEK puanlarına ilişkin minimum–maksimum değerler, ortalama–standart sapmalar ve Cronbach alfa katsayıları Tablo 1'de sunulmuştur. Ölçeklerin iç tutarlılık katsayıları .823 ile .935 aralığında bulunmuştur.

Tablo 1. Ölçeklere Ait Tanımlayıcı İstatistikler ve Araştırma Verilerinin Dağılımına İlişkin Bulgular

Ölçek	n	Min	Maks	$\bar{X}$	SS	Basıklık	Çarpıklık	Cronbach Alpha (α)
BİFÖ	346	15	90	61.6908	14.9862	-0.249	-0.484	.897
BEE TOPLAM	346	2.07	5	3.9027	0.5780	-0.423	-0.059	.887
BEE KONTROL	346	1.29	5	3.7353	0.7962	-0.498	-0.304	.823
BEE ALTERNATİFLER	346	1.08	5	4.0700	0.6664	2.078	-1.034	.921
DEK TOPLAM	346	.0	4	1.3958	0.9607	-0.249	0.588	.926
DEK AHLAK	346	.0	4	1.6905	1.0801	-0.916	0.254	.911

3.3. Demografik değişkenlere göre farklılıklar

Yaş gruplarına göre BİFÖ toplam puanı ($F=5.669$, $p=.004$) ve BEE toplam puanı ($F=7.851$, $p<.001$) anlamlı farklılaşmış; DEK toplam ve alt boyutlarında yaşa göre anlamlı fark saptanmamıştır ($p>.05$). Cinsiyete göre yalnızca BEE toplam ($t=-3.464$, $p=.001$) ve BEE Kontrol ($t=-4.044$, $p<.001$) puanlarında fark bulunmuş; diğer ölçeklerde anlamlı fark saptanmamıştır. Medeni duruma göre BİFÖ ($p=.017$), BEE toplam ($p=.044$) ve BEE Kontrol ($p=.040$) puanları ilişkisi olan grupta daha yüksek bulunurken, DEK puanları anlamlı farklılaşmamıştır ($p>.05$). Eğitim düzeyine göre BİFÖ ve BEE puanları anlamlı farklılaşmazken, DEK toplam ($F=8.485$, $p<.001$) ve alt boyutları (Ahlak: $F=12.024$, $p<.001$; Olasılık: $F=4.601$, $p=.011$) anlamlı farklılaşmıştır. Tedavi durumuna göre BEE toplam

(U=5683.000, p=.035) ve BEE Kontrol (U=5451.000, p=.013) ile DEK Ahlak (U=5702.500, p=.038) puanlarında anlamlı farklılık bulunmuştur. Çalışma durumuna göre BİFÖ (p=.027), BEE toplam (p=.010), BEE Kontrol (p=.010) ve DEK toplam (p=.027) puanları anlamlı farklılaşmıştır.

3.4. Değişkenler arası ilişkiler

Pearson korelasyon analizine göre bilinçli farkındalık ile bilişsel esneklik arasında pozitif yönlü ilişki vardır (r=.304, p<.01). Bilinçli farkındalık, DEK toplam (r=-.268, p<.01) ve özellikle DEK Olasılık alt boyutu (r=-.383, p<.01) ile negatif yönde ilişkilidir. BEE toplam ile DEK toplam arasında anlamlı ilişki bulunmamıştır (r=-.051, p=.342). Korelasyon katsayıları Tablo 2'de sunulmuştur.

Tablo 2. Bilinçli Farkındalık, Bilişsel Esneklik ve Düşünce-Eylem Kaynaşması Arasındaki İlişkinin İncelenmesi

Ölçek	1	2	3	4	5	6	7
1-Bilinçli Farkındalık	1						
2-Bilişsel Esneklik	.304**	1					
4-Kontrol	.390**	.829**	1				
5-Alternatifler	.063	.744**	.244**	1			
8-Düşünce Eylem Kaynaşması	-.268**	-.051	-.150**	.091	1		
9-Ahlak	-.063	.039	-.061	.141**	.842	1	
10-Olasılık	-.383**	-.120**	-.190**	.019	.867**	.460**	1

***p<0.01, *p<0.05 Uygulanan testin ismi: Pearson Korelasyon Testi*

4.5. Regresyon analizleri

Basit doğrusal regresyon analizinde bilinçli farkındalık bilişsel esnekliği anlamlı olarak yordamıştır (β=.304, t=5.927, p<.001) ve model bilişsel esneklikteki varyansın %9.3'ünü açıklamıştır (R^2=.093; F(1,344)=35.129, p<.001). Çoklu regresyon analizinde bilinçli farkındalık DEK toplam puanını negatif yönde anlamlı biçimde yordamış (β=-.278, p<.001),

bilişsel esneklik ise DEK'yi anlamlı biçimde yordamamıştır (β=.033, p=.540). Model anlamlı olup DEK varyansının yaklaşık %7.3'ünü açıklamıştır (F(2,343)=13.48, p<.001; R^2=.073). Aracılık analizinin ön koşullarından biri olan aracı değişken (BEE) ile bağımlı değişken (DEK) arasındaki ilişkinin anlamsız olması (r=-.051, p=.342) nedeniyle aracılık testi yürütülmemiştir.

Tablo 3. Regresyon Analizlerine İlişkin Bulguların Özeti

Model	Yordayıcı	B	β	t	p	R^2
Basit	Bilinçli Farkındalık → BEE	0.012	0.304	5.93	<.001	.093
Çoklu	Bilinçli Farkındalık → DEK	-0.018	-0.278	-5.10	<.001	.073
	Bilişsel Esneklik → DEK	0.056	0.033	0.61	.540	
Hiyerarşik (1)	Bilinçli Farkındalık → DEK	-0.017	-0.268	-5.16	<.001	.072
Hiyerarşik (2)	Bilinçli Farkındalık → DEK	-0.018	-0.278	-5.10	<.001	.073
	Bilişsel Esneklik → DEK	0.056	0.033	0.61	.540	ΔR^2=.001

Not. BEE: Bilişsel Esneklik, DEK: Düşünce–Eylem Kaynaşması.

****p<.001, **p<.01, *p<.05; Not, GA: Güven Aralığı*

4. TARTIŞMA

Bu çalışmada bilinçli farkındalık, bilişsel esneklik ve düşünce–eylem kaynaşması arasındaki ilişkiler klinik olmayan bir örneklemde incelenmiş ve bulgular alan yazın çerçevesinde değerlendirilmiştir. Genel olarak sonuçlar, mindfulness ve bilişsel esnekliğin ruh sağlığını destekleyen süreçler olabileceğini vurgulayan literatürle uyumlu bir örüntü ortaya koymaktadır (Gürpınar & İkiz, 2022).

Korelasyon ve regresyon bulguları, bilinçli farkındalığın bilişsel esneklikle pozitif ve anlamlı biçimde ilişkili olduğunu ve bilişsel esnekliği anlamlı düzeyde yordadığını göstermiştir. Bu sonuç, mindfulness ile bilişsel esneklik arasında pozitif ilişki bildiren çalışmalarla tutarlıdır (Moore & Malinowski, 2009; Bekirler & Günay Bilaloğlu, 2022; İmiroğlu ve ark., 2021; Gürpınar, 2021; Peker Akman & Demir, 2021; Stenhaug & Solem, 2024). Mindfulness temelli müdahalelerin bilişsel esneklik üzerinde etkili olabildiğini bildiren çalışmalar (Zou ve ark.,

2020) ve mindfulness/pozitif psikoloji temelli eğitimlerin bilişsel esnekliği artırabildiğini gösteren bulgular (Charness ve ark., 2023) da bu ilişkiyi destekler niteliktedir. Ayrıca mindfulness'ın yürütücü işlevler bağlamında bilişsel esnekliği etkileyebileceğine işaret eden tematik ve meta-analitik bulgularla da uyumludur (Koch, 2024; Zainal & Newman, 2024).

Alt boyut düzeyinde, bilinçli farkındalık ile bilişsel esnekliğin kontrol boyutu arasında anlamlı ilişki varken alternatifler boyutunda anlamlı ilişki saptanmamıştır. Bu örüntü, bilişsel esnekliğin özellikle kontrol boyutunun psikopatoloji belirtileriyle daha işlevsel ilişkiler sergilediğine ilişkin bulgular dikkate alındığında (Dağ & Gülüm, 2013) kuramsal olarak anlamlı görünmektedir. Literatürde alternatifler boyutu ile mindfulness arasında pozitif fakat düşük düzeyli ilişkiler bildiren çalışmalar olsa da (Mahmut Önalan, 2022; Gürpınar & İkiz, 2022), bu ilişkilerin zayıf olması ve örneklem/analiz farklılıkları nedeniyle mevcut çalışmada anlamlılık eşiğini geçmemiş olabileceği değerlendirilebilir. Nitekim ilgili çalışmalarda da kontrol boyutunun mindfulness ve ruhsal belirtilerle daha güçlü ve tutarlı ilişkiler gösterdiği; alternatifler boyutunun ise her zaman yordayıcı rol üstlenmediği vurgulanmaktadır (Gürpınar & İkiz, 2022; Mahmut Önalan, 2022).

Bu çalışmada bilinçli farkındalık ile düşünce–eylem kaynaşması (DEK) toplam puanı arasında negatif yönlü anlamlı ilişki bulunmuş; özellikle olasılıksal DEK ile ilişki daha belirgin iken ahlaki DEK ile anlamlı ilişki saptanmamıştır. Mindfulness'ın düşüncelere yargısız farkındalıkla yaklaşmayı, düşünceleri "zihinsel olaylar" olarak gözlemlemeyi ve otomatik tepkileri azaltmayı destekleyen bir süreç olduğu tanımları (American Psychological Association Dictionary of Psychology, 2018; Kabat-Zinn, 2005; Brown & Ryan, 2003; Baer, 2003) bu bulguyla kavramsal olarak örtüşmektedir. Alan yazında mindfulness temelli yaklaşımların DEK düzeylerinde azalma ile ilişkili olabileceği bildirilmekte (Hanstede ve ark., 2008; Asli Azad ve ark., 2019) ve deneysel bulgular, mindfulness temelli müdahaleler sonrasında DEK'in azaldığını göstermektedir (Hanstede ve ark., 2008; Asli Azad ve ark., 2019). Klinik olmayan örneklemlerde bilinçli farkındalık ile DEK arasında negatif ilişki bildirilen bulgular (Asgharnezhad ve ark., 2024) da mevcut çalışmanın örüntüsüyle tutarlıdır.

Alt boyutlar bağlamında, olasılıksal DEK'in rahatsız edici bir olayı düşünmenin olayın gerçekleşme olasılığını artırdığına inanma gibi bilişsel yanlılıklarla ilişkili olması (Shafran ve ark., 1996; APA Dictionary of Psychology, 2018) ve düşünce bastırma/nötralizasyon çabalarıyla bağlantısı (Berle & Starcevic, 2005; Altın & Gençöz, 2011) dikkate alındığında, mindfulness'ın özellikle bu boyutla daha güçlü ilişki göstermesi açıklanabilir görünmektedir.

Buna karşılık ahlaki DEK'in daha çok abartılmış sorumluluk, suçluluk ve benlik/değer temelli şemalarla ilişkili olabileceği (Rachman, 1993; Berle & Starcevic, 2005) vurgusu, ahlaki boyutla anlamlı ilişki bulunmamasını açıklayan bir çerçeve sunmaktadır.

Bilişsel esneklik ile DEK toplam puanı arasında anlamlı ilişki saptanmamış; ancak olasılıksal DEK ile negatif ve anlamlı ilişki belirlenmiştir. Bu örüntü, DEK'in özellikle tehdit değerlendirmeleri, kontrol edilebilirlik inançları ve sorumluluk algısı gibi özgül bilişsel yanlılıklarla sürdürüldüğünü vurgulayan yaklaşımlarla uyumludur (Shafran ve ark., 1996; Altın & Gençöz, 2011). Alt boyut düzeyinde bilişsel esnekliğin kontrol boyutunun DEK'le ilişkili bulunması, kontrol algısının olasılıksal değerlendirmelerle daha doğrudan bağ kurabileceğini düşündürmektedir (Gülüm & Dağ, 2012). Buna karşılık alternatifler boyutunun DEK'in çoğu boyutuyla ilişki göstermemesi, bu boyutun daha soyut bir bilişsel özellik olarak kontrol algısına kıyasla DEK'le daha dolaylı ilişkilenebileceği açıklamasıyla uyumludur (Gülüm & Dağ, 2012). Bununla birlikte alternatifler boyutu ile ahlaki DEK arasındaki düşük düzeyli pozitif ilişki, literatürde alternatifler boyutunun bazı işlevsiz bilişsel duygu düzenleme stratejileriyle de ilişkili olabildiğine dair bulgularla birlikte yorumlanmıştır (Demirci & Güneri, 2020).

Regresyon sonuçlarında bilişsel esnekliğin DEK'i anlamlı biçimde yordayamaması ve hiyerarşik modele ek katkı sağlamaması, bilişsel esnekliğin DEK üzerinde doğrudan ve bütüncül bir yordayıcı rol üstlenmeyebileceğini düşündürmektedir. Ayrıca DEK alt boyutları arasındaki ayrışmayı vurgulayan deneysel bulgular, olasılıksal boyutun psikoeğitim/deneysel manipülasyonla daha değişebilir; ahlaki boyutun ise daha sınırlı yanıt verebilir olduğunu göstermekte (Demirsöz, Mısırlısoy & Karancı, 2018) ve bu durum mevcut çalışmada süreç temelli değişkenlerin olasılıksal DEK'le ilişkili bulunmasına karşın ahlaki DEK'le ilişkili bulunmamasını desteklemektedir. Kaya Yıldırım ve Yorulmaz (2021) da ahlaki DEK'in dini/kültürel bağlam, suçluluk ve abartılmış sorumluluk gibi şemalarla daha güçlü biçimde şekillenebileceğini vurgulayarak bu ayrımı kuramsal olarak güçlendirmektedir.

SONUÇ

Bu çalışmada, klinik tanısı bulunmayan yetişkin bir örneklemde bilinçli farkındalık, bilişsel esneklik ve düşünce-eylem kaynaşması arasındaki ilişkiler incelenmiştir. Bulgular, bilinçli farkındalığın bilişsel esneklik ile pozitif yönde; düşünce-eylem kaynaşması ile ise negatif yönde ilişkili olduğunu göstermektedir. Buna karşılık, bilişsel esnekliğin düşünce-eylem kaynaşmasını doğrudan yordamadığı ve bilinçli farkındalık ile düşünce-eylem kaynaşması arasındaki ilişkide aracı bir rol üstlenmediği belirlenmiştir. Genel olarak elde edilen sonuçlar,

bilinçli farkındalığın hem uyumlu bilişsel süreçlerle ilişkili olduğunu hem de düşünce-eylem kaynaşması gibi işlevsiz bilişsel örüntülerle ters yönlü bir bağlantı sergilediğini ortaya koymakta; bu yönüyle normal popülasyonda söz konusu yapılar arasındaki ilişkilerin anlaşılmasına katkı sağlamaktadır.

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EXPERIENCES OF ELDERLY RESIDENTS IN RESIDENTIAL CARE HOMES

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Abstract.

This study presents a qualitative case study on the daily experiences of older adults living in a Permanent/Residential Care Center in Arad, Romania. It explores how life in an institutional setting can influence an older adult's emotional well-being, independence, social relationships, and quality of care, from the perspective of a Social Work student. Using direct observation and informal discussions with an older adult, the paper presents the personal experience of the resident. The results show that, although Residential Centers provide significant benefits such as safety and support, residents often face challenges such as loneliness, limited independence, and reduced opportunities to engage in activities they previously had easy access to before becoming a center resident. The paper also emphasizes that personalized care tailored to each older adult's needs, frequent and genuine interactions between residents and staff, and the continuous improvement of service quality are essential for all centers, whether private or public.

Keywords: residential care, emotional well-being, independence, personalized care

EVLİ VE BOŞANMIŞ ANNE BABALARDA PSİKO-BİLİŞSEL PERFORMANSIN İNCELENMESİ

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ÖZET

Değişen toplumsal ve ekonomik koşullar, ebeveynlerin psikolojik iyi oluşunu ve bilişsel işlevlerini etkileyebilmektedir. Ebeveynlik süreciyle birlikte artan sorumlulukların bireylerin algınana stres düzeylerinde artışa ve dikkat ile çalışma belleği gibi bilişsel süreçlerde değişimlerde yol açabilmektedir. Bu araştırmanın amacı, ebeveynlerin algılanan stres düzeyleri ile dikkat becerileri arasındaki ilişkinin incelenmesidir. Ayrıca, medeni durumun (evli ve boşanmış) bu değişkenler üzerindeki olası etkilerinin ön bulgular düzeyinde değerlendirilmesi amaçlanmıştır. Araştırma, tanımlayıcı ve ilişkisel türde bir çalışma olup örneklemini gönüllü olarak katılan 176 ebeveynden elde edilen veriler analiz edilmiştir. Veri toplama sürecinde yüz yüze anket tekniği kullanılmış; Sosyo-Demografik Bilgi Formu, Beck Depresyon Envanteri, Beck Anksiyete Envanteri, Algılanan Stres Ölçeği, İşitsel Modalitede Adımlandırılmış Dizisel Toplama Testi (PASAT) ve İleri–Geri Sayı Menzili Testleri uygulanmıştır. Klinik düzeyde depresyon veya anksiyete belirtileri bildiren bireyler çalışma dışı bırakılmıştır. Toplam 232 katılımcıdan elde edilen verilerden 176'sı analizlere dâhil edilmiştir. Çalışmaya evli anne (N=59), evli baba (N=41), boşanmış anne (N=52) ve boşanmış baba (N=24) katılmıştır. Ön analizler kapsamında gerçekleştirilen korelasyon analizleri, algılanan stres, anksiyete ve depresyon düzeyleri arasında beklenen yönde anlamlı ilişkiler olduğunu göstermiştir. Benzer şekilde, dikkat ve çalışma belleğini değerlendiren testler arasında pozitif ve anlamlı ilişkiler saptanmıştır. Betimleyici incelemelerde, ebeveyn gruplarının psikolojik ve bilişsel ölçümlerde farklı ortalama değerlere sahip olduğu gözlenmiştir. Ancak bu aşamada gruplar arası çoklu karşılaştırmalara ilişkin ileri analizler raporlanmamıştır. Bu çalışma, devam eden yüksek lisans tezinin ön bulgularını sunmakta olup, ilerleyen aşamalarda kapsamlı biçimde değerlendirilmesi planlanmaktadır. Bulgular, ebeveynlik bağlamında algılanan stresin psikolojik belirtiler ve bilişsel süreçlerle ilişkili olduğunu ortaya koyarak literatüre ön düzeyde katkı sağlamaktadır.

Anahtar Kelimeler: Ebeveynlik, algılanan stres, dikkat, bilişsel işlevler, medeni durum

INVESTIGATION OF PSYCHO-COGNITIVE PERFORMANCE IN MARRIED AND DIVORCED PARENTS

ABSTRACT

Changing social and economic conditions may influence parents' psychological well-being and cognitive functioning. The increasing responsibilities associated with parenting can elevate perceived stress levels and may lead to changes in attention and working memory processes. This study aimed to examine the relationships between perceived stress, psychological symptoms, and attention/working memory performance among parents, and to explore the potential role of marital status (married vs. divorced) at a preliminary level. The research was conducted using a descriptive and correlational design. The sample consisted of 176 parents who voluntarily participated in the study. Data were collected using self-report measures assessing perceived stress and psychological symptoms, along with neuropsychological tests evaluating attention and working memory. Individuals reporting clinically elevated levels of depression or anxiety, as well as those using neurological or psychiatric medication, were excluded from the analyses. Preliminary analyses based on correlation methods revealed significant associations between perceived stress, anxiety, and depressive symptoms in the expected directions. In addition, positive and meaningful relationships were observed among the cognitive measures of attention and working memory, indicating that the applied tests provided consistent information regarding cognitive performance. Descriptive examination of group means suggested that parents differed in psychological and cognitive measures according to marital status; however, no multiple group comparison analyses were reported at this stage. This study presents preliminary findings from an ongoing graduate thesis. Further analyses, including comprehensive group comparisons, are planned upon completion of the full dataset. The findings provide initial evidence that perceived stress is closely related to psychological symptoms and cognitive processes within the context of parenting.

Keywords: Parenting, perceived stress, attention, cognitive functions, marital status

1. GİRİŞ

Aile, bireyin psikolojik, sosyal ve bilişsel gelişiminde temel bir bağlam oluşturmaktadır. Aile yapısında meydana gelen değişimler, bireylerin ruhsal uyum süreçlerini ve bilişsel işlevlerini doğrudan etkileyebilmektedir. Evlilik ve boşanma, bireyin yaşamında önemli stres kaynakları arasında yer almakta; bu süreçler ebeveynlerin psikolojik iyi oluşunu ve bilişsel performansını belirgin biçimde etkileyebilmektedir.

Stres, bireyin çevresel talepleri kendi baş etme kaynaklarını aşan ya da tehdit edici olarak algılaması sonucunda ortaya çıkan bir durumdur (Lazarus & Folkman, 1984). Ebeveynlik rolü ise sorumluluk, zaman yönetimi ve duygusal yükler içermesi nedeniyle stresle yakından ilişkilidir. Özellikle boşanma sonrasında ebeveynler, artan sorumluluklar, ekonomik zorluklar ve sosyal destek kaybı nedeniyle daha yüksek düzeyde stres yaşayabilmektedir (Amato, 2014). Algılanan stresin bilişsel işlevler üzerindeki etkisi, son yıllarda yapılan araştırmalarda sıklıkla ele alınmaktadır. Stresin dikkat, bellek ve yürütücü işlevler üzerinde olumsuz etkiler yarattığı; özellikle dikkat süreçlerini zayıflattığı belirtilmektedir (Arnsten, 2009). Dikkat, bireyin çevresel uyaranlar arasından seçim yapmasını, dikkatini sürdürmesini ve bilişsel kontrol sağlamasını mümkün kılan temel bir bilişsel süreçtir (Karakaş, 1997).

Bellek ise bilginin kodlanması, depolanması ve geri çağrılmasını içeren temel bir bilişsel yetenektir. Dikkat süreçlerindeki bozulmaların, bellek performansını da olumsuz etkilediği bilinmektedir. Bu bağlamda stres, dikkat ve bellek arasındaki etkileşim, ebeveynlerin günlük işlevselliğini ve ebeveynlik rollerini doğrudan etkilemektedir.

Bu çalışmanın amacı, evli ve boşanmış ebeveynlerin algılanan stres düzeyleri ile dikkat ve bellek becerileri arasındaki ilişkiyi incelemek ve algılanan stresin bu bilişsel beceriler üzerindeki yordayıcı rolünü ortaya koymaktır.

2. KURAMSAL ÇERÇEVE

2.1. Stres ve Ebeveynlik

Ebeveynlik stresi, yalnızca bireysel psikolojik iyilik halini değil, aynı zamanda ebeveyn-çocuk etkileşimlerini ve aile sisteminin genel işleyişini de etkilemektedir. Yüksek düzeyde algılanan stres, ebeveynlerin duygusal düzenleme becerilerini zayıflatmakta, sabır ve dikkat gerektiren ebeveynlik davranışlarını olumsuz yönde etkileyebilmektedir. Özellikle boşanmış ebeveynlerde, tek ebeveynlik sorumluluğu, azalan sosyal destek ve ekonomik zorluklar algılanan stres düzeylerini artırabilmektedir (Amato, 2014).

Algılanan stres, bireyin yaşamındaki olayları ne derece zorlayıcı, kontrol edilemez ve tehdit edici olarak değerlendirdiğini ifade eden öznel bir kavramdır (Cohen, Kamarck & Mermelstein, 1983). Ebeveynlik, doğası gereği sürekli sorumluluk, duygusal emek ve zaman yönetimi gerektiren bir rol olduğundan, algılanan stres düzeyleri açısından önemli bir bağlam sunmaktadır. Ebeveynlerin çocuk bakımı, ekonomik yükler, rol çatışmaları ve sosyal beklentiler gibi çoklu stres kaynaklarıyla karşı karşıya kaldıkları bilinmektedir.

Literatür, evlilik durumunun ebeveynlik stresini etkileyen önemli bir değişken olduğunu göstermektedir. Boşanma sonrası dönemde ebeveynlerin, rol değişimleri ve uyum süreçleri nedeniyle daha yüksek stres yaşadıkları bildirilmektedir. Bu stresin, dikkat ve bellek gibi bilişsel işlevler üzerinde dolaylı etkiler yaratarak ebeveynlik performansını ve psikolojik iyilik halini zayıflatabileceği öne sürülmektedir. Bu nedenle algılanan stres, ebeveynlik ve bilişsel işlevler arasındaki ilişkilerin anlaşılmasında merkezi bir kavram olarak değerlendirilmektedir.

2.2.Dikkat

Dikkat, bilişsel süreçlerin temelini oluşturan ve bireyin çevresinden gelen çok sayıdaki uyaran arasından belirli olanlara zihinsel kaynaklarını yönlendirmesini sağlayan merkezi bir mekanizma olarak tanımlanmaktadır. Karakaş'a (1997) göre dikkat, bireyin duyusal alıcıları aracılığıyla algıladığı uyaranlar arasında seçici bir yönelim geliştirmesi sürecidir. Bu süreç, bireyin amaçları doğrultusunda ilgili uyaranlara odaklanmasını, ilgisiz olanları ise bastırmasını içermektedir. Tanrıdağ ve arkadaşları (1994) dikkati, bilinçli zihnin belirli bir hedef doğrultusunda yoğunlaşması olarak ele almakta ve dikkat süreçlerinin öğrenme, problem çözme ve karar verme gibi üst düzey bilişsel işlevlerin ön koşulu olduğunu vurgulamaktadır. Literatürde dikkat, işlevsel özelliklerine göre farklı alt bileşenler altında incelenmektedir. Seçici dikkat, bireyin hedefle ilişkili uyaranlara yönelmesini ve dikkat dağıtıcı unsurları bastırmasını sağlarken; sürdürülen dikkat, belirli bir uyaran ya da görev üzerinde uzun süre boyunca odaklanabilme kapasitesini ifade etmektedir. Bölünmüş dikkat ise bireyin aynı anda birden fazla bilişsel görevi yürütebilme becerisini kapsamaktadır (Soysal vd., 2008). Bu alt bileşenler, günlük yaşamda olduğu kadar akademik ve mesleki performans açısından da kritik öneme sahiptir.

Stresin dikkat süreçleri üzerindeki etkisi, bilişsel psikoloji ve nörobilim literatüründe kapsamlı biçimde ele alınmıştır. Lupien ve arkadaşları (1998), yüksek düzeyde stres hormonlarına maruz kalan bireylerin özellikle seçici ve sürdürülen dikkat performanslarında belirgin düşüşler yaşadıklarını ortaya koymuştur. Stres altında dikkat kaynaklarının tehdit algısına yönelmesi, bireyin görevle ilişkili uyaranlara odaklanmasını güçleştirmekte ve bilişsel verimliliği azaltmaktadır. Uzun süreli stresin prefrontal korteks işlevlerini baskıladığı, bunun da dikkat kontrolünü ve yürütücü işlevleri olumsuz etkilediği bildirilmektedir (Arnsten, 2009). Bu bağlamda, ebeveynlik gibi sürekli sorumluluk ve yük içeren rollerin dikkat süreçleri üzerindeki etkilerinin incelenmesi önem kazanmaktadır.

2.3. Bellek

Bellek, bireyin yaşantılarından elde ettiği bilgileri kodlama, depolama ve gerektiğinde geri çağırma süreçlerini kapsayan temel bir bilişsel yetenektir. Atkinson ve Shiffrin'in (1968) modal bellek modeline göre bellek, duyusal bellek, kısa süreli bellek ve uzun süreli bellek olmak üzere üç temel yapıdan oluşmaktadır. Duyusal bellek, çevreden gelen bilgilerin çok kısa süreli olarak tutulduğu bir sistem iken; kısa süreli bellek sınırlı kapasiteye sahip olup bilgilerin geçici olarak depolandığı bir aşamayı temsil etmektedir. Uzun süreli bellek ise bilginin kalıcı olarak saklandığı ve gerektiğinde geri çağrıldığı sistemdir.

Bellek süreçleri, dikkat mekanizmalarıyla yakından ilişkilidir. Dikkatin yeterli düzeyde yönlendirilmediği durumlarda, bilginin etkili bir şekilde kodlanması mümkün olmamakta ve bu durum bellek performansında düşüşe yol açmaktadır. Özellikle stres altındaki bireylerde, dikkat kaynaklarının tehdit algısına yönelmesi, öğrenme ve hatırlama süreçlerini olumsuz etkilemektedir. McEwen (2007), kronik stresin hipokampus üzerinde yapısal ve işlevsel değişimlere yol açtığını, bunun da bellek süreçlerinde bozulmalara neden olduğunu belirtmektedir.

Ebeveynlik bağlamında bellek işlevleri, günlük sorumlulukların yerine getirilmesi, çocukların ihtiyaçlarının hatırlanması ve çoklu görevlerin yönetilmesi açısından kritik öneme sahiptir. Sürekli stres altında olan ebeveynlerde, bellek performansındaki düşüşler hem ebeveynlik işlevselliğini hem de genel yaşam kalitesini olumsuz etkileyebilmektedir. Bu nedenle bellek, stres ve ebeveynlik ilişkilerinin birlikte ele alınması, bilişsel ve psikolojik iyilik hali açısından önemli bir araştırma alanı sunmaktadır.

3. YÖNTEM

Araştırmanın bu bölümünde gönüllü katılım sağlamak isteyen ebeveynlere yönelik yürütülen alan çalışmasının amacı ve önemi, araştırmanın modeli ve hipotezleri, veri toplama araçları, çalışma grubu ve verilerin analizi ile ilgili bilgiler verilmiştir.

3.1. Araştırmanın Amacı ve Önemi

Bu araştırmanın amacı, ebeveynlerin algılanan stres ve depresyon düzeylerinin dikkat ve bellek gibi temel bilişsel süreçler üzerindeki etkilerini incelemektir. Özellikle ebeveynlik rolünün getirdiği sorumluluklar, yaşam olayları ve psikososyal stresörler bağlamında algılanan stres ve depresyonun bilişsel işlevlerle nasıl ilişkilendiğinin ortaya konulması hedeflenmektedir. Araştırma, evli ve boşanmış ebeveynler arasındaki olası farklılıkları da dikkate alarak, ebeveynlik deneyiminin psikolojik ve bilişsel boyutlarını bütüncül bir çerçevede ele almaktadır.

Araştırmanın önemi, ebeveynlerin ruhsal iyi oluşunun yalnızca bireysel değil, aynı zamanda çocukların gelişimi ve aile işlevselliği açısından da belirleyici bir role sahip olmasından kaynaklanmaktadır. Algılanan stres ve depresyon düzeylerinin artması, ebeveynlerin dikkat ve bellek performanslarını olumsuz etkileyerek günlük yaşamda karar verme, problem çözme ve ebeveynlik davranışlarında işlevsel güçlükler yaratabilmektedir. Bu durum, ebeveyn-çocuk etkileşimini dolaylı olarak etkileyerek çocukların duygusal ve bilişsel gelişimini de risk altına sokabilmektedir.

Bu bağlamda çalışma, ebeveynlik sürecinde stres ve depresyonun bilişsel işlevlerle ilişkisini ortaya koyarak literatüre katkı sağlamayı; aynı zamanda psikolojik destek, danışmanlık ve önleyici ruh sağlığı hizmetlerine yönelik uygulamalara bilimsel bir temel sunmayı amaçlamaktadır. Özellikle ebeveynlere yönelik psiko-eğitim programlarının ve stresle başa çıkma müdahalelerinin geliştirilmesine ışık tutması açısından araştırmanın önemli bir boşluğu dolduracağı düşünülmektedir.

3.2. Evren ve Örneklem

Çalışmanın evrenini İstanbul'da yaşayan evli ve boşanmış ebeveynler oluşturmaktadır. Söz konusu araştırmanın örneklemini gönüllü olarak katılım sağlamak isteyen ebeveynleri kapsamaktadır. Bu araştırmaya gönüllü olarak katılan ebeveynler basit örneklem yöntemi ile alınacaktır. Araştırmaya dâhil edilme kriterlerine uyan 176 kişi ile çalışma tamamlanmıştır. Araştırmaya dâhil edilmeme kriterleri olarak gönüllü olmamak, ebeveyn olmamak, medeni halinin evli veya boşanmış olmaması, nörolojik ve psikolojik ilaç kullanıyor olması, Beck Depresyon Envanteri'nden ve Beck Anksiyete Envanteri'nden 30 ve üzeri derecelendirme almış olmaktır.

3.3. Veri Toplama Araçları

Bu araştırmada, ebeveynlerin algılanan stres, depresyon düzeyleri ile dikkat ve bellek işlevlerini değerlendirmek amacıyla beş farklı veri toplama aracı kullanılmıştır. Katılımcıların algılanan stres düzeylerini belirlemek için, bireylerin son bir ay içinde yaşamlarındaki durumları ne ölçüde stresli algıladıklarını değerlendiren Algılanan Stres Ölçeği kullanılmış; ölçekten elde edilen yüksek puanların algılanan stres düzeyinin yüksekliğine işaret ettiği kabul edilmiştir. Depresif belirtilerin değerlendirilmesinde, bireylerin bilişsel, duygusal ve somatik depresyon belirtilerini ölçmeye yönelik olarak geliştirilen ve öz-bildirim esasına dayanan Beck Depresyon Envanteri kullanılmıştır. Aynı zaman da anksiyete düzeyini belirlemek için Beck Anksiyete Envanteri kullanılmıştır. Dikkat ve çalışma belleği performansını değerlendirmek amacıyla

PASAT ve Sayı Menzili (Digit Span) Testi kullanılmıştır. PASAT, katılımcıların ardışık olarak sunulan işitsel sayıları zihinde tutarak her yeni sayıyı bir öncekiyle toplamasını gerektiren, dikkat, işlem hızı ve çalışma belleğini eş zamanlı olarak ölçen bir nöropsikolojik değerlendirme aracıdır. Test, özellikle sürdürülen dikkat ve bilişsel esneklik düzeylerinin belirlenmesinde duyarlıdır. Sayı Menzili Testi ise kısa süreli bellek ve çalışma belleği kapasitesini değerlendirmeye yönelik olarak geliştirilmiş olup, ileri ve geri sayı dizilerini tekrarlama görevlerinden oluşmaktadır. İleri sayı menzili, dikkat ve kısa süreli bellek kapasitesini ölçerken; geri sayı menzili, bilgiyi zihinde tutma ve işlemleme becerilerini değerlendirmektedir. Bu testlerden elde edilen puanlar, katılımcıların dikkat ve bellek performanslarının nesnel bir göstergesi olarak kullanılmıştır.

3.4. Veri Analizi

Araştırma grubunun sosyodemografik özellikleri ile psikolojik ve bilişsel ölçümlere ait puanların betimlenmesi amacıyla tanımlayıcı istatistikler kullanılmış; bu kapsamda ortalama, standart sapma, minimum ve maksimum değerler hesaplanmıştır. Algılanan stres, depresyon, kaygı ve dikkatle ilişkili bilişsel performans değişkenleri arasındaki ilişkilerin incelenmesinde Pearson Momentler Çarpımı Korelasyon Analizi kullanılmıştır. Korelasyon katsayıları, ilişkinin yönü ve gücü dikkate alınarak yorumlanmıştır. İstatistiksel analizlerde anlamlılık düzeyi $p < .05$ olarak kabul edilmiştir. Dikkat ve bilişsel performansın değerlendirilmesinde kullanılan PASAT ile Sayı Menzili İleri ve Sayı Menzili Geri testlerinden elde edilen puanlar ayrı ayrı analiz edilmiştir. PASAT puanları, bireylerin işleyen bellek, dikkat sürekliliği ve bilişsel hız performansını yansıtan bir gösterge olarak ele alınmıştır. Sayı Menzili İleri testi kısa süreli bellek ve dikkat kapasitesini, Sayı Menzili Geri testi ise işleyen bellek ve yürütücü işlevleri temsil eden bilişsel göstergeler olarak değerlendirilmiştir.

4. BULGULAR

Çalışmaya katılan katılımcılardan elde edilen sosyodemografik veriler Tablo1'de gösterilmektedir.

Tablo 1. Katılımcıların Sosyo-Demografik Özellikleri

	Değişkenler	**Katılımcı Sayısı (f)**	**Yüzde (%)**
Cinsiyet	Kadın	111	63.1
	Erkek	65	36.9
	Toplam	176	100.0
Yaş	25-34	36	20.5

	Değişkenler	Katılımcı Sayısı (f)	Yüzde (%)
	35-44	83	47.2
	45-60	57	32.4
	Toplam	176	100.0
Medeni Durum (Ayrıntılı)	Evli Anne	59	33.5
	Evli Baba	41	23.3
	Boşanmış Anne	52	29.5
	Boşanmış Baba	24	13.6
	Toplam	176	100.0
Medeni Durum	Evli	100	56.8
	Bekar	76	43.2
	Toplam	176	100.0
Evlilik Yaşı	17-22	50	28.4
	23-28	86	48.9
	29-34	30	17.0
	35-43	10	5.7
	Toplam	176	100.0
Evlilik Süresi	1-7	41	23.3
	8-14	68	38.6
	15-36	67	38.1
	Toplam	176	100.0
Çocuk Sayısı	1	61	34.7
	2	91	51.7
	3	22	12.5
	4	2	1.1
	Toplam	176	100.0
Eğitim Düzeyi	İlköğretim	22	12.5
	Ortaokul	14	8.0
	Lise	65	36.9
	Önlisans	22	12.5
	Lisans	41	23.3

	Değişkenler	Katılımcı Sayısı (f)	Yüzde (%)
	Lisansüstü	12	6.8
	Toplam	176	100.0
Meslek Grubu	Özel Sektör	92	52.3
	Ev Hanımı	40	22.7
	Kamu Sektörü	33	18.8
	Emekli	11	6.3
	Toplam	176	100.0
Çalışma Süresi (Yıl)	0-10	80	45.5
	11-20	54	30.7
	21-45	42	23.9
	Toplam	176	100.0
Psikolojik Tanı	Yok	176	100.0
İlaç Kullanımı	Var	22	12.5
	Yok	154	87.5
	Toplam	176	100.0

Katılımcıların cinsiyet dağılımı incelendiğinde kadınların %63.1'i (f: 111), erkeklerin ise %36.9'u (f: 65) yer almaktadır. Yaş gruplarına bakıldığında katılımcıların %20.5'i 25–34 yaş aralığında (f: 36), %47.2'si 35–44 yaş aralığında (f: 83) ve %32.4'ü 45–60 yaş aralığında (f: 57) bulunmaktadır. Medeni durumun ayrıntılı sınıflamasında katılımcıların %33.5'i evli anne (f: 59), %23.3'ü evli baba (f: 41), %29.5'i boşanmış anne (f: 52) ve %13.6'sı boşanmış baba (f: 24) grubunda yer almaktadır. İkili sınıflamaya göre medeni durum dağılımında ise katılımcıların %56.8'i evli (f: 100), %43.2'si bekar (f: 76) olarak belirlenmiştir.

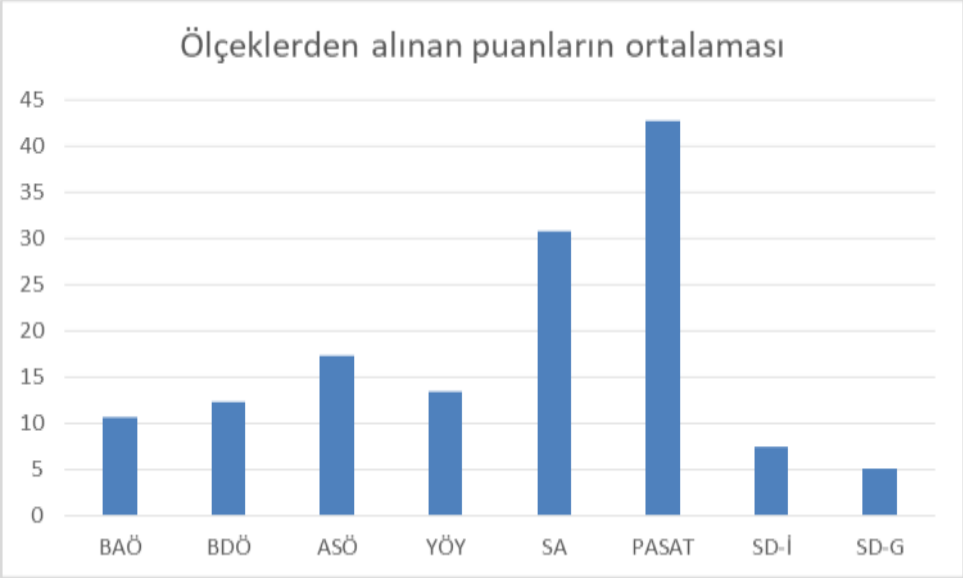
Katılımcılara uygulanan testlere ait betimsel istatistik değerleri Tablo2'de verilmiştir.

Tablo.2 Kullanılan Ölçeklere Ait ortalamalar

Ölçekler	Min.	Maks.	Ort.	Std. sp.
BAÖ	1.00	29.00	10.6705	7.84379
BDÖ	1.00	29.00	12.3636	7.06975
ASÖ	3.00	27.00	17.3011	3.60083
YÖY	1.00	24.00	13.4091	4.62203

SA	9.00	43.00	30.7102	5.42914
PASAT	29	58	42.63	7.589
SD-İ	2	12	7.43	2.118
SD-G	2	12	5.13	1.918

BAÖ: Beck Anksiyete Ölçeği; BDÖ: Beck Depresyon Ölçeği; ASÖ: Algılanan Stres Ölçeği; YÖY: Yetersiz Öz-Yeterlik Algısı Boyutu; SA: Stres Algısı (Rahatsızlık Algısı) Boyutu; PASAT: İşitsel Modalitede Adımlandırılmış Dizisel Toplama Testi; SD-İ: Sayı Dizisi – İleri (Digit Span Forward); SD-G: Sayı Dizisi – Geri (Digit Span Backward).



Kullanılan ölçeklere ait ortalamaların grafiği

Bu grafikte tüm örnekleme ait (N=176) ortalama değerler yer almaktadır.

BAÖ: Beck Anksiyete Ölçeği; BDÖ: Beck Depresyon Ölçeği; ASÖ: Algılanan Stres Ölçeği; YÖY: Yetersiz Öz-Yeterlik Algısı Boyutu; SA: Stres Algısı (Rahatsızlık Algısı) Boyutu; PASAT: İşitsel Modalitede Adımlandırılmış Dizisel Toplama Testi; SD-İ: Sayı Dizisi – İleri (Digit Span Forward); SD-G: Sayı Dizisi – Geri (Digit Span Backward).

Tablo 3. Kullanılan Ölçeklere Ait Korelasyon Analizi Sonuçları

Değişken	BAÖ	BDÖ	YÖY	SA	ASÖ	PASAT	SD-İ	SD-G
BAÖ	1							
BDÖ	0.460**	1						
ASÖ	-0.200**	-0.364**	1					
YÖY	0.490**	0.443**	-0.146	1				
SA	0.284**	0.136	0.539**	0.755**	1			
PASAT	-0.185*	-0.144	0.123	-0.136	-0.034	1		
SD-İ	-0.036	-0.053	0.090	0.041	0.094	0.367**	1	
SD-G	-0.032	-0.006	0.086	0.102	0.144	0.472**	0.421**	1

BAÖ: Beck Anksiyete Ölçeği; BDÖ: Beck Depresyon Ölçeği; ASÖ: Algılanan Stres Ölçeği; YÖY: Yetersiz Öz-Yeterlik Algısı Boyutu; SA: Stres Algısı (Rahatsızlık Algısı) Boyutu; PASAT: Paced Auditory Serial Addition Test; SD-İ: Sayı Dizisi – İleri; SD-G: Sayı Dizisi – Geri

* p < 0.05. ** p < 0.01.

BAÖ ile BDÖ arasında orta düzeyde (r = 0.460) pozitif ve anlamlı bir ilişki saptanmıştır (p < 0.01). BAÖ ile YÖY arasında düşük düzeyde (r = -0.200) negatif ve anlamlı bir ilişki belirlenmiştir (p < 0.01). BAÖ ile SA arasında orta düzeyde (r = 0.490) pozitif ve anlamlı bir ilişki saptanmıştır (p < 0.01). BAÖ ile ASÖ arasında düşük düzeyde (r = 0.284) pozitif ve anlamlı bir ilişki belirlenmiştir (p < 0.01). BDÖ ile YÖY arasında orta düzeyde (r = -0.364) negatif ve anlamlı bir ilişki saptanmıştır (p < 0.01). BDÖ ile SA arasında orta düzeyde (r = 0.443) pozitif ve anlamlı bir ilişki belirlenmiştir (p < 0.01). BDÖ ile ASÖ arasında anlamlı bir ilişki bulunmamıştır (r = 0.136, p > 0.05). ASÖ ile YÖY arasında orta düzeyde (r = 0.539) pozitif ve anlamlı bir ilişki saptanmıştır (p < 0.01). ASÖ ile SA arasında güçlü düzeyde (r = 0.755) pozitif ve anlamlı bir ilişki belirlenmiştir (p < 0.01). SA ile YÖY arasında anlamlı bir ilişki bulunmamıştır (r = -0.146, p > 0.05). PASAT ile BAÖ arasında düşük düzeyde (r = -0.185) negatif ve anlamlı bir ilişki saptanmıştır (p < 0.05). PASAT ile BDÖ arasında anlamlı bir ilişki bulunmamıştır (r = -0.144, p > 0.05). PASAT ile ASÖ arasında anlamlı bir ilişki bulunmamıştır (r = -0.034, p > 0.05). PASAT ile SD-İ arasında orta düzeyde (r = 0.367) pozitif ve anlamlı bir ilişki saptanmıştır (p < 0.01). PASAT ile SD-G arasında orta düzeyde (r = 0.472) pozitif ve anlamlı bir ilişki belirlenmiştir (p < 0.01). SD-İ ile SD-G arasında orta düzeyde (r = 0.421) pozitif ve anlamlı bir ilişki saptanmıştır (p < 0.01).

5. TARTIŞMA VE SONUÇ

Bu araştırmada, ebeveynlerin algılanan stres ve depresyon düzeyleri ile dikkat ve çalışma belleği performansları arasındaki ilişkiler incelenmiştir. Elde edilen bulgular, algılanan stres, anksiyete ve depresyon düzeyleri arasında beklenen yönde anlamlı ilişkiler bulunduğunu; benzer biçimde dikkat ve çalışma belleğini değerlendiren bilişsel testlerin birbiriyle anlamlı biçimde ilişkili olduğunu göstermektedir. Bu sonuçlar, psikolojik belirtiler ile bilişsel süreçlerin ebeveynlik bağlamında bir arada ele alınması gerektiğine işaret etmektedir. Bu çalışmada Algılanan stres düzeyleri ile dikkat ve çalışma belleğini temsil eden ölçümler arasındaki ilişkiler, stresin bilişsel kaynaklarla yakından ilişkili olduğunu ileri süren kuramsal yaklaşımlarla uyumludur. Literatürde stresin, özellikle dikkat süreçleri ve çalışma belleği gibi yürütücü işlevlerle ilişkili bilişsel sistemler üzerinde baskı oluşturabildiği belirtilmektedir. Bu çalışmada kullanılan PASAT ve Sayı Menzili testleri arasındaki pozitif ilişkiler, dikkat ve

çalışma belleği bileşenlerinin birbiriyle tutarlı biçimde işlediğini ve kullanılan bilişsel ölçümlerin güvenilir bilgi sağladığını düşündürmektedir. stresin bilişsel kaynakların etkin kullanımını sınırladığı ve özellikle yürütücü işlevler üzerinde baskı oluşturduğunu ileri süren kuramsal yaklaşımlarla örtüşmektedir (Arnsten, 2009; Lupien et al., 1998). PASAT performansındaki düşüş, bireylerin zihinsel işlem hızı, dikkatini sürdürme ve bilişsel esneklik gerektiren görevlerde zorlandığını düşündürmektedir. Literatürde, kronik stresin prefrontal korteks işlevlerini zayıflattığı ve dikkat kontrolünde bozulmalara yol açtığı belirtilmektedir (McEwen, 2007). Depresyon ve anksiyete düzeyleri ile algılanan stres arasındaki anlamlı ilişkiler, psikolojik belirtilerin ebeveynlerin bilişsel yükleriyle birlikte değerlendirilmesi gerektiğini göstermektedir. Depresif belirtilerin dikkat dağınıklığı, bilgi işleme hızında yavaşlama ve bilişsel kaynakların etkin kullanımında zorlanma ile ilişkili olabileceği daha önceki çalışmalarda da vurgulanmıştır (Kessler & Bromet, 2013; Türkçapar, 2018). Bu araştırmada elde edilen bulgular, depresyon ve stresin yalnızca duygusal değil, bilişsel süreçlerle de ilişkili olabileceğini düşündürmektedir. Bu çalışmada elde edilen bulgular, söz konusu nörobiyolojik açıklamaları destekler niteliktedir. Benzer biçimde, Sayı Menzili testinde gözlenen performans düşüşleri, stresin çalışma belleği kapasitesi üzerinde olumsuz etkileri olduğunu ortaya koyan önceki araştırmalarla tutarlıdır (Shipstead et al., 2015). Depresyon düzeyi ile dikkat ve bellek performansı arasındaki ilişkiler değerlendirildiğinde, depresif belirtilerin bilişsel süreçleri olumsuz yönde etkilediği görülmektedir. Depresyonun dikkat dağınıklığı, bilgi işleme hızında yavaşlama ve bellek kodlama süreçlerinde zayıflamaya yol açtığı bilinmektedir (Kessler & Bromet, 2013; Türkçapar, 2018). Bu çalışmada elde edilen bulgular, depresyonun yalnızca duygusal değil, aynı zamanda bilişsel işlevsellik üzerinde de belirleyici bir rol oynadığını göstermektedir. Ebeveynlik bağlamında ele alındığında, özellikle boşanmış ebeveynlerin artan sorumluluklar, rol yükleri ve sınırlı sosyal destek kaynakları nedeniyle daha yüksek stres düzeyleri deneyimleyebileceği belirtilmektedir (Amato, 2014; Lorenz et al., 1997). Bu çalışmada grup karşılaştırmalarına yönelik ileri istatistiksel analizler raporlanmamış; bunun yerine betimsel istatistikler ve değişkenler arası ilişkiler ön bulgular düzeyinde ele alınmıştır. Betimleyici incelemelerde, ebeveyn gruplarının psikolojik ve bilişsel ölçümlerde farklı ortalama değerlere sahip olabildiği gözlenmiş olmakla birlikte, bu farklılıklar çoklu karşılaştırmalarla test edilmemiştir. Bu nedenle söz konusu gözlemler, ileri analizler için öncü göstergeler olarak değerlendirilmelidir. Bu çalışmanın bazı sınırlılıkları bulunmaktadır. Öncelikle, öz-yeterlik algısı gibi önemli bir psikolojik değişken doğrudan ölçülmemiştir.

Ayrıca kesitsel araştırma deseni, değişkenler arasındaki nedensel ilişkilerin belirlenmesini sınırlamaktadır. Bununla birlikte, dikkat ve bellek gibi nesnel bilişsel testlerin kullanılması, öz-bildirim temelli ölçümlere dayanan araştırmalara kıyasla çalışmanın güçlü yönlerinden birini oluşturmaktadır. Sonuç olarak, bu araştırma ebeveynlerde algılanan stres ve psikolojik belirtiler ile dikkat ve çalışma belleği performansları arasında anlamlı ilişkiler bulunduğunu ortaya koymaktadır. Bulgular, ebeveynlere yönelik psikososyal destek ve müdahale programlarının planlanmasında bilişsel süreçlerin de dikkate alınmasının önemine işaret etmektedir. Gelecek çalışmalarda, örneklemin genişletilmesi, boylamsal araştırma desenlerinin kullanılması ve grup karşılaştırmalarına yönelik ileri analizlerin yapılması, ebeveynlik sürecinde psikolojik ve bilişsel değişkenler arasındaki ilişkilerin daha kapsamlı biçimde anlaşılmasına katkı sağlayacaktır.

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ROLE OF EMPATHY IN THE RELATIONSHIP BETWEEN PETS ATTACHMENT AND MENTAL HEALTH AMONG PET OWNERS

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Abstract

This study examines the relationship between pet attachment, empathy, and mental health among pet owners, drawing on principles from attachment theory. A quantitative co relational approach was employed with a sample of 250 pet owners (balanced by gender) from Rawalpindi and Islamabad, Pakistan. Standardized measures including the Animal Empathy Scale–Short Form (AES-SF), Lexington Attachment to Pets Scale (LAPS), and Depression, Anxiety, and Stress Scale (DASS-21) were used to assess key variables. Findings demonstrated that stronger emotional bonds with pets were associated with lower levels of depression ($r=0.27$, $p<.01$), anxiety ($r=-0.28$, $p<.01$), and stress ($r=-0.31$, $p<.01$), supporting the mental health benefits of human-animal connections. Empathy was found to enhance these benefits, particularly in mitigating stress and anxiety, suggesting that individuals with greater empathy derive more psychological support from their pets ($B=-3.40$, $P=<.05$). Demographic variations emerged, with married participants reporting higher empathy and better mental health outcomes compared to unmarried individuals. Conversely, unemployed respondents exhibited stronger pet attachment but poorer mental health, implying that pets may serve as compensatory sources of emotional support in the absence of other social resources. Gender differences were also observed, with women displaying higher levels of both empathy and pet attachment. These results highlight the potential of pet companionship as a therapeutic tool, particularly for emotionally attuned individuals. The study contributes to existing knowledge on animal-assisted support and suggests practical applications for mental health interventions. Methodological limitations, such as the cross-sectional design and geographically restricted sample, indicate a need for future longitudinal and cross-cultural research to validate and expand these findings.

Keywords: pet attachment, empathy, mental health, human-animal bond, stress, depression, anxiety, animal-assisted support, gender differences, Pakistan

A STUDY OF LIFE ORIENTATION AMONG INDIVIDUALS AFFECTED BY WAR

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Abstract

The 2008 Russia–Georgia war substantially altered the living conditions, psychological well-being, and future-oriented cognitive-emotional attitudes of the affected population. War-induced trauma may be conceptualized as a mass catastrophe that exerts significant psychological influence not only on individuals but also on society, shaping its subsequent development and life orientations. Optimistic and pessimistic attitudes toward life determine individuals' everyday functioning, decision-making, and long-term adaptation. Life orientation represents a core cognitive-emotional mechanism associated with psychological health and the capacity for social reintegration. Accordingly, its examination is particularly important among groups with experiences of high stress, forced displacement, and loss of safety. Although the post-war psychological consequences have been widely studied at the symptomatic level, the influence of traumatic experience on future-oriented cognitive appraisals and life attitudes in the Georgian population has been insufficiently described. In line with this, the aim of the present study was to assess life orientation among individuals with war experience using a quantitative method, specifically the Life Orientation Test. Based on the data analysis, it was found that life orientation among individuals with war experience was associated with elevated pessimism, indicating that war-related experiences shape not only emotional responses but also long-term cognitive evaluations.

Keywords: *dispositional optimism–pessimism; generalized expectancies; trauma*

AFETLERE HAZIRLIKTA JAPONYA ÖRNEĞİNİN İNCELENMESİ ve ÖZ YARDIMIN ÖNEMİ

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ÖZET

Bu çalışma, afetlere hazırlık süreçlerinde Japonya örneğini inceleyerek öz yardımın (bireysel hazırlık**),** karşılıklı yardımın (topluluk dayanışması) ve kamu desteğinin sürdürülebilir afet yönetimindeki rolünü ele almaktadır. Doğal afetlerin yalnızca can ve mal kayıplarına değil, aynı zamanda uzun vadeli sosyal ve ekonomik sorunlara yol açtığı vurgulanmakta; bu nedenle bireylerin ve toplulukların afet öncesinde güçlendirilmesinin kritik önemde olduğu belirtilmektedir.

Japonya'da yaşanan büyük depremler ve diğer afet deneyimleri, afetin hemen ardından kurtarma ve müdahalede komşuluk ilişkileri ve bireysel inisiyatifin hayati rol oynadığını göstermektedir. Özellikle 1995 Büyük Hanshin-Awaji Depremi'nde kurtarılanların büyük çoğunluğunun komşular tarafından kurtarılması, öz yardım ve karşılıklı yardımın kamu desteği gelene kadar ne kadar belirleyici olduğunu ortaya koymuştur. Bu bağlamda, acil durum malzemelerinin hazırlanması, afet eğitimleri, sigorta sistemleri ve afet önleme uygulamaları Japonya'da yaygın öz yardım araçları olarak öne çıkmaktadır.

Çalışmada ayrıca kırılgan gruplar (yaşlılar, kadınlar, engelliler ve düşük gelirli bireyler) için öz yardım kapasitesinin güçlendirilmesinin gerekliliği vurgulanmaktadır. Kadınların ekonomik, sosyal ve psikolojik olarak güçlendirilmesi ile teknolojik tabanlı çözümlerin (afet uygulamaları, çevrimiçi destek ve e-ruh sağlığı hizmetleri) afetlere hazırlık ve afet sonrası iyileşme süreçlerine önemli katkılar sunduğu ifade edilmektedir.

Sonuç olarak, Japonya örneği, afetlere dirençli bir toplum oluşturmak için sürdürülebilir eğitim, bireysel hazırlık, topluluk dayanışması ve kamu politikalarının bütüncül bir yaklaşımla ele alınması gerektiğini göstermektedir. Öz yardımın merkezde olduğu bu yaklaşım, afet yönetim döngüsünün tüm aşamalarında etkinliği artırmaktadır.

Anahtar Kelimeler: Afet yönetimi, öz yardım, afetlere hazırlık, Japonya örneği

AN ANALYSIS OF JAPAN'S EXAMPLE IN DISASTER PREPAREDNESS AND THE IMPORTANCE OF SELF-HELP

ABSTRACT

This study examines the role of self-help (individual preparedness), mutual aid (community solidarity) and public support in sustainable disaster management by analysing the example of

Japan in disaster preparedness processes. It emphasises that natural disasters cause not only loss of life and property but also long-term social and economic problems; therefore, it stresses the critical importance of empowering individuals and communities before disasters strike.

Major earthquakes and other disaster experiences in Japan demonstrate that neighbourly relations and individual initiative play a vital role in rescue and response immediately after a disaster. Particularly in the 1995 Great Hanshin-Awaji Earthquake, the fact that the vast majority of those rescued were saved by neighbours highlights how decisive self-help and mutual aid are until public support arrives. In this context, the preparation of emergency supplies, disaster training, insurance systems, and disaster prevention practices stand out as common self-help tools in Japan.

The study also emphasises the need to strengthen self-help capacity for vulnerable groups (the elderly, women, persons with disabilities, and low-income individuals). It is stated that the economic, social, and psychological empowerment of women, along with technology-based solutions (disaster applications, online support, and e-mental health services), make significant contributions to disaster preparedness and post-disaster recovery processes.

In conclusion, the example of Japan demonstrates that creating a disaster-resilient society requires a holistic approach to sustainable education, individual preparedness, community solidarity, and public policies. This approach, with self-help at its core, increases effectiveness at all stages of the disaster management cycle.

Keywords: Disaster management, self-help, disaster preparedness, the Japanese example

1.GİRİŞ

Doğal afetler genellikle çok büyük can kayıplarına neden olmakla birlikte, ekonomik kayıplara da yol açmaktadır. Ekosisteme zarar vermenin yanı sıra, kısa ve uzun vadeli sosyal sorunları da beraberinde getirmektedir. Nüfusun yer değiştirmesi, geçim kaynaklarının kaybı ve ailelerin dağılması bu tür sorunların en yaygın örnekleri arasındadır (Khan, 2008). Doğal afetlerle birlikte gelen belirsizlik nedeniyle, öz yardım afet riskinin azaltılmasında giderek daha etkili bir faktör haline gelmiştir. Acil durumlarda kamu desteğinin ilk süreçlerde eksikliklerine rağmen, vatandaşların öz yardım ile daha düşük bağlılık durumu göstermesi afete hazırlık süreçlerine bireysel katılımları ile mümkün olmaktadır. Bireysel hazırlık süreçleri, işbirlikçi toplumsal uygulamalar, bireyleri daha geniş sosyal sisteme dahil etme konusunda ek bir fayda sağlamaktadır (Nakai & Nakano, 2023). Afet mağdurları arasında öz yardım ve karşılıklı destek, bir felaketin hemen sonrasında yaşanan zorlukların çözümü için kritik öneme sahiptir;

ancak bu tür çözüm süreçleri için bireysel kolaylaştırıcı faktörlerin de önem kazandığı görülmektedir (Sugiura, et al., 2021). Hükümet ve uzmanlar tarafından tasarlanmış çerçeveler genellikle tek yönlü bir iletişim biçimini içermektedir. Bu noktada eksiklik modeline dayalı iletişimle ilişkili birkaç sorun gözlemlenmektedir. (1) İletişimin yalnızca özne (uzmanlar) ve nesne (vatandaşlar) arasındaki ilişkiyi içerdiği anlaşılmaktadır. Bu nedenle, (2) davranışsal iyileştirme stratejileri, vatandaşların düşük düzeydeki öz yardım davranışlarının esas olarak afet riski hakkında bilgi eksikliğinden kaynaklandığı ve (3) uzmanlar ve vatandaşlar arasındaki bilgi boşluğunu dolduracak yeterli bilgiyi sağlamanın davranış değişikliğini teşvik edeceği inancına dayanarak önerilmektedir (Nakai & Nakano, 2023). Karşılıklı yardım, komşular ve yerel sakinlerle işbirliği olarak tanımlanır. Afetler sırasında karşılıklı yardım duygusunu artırmak, öz yardım önlemlerini teşvik etmenin yanı sıra çok önemlidir. Bu nedenle, karşılıklı yardım yeteneklerini geliştirmek için eğitim girişimleri ve diğer çabaları üstlenmek önemlidir (Arakawa, Yamada, & Sugimori, 2024). Afet sonrası dönemde kişilerarası ve kolektif işleyişi hafifletmek, yeniden düzenlemek, iyileştirmek ve normalleştirmek için müdahaleci bir yaklaşım ve araç olarak öz-yardım gruplarının (ÖG) oluşturulmasının karşılıklı yardım kapsamında önemi ve öz yardımın afet yönetim döngüsünde hem bireyler hem de kurumlar açısından önemine değinilmiştir (K.C. & Rai, 2024).

2.AFETLERDE ÖZ YARDIM

Kuraklık, sel veya siklon şeklindeki doğal afetler, afete eğilimli bölgelerde geçim kaynakları için büyük zorluklar oluşturmaktadır. Kendi kendine yardım grupları, kaynak kısıtlamalarının üstesinden gelmek için sosyal sermaye kullanımı, kırsal kalkınma, kadınlar ve sosyal güçlendirme için bir katalizör görevi gören gayri resmi yardımlardır.

Afetlerde öz yardım afetlere hazırlıkta bireysel yeterliliğin kazanılması olarak tanımlanabilir. Özellikle refakatçi eşleniğine ihtiyaç duyan kırılgan gruplarda bir afet durumunda sağlık yönetimiyle ilgili kaygıyı azaltmak için kişilerin ihtiyaç duydukları eşyaları saklamaları, güvenli bir yerde kalmaları ve güvenilir bakıcılara sahip olmaları önemli olacaktır (Takahashi & Kitamura, 2016). Kırılgan grupların özellikleri doğrultusunda afet sonrası ihtiyaç duydukları birincil öncelik ihtiyaçlarına göre bir planlamanın yapılması da öz yardımın sağlanmasında güçlendirici bir etki yaratacağı belirtilebilir.

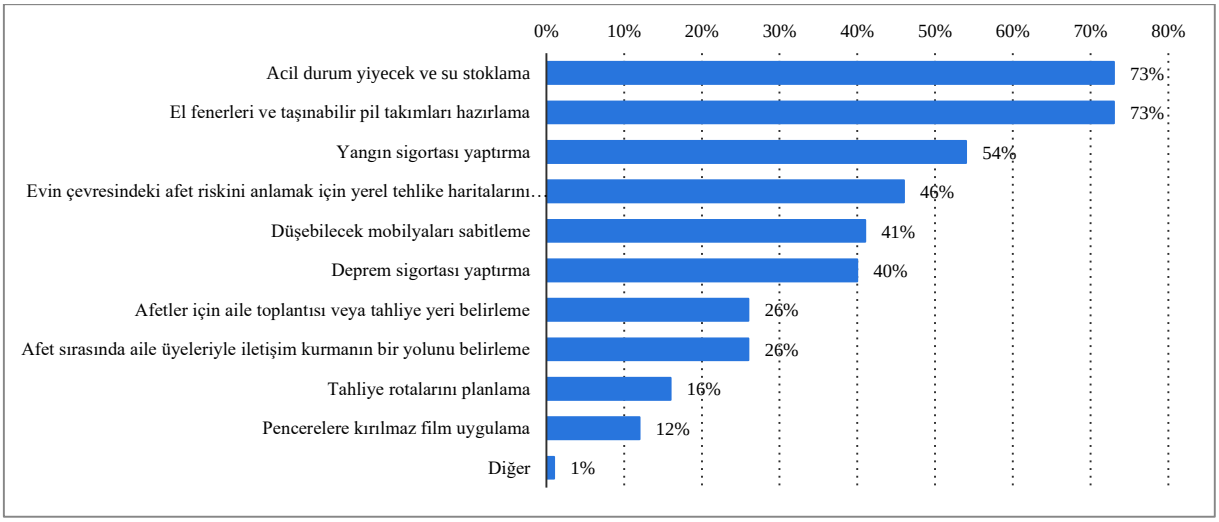
17 Ocak 1995'te meydana gelen Büyük Hanshin-Awaji Depremi sırasında kurtarılanların %77,1'inin komşular tarafından, sadece %22,9'unun ise itfaiye, polis ve öz savunma kuvvetleri tarafından kurtarıldığı bildirilmiştir. Morisaki ve diğerleri, depremin yol açtığı idari işlevlerin

felç olması nedeniyle hükümetin mağdurlara yeterli desteği sağlayamaması nedeniyle, öz yardım ve karşılıklı yardım yoluyla kurtarma oranının yüksek olduğunu tespit etmiş ve öz yardım ve karşılıklı yardımın önemini doğrulamıştır (Arakawa, Yamada, & Sugimori, 2024).

Öz yardım faaliyetlerinin genişletilebilmesi için üç farklı boyutta başta kadınlar olmak üzere güçlendirme çalışmalarının da risk planlarına dahil edilmesi gerekmektedir. Bu faaliyetler ekonomik güçlendirme, sosyal ve siyasi güçlendirme ile psikolojik güçlendirme olarak üç grupta toplanabilir. Kadınların tasarruf ve krediye erişimi, karar alma süreçlerinde onlara daha büyük bir ekonomik rol kazandırır. Kadınlar kredi ve tasarrufla ilgili kararları kontrol ettiklerinde, kendi ve hane halkının refahını optimize ederler. Kadınların faaliyetlerine yapılan yatırım, kadınlar için istihdam olanaklarını artıracak ve böylece "aşağıya doğru yayılma" etkisi yaratacaktır. Sosyal ve siyasal güçlendirme ise kadınların artan ekonomik faaliyetleri ve mikro finansa erişimden kaynaklanan gelir üzerindeki kontrollerinin yanı sıra, kadınların becerilerinin, hareketliliğinin ve bilgiye ve destek ağlarına erişiminin iyileştirilmesinin birleşimidir. Finansal öz-sürdürülebilirlik paradigması ve yoksulluğu azaltma paradigması, sosyal ve politik güçlenmenin, hane halkı, topluluk veya makro düzeylerde cinsiyet ilişkilerini değiştirmek için özel müdahaleler olmaksızın gerçekleşeceğini varsayar. Psikolojik güçlendirme ise özgüven oluşturmayı, etkililik duygusu kazanmayı ve çaresizlik duygusunun üstesinden gelmeyi ifade eder. Kadınların karar alma üzerindeki kontrolü, hane halkı gelirinin verimsiz faaliyetlere sızmasını önleyerek fayda sağladığı görülmektedir. Hane halkında finansal güvenlik, geleceğe dair kaygıyı azaltır ve kadınların duygusal refahını iyileştirir (Sagayaraj, 2013). Afet öncesi öz yardım faaliyetlerini güçlendirici bir zemin hazırlanabileceği bu kapsamda söylenilebilir. Savunmasız grupların güçlendirilmesine yönelik çalışmaların da ayrıca yürütülmesi gerekmektedir. Al-rousan vd. (2014) ABD'deki yaşlılar arasındaki doğal afetlere hazırlık durumlarını inceledikleri çalışmalarında yaş ortalaması 70 yaş olarak çıkan yetişkin gruplarının sadece %34.3'ü afet hazırlığı hakkında eğitim programına katıldığını veya bu konuda okuma materyalleri aldığını bildirmişlerdir. Yaklaşık %15'i elektrik kesintisinde risk altında olabilecek elektrikle çalışan tıbbi cihazlar kullandığını belirtmiştir. Hazırlık puanının, artan yaş, fiziksel engellilik ve düşük eğitim seviyesi ve gelir düzeyi, genel hazırlık düzeyinin yetersiz olmasıyla birlikte değerlendirildiğinde, hazırlığı ile arasında negatif yönlü anlamı bir ilişki olduğunu belirlemişlerdir. Hem afetlere karşı artan kırılganlığa hem de yaşlı yetişkinlerin sayısındaki sürekli artışın da kırılganlık durumlarını afete hazırlık konusunda öz yardım

faaliyetlerini olumsuz yönde etkileyen bir duruma işaret ettiği görülmektedir (Al-rousan , Rubenstein , & Wallace , 2014).

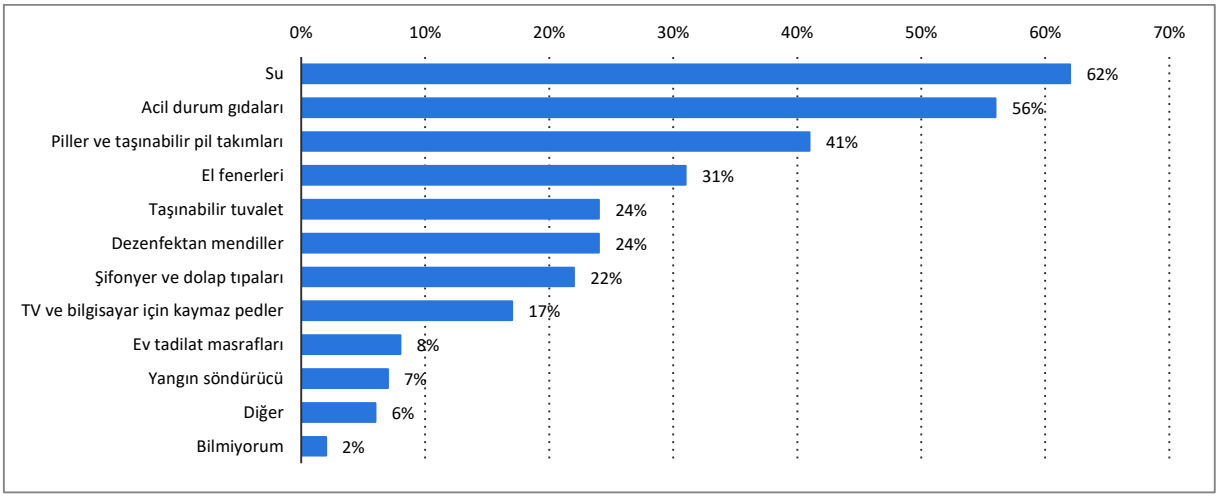
Tablo 6: Ağustos 2024 itibarıyla Japonya'da doğal afetlere hazırlık için en yaygın önlemler



Kaynak: (Statista, 2025)

Bir sigorta şirketinin Japonya'da yapmış olduğu ankete katılan katılımcılar, Japonya'da 2024 yılında meydana gelebilecek doğal afetler üzerine yapılan bir ankete göre, katılımcılar arasında en yaygın afet hazırlık önlemleri acil durum gıda ve su stoklamak, el feneri ve cep telefonu pilleri bulundurmak olmuştur ve her iki eylemin de katılımcıların %73'ü tarafından desteklendiği görülmüştür. Bunları, katılımcıların %54'ü tarafından belirtilen yangın sigortasına ilişkin önlemlerin izlediğini belirtmişlerdir (Sompo Japan Insurance Inc., 2024). Öz yardımın önemi, afetlere hazırlıklı hanelerin daha olumlu bir sağlık durumuna ve daha iyi bir refaha sahip olma eğiliminde olması gerçeğiyle de desteklenmektedir. Bu gerçekler, bir toplumun kriz ve belirsizlikle karşı karşıya kaldığı durumlarda öz yardımın öneminin vurgulanmasının giderek daha etkili bir faktör haline geldiğini göstermektedir (Nakai & Nakano, 2023).

Tablo 2: Ağustos 2024 itibarıyla Japonya'da doğal afetlere hazırlık için en sık satın alınan ürünler veya hizmetler



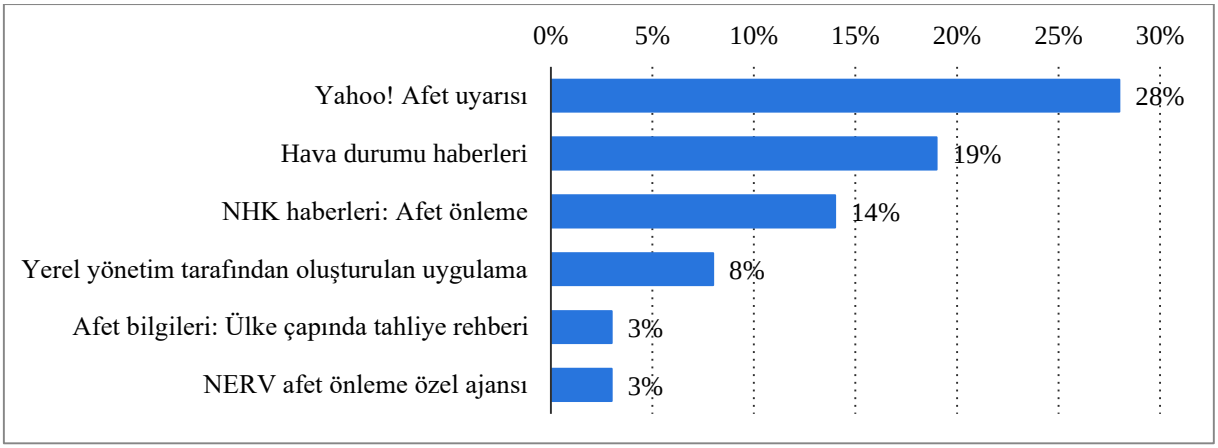
Kaynak: (Fernández, Most commonly purchased items or services to prepare for natural disasters in Japan as of August 2024, 2025)

2024 yılında Japonya'da yapılan bir ankete göre, doğal afetlere hazırlık için en çok satın alınan ürün, katılımcıların %62'si tarafından su olarak bildirilmiştir. Bunu, katılımcıların %56'sı tarafından satın alınan acil durum gıdası izlemektedir (Fernández, Most commonly purchased items or services to prepare for natural disasters in Japan as of August 2024, 2025).

Beattly vd. (2019) çalışmasında Şişelenmiş su, pil ve el feneri satışlarının, bir bölgenin kasırga tehdidi altında olması durumunda, varsayımsal satışlara (yani kasırga tehdidi olmaması durumundaki beklenen satışlara) kıyasla arttığını belirlemiştir. Satıştaki artışların büyük kısmı, kasırganın karaya ulaşmasının tahmin edildiği andan hemen önce gerçekleşmektedir. Şişelenmiş su, pil ve el feneri satışları, kasırgalar yakındaki karaya ulaştıktan sonra da varsayımsal satışlara kıyasla artmaktadır. Kasırga tehdidi sırasında gözlemlenen acil durum hazırlıklarının, kıyı bölgelerinde, daha varlıklı ve beyaz nüfuslu bölgelerde daha yüksek olduğunu belirlemişlerdir. Kasırgalar karaya ulaştıktan sonraki acil durum müdahalelerinin ise Afrika kökenli Amerikalıların, düşük gelirli ve daha az eğitimli bölgelerde çok daha yüksek olduğunu tespit etmişlerdir. Araştırma sonuçlarına göre, Kasırga karaya ulaşmadan önce daha fazla acil durum malzemesi temin eden bölgelerde (daha yüksek gelirli ve daha eğitimli bölgelerde) kasırga karaya ulaştıktan sonra bu malların satışlarında daha az artış yaşanmaktadır. Düşük gelirli, daha az eğitimli ve azınlık nüfuslar, kasırgalar yaklaşırken acil durum malzemelerinin satışlarında daha az artış yaşarken, kasırga karaya ulaştıktan sonra acil müdahale malzemelerinin satışlarında daha büyük artışlar yaşamaktadır. Potansiyel olarak

savunmasız gruplar, afetlere daha az hazırlıklı olabilir, afetlerden daha büyük zararlar görebilir veya her ikisi de olabilir şeklinde bir çıkarımda bulunulmaktadır. Mevcut iletişim stratejileriyle yeterince hizmet alamayan risk altındaki nüfus gruplarına tam olarak ulaşmak için daha çok hedef yönelimli mesajlaşma kampanyalarının hükümet tarafından gerçekleştirilmesi gerektiğine vurgu yapılmıştır (Beatty, Shimshack, & Volpe, 2019).

Tablo 3: Ocak 2023 itibarıyla Japonya'da en sık yüklenen afet önleme uygulamaları, hizmete göre



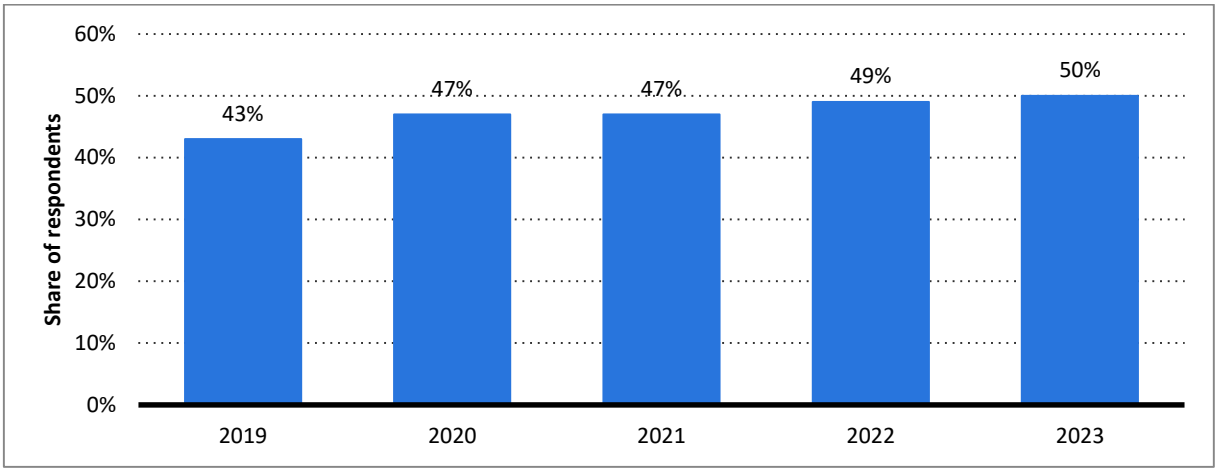
Kaynak: (Klein, Most often installed disaster prevention apps in Japan as of January 2023, by service, 2025)

Ocak 2023'te yapılan bir ankete göre, Yahoo! Disaster uyarı uygulaması, Japonya'da katılımcıların %28'i tarafından yüklenen en popüler afet önleme akıllı telefon uygulaması olarak belirtilmiştir. İkinci en popüler hizmet ise, katılımcıların %19'unun akıllı telefonlarında yüklü olduğu hava durumu haberleri olarak belirlenmiştir. Ayrıca rapora göre gençler arasında uygulamaların kurulum oranının da son beş yılda arttığının gözlemlenmiştir (Klein, Most often installed disaster prevention apps in Japan as of January 2023, by service, 2025), (Mobile Society Research Institue, 2023).

Bu uygulamaların dışında ayrıca teknoloji tabanlı öz yardım müdahaleleri, özellikle doğal afetlerden etkilenen aileler için ruh sağlığı hizmetlerine erişimi artırma potansiyeline sahiptir. Bireylerin bir uygulamayı başarıyla kullanma becerisi de, bir öz yardım müdahalesinin kalitesi üzerinde önemli bir etkiye sahip olabilir (Yuen, et al., 2016). Sistematik incelemeler, doğal bir afete doğrudan maruz kalan kişilerin %40'a kadarının travma sonrası stres bozukluğu (TSSB), majör depresyon, karmaşık yas, madde kullanımına bağlı bozukluklar veya uykusuzluk gibi durumlarla karşı karşıya olduğnu göstermektedir. Doğal afetlerden sonra ortaya çıkan çeşitli ruh sağlığı ihtiyaçlarını karşılamak için çok sayıda

stratejiye ihtiyaç duyulabileceği öne sürülmektedir. Çevrimiçi tedavi platformu üzerinden, 2016 Fort McMurray, Alberta orman yangınlarından tahliye edilenlerde travma sonrası stres bozukluğu, depresyon ve uykusuzluk semptomlarını azaltmada etkili olduğunu göstermiştir. Bu bilgisayar destekli psikoterapi aracı, bir felaketten sonra uzmanlaşmış kanıta dayalı ruh sağlığı hizmetlerine erişim sağlamada başarılı olmuş ve e-ruh sağlığının daha erişilebilir, güçlendirici ve sürdürülebilir bakım modellerine doğru bir adım olduğunu tespit etmiştir (Belleville, et al., 2023). Çevrimiçi destek platformlarının da afet sonrası kullanılabilirliğindeki artış, bireylerin afet sonrası öz yardım becerilerini de güçlendirdiğini göstermektedir.

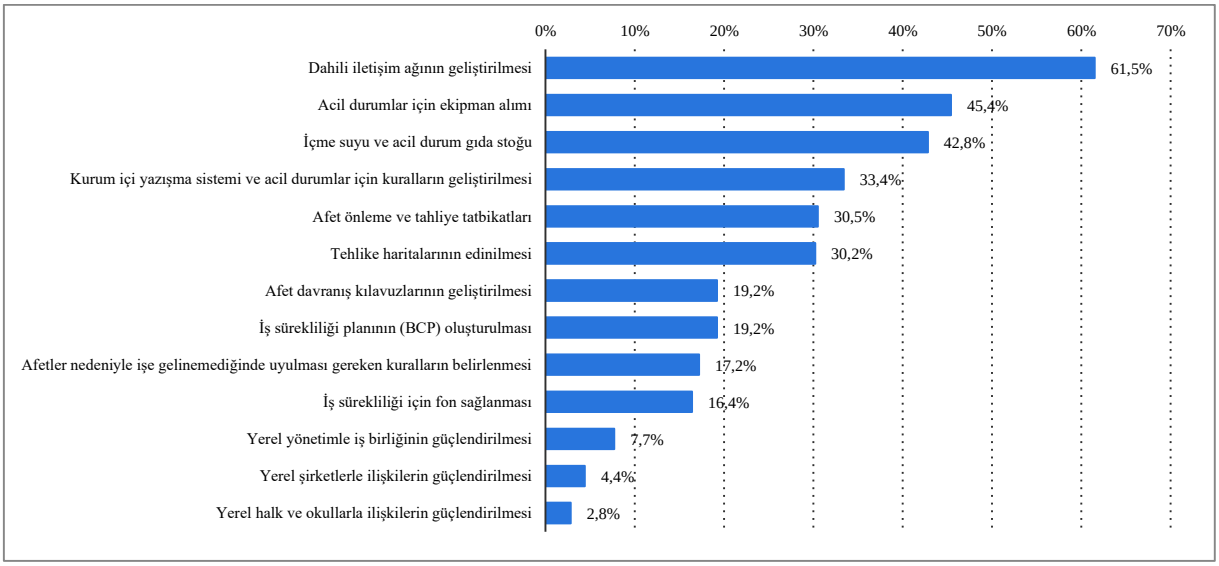
Tablo 4: Japonya'da 2019'dan 2023'e kadar afet önleme uygulamalarının kurulum oranı



Kaynak: (Fernández, Installation rate of disaster prevention apps in Japan from 2019 to 2023, 2025)

Ocak 2023'te yapılan bir ankete göre, Japonya'daki katılımcıların %50'sinin akıllı telefonlarında bir afet önleme uygulamasının yüklü olduğu görülmektedir. Akıllı telefon sahibi olup afet önleme uygulaması yüklü olanların oranı, beş yıllık süre boyunca istikrarlı bir artış eğilimi göstermektedir (Fernández, Installation rate of disaster prevention apps in Japan from 2019 to 2023, 2025); (Mobile Society Research Institute, 2025). Afetler sırasında, sürdürülebilir afet eğitimi için "kendine yardım", "karşılıklı yardım" ve "kamu desteği" önemli faktörlerdir (Arakawa, Yamada, & Sugimori, 2024). Bu bakımdan öncelikle öz yardım sürecine yönelik bilinçlenme afet sonrası olay yönetim sürecinin de kolaylaştırmak ile birlikte kamu desteği gelene kadar, karşılıklı yardım ihtiyacına bilinçli düzeyde bir cevap verilmesini sağlayacaktır.

Tablo 5: Ekim 2020 itibarıyla Japonya'daki şirketlerin doğal afetlere yönelik öncü hazırlık önlemleri



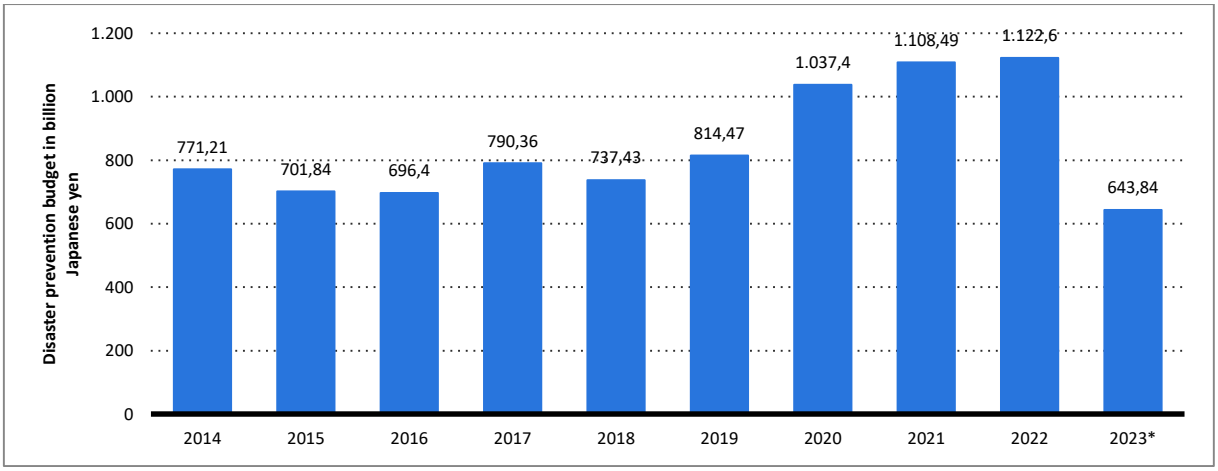
Kaynak: (Klein, Leading preparation measures for natural disasters among companies in Japan as of October 2020, 2025)

Ekim 2020'de yapılan bir ankete göre, Japonya'daki şirketlerin yaklaşık %61,5'i doğal afetlere hazırlık için şirket içi bir iletişim ağı geliştirmiştir. Şirketlerin yaklaşık %45,4'ü ise doğal afetlere hazırlık önlemi olarak acil durumlar için ekipman alımı yapmıştır. Aynı ankete göre, Japon şirketleri arasında en büyük endişe kaynağı depremler olarak bildirilmiştir (Klein, Leading preparation measures for natural disasters among companies in Japan as of October 2020, 2025).

1987'den beri sürdürülebilir kalkınma, dünya kalkınma gündeminin ön saflarında yer almaktadır. 1987 tarihli Brundtland Komisyonu, çevresel istikrar ve ekonomik kalkınmayı birbirine bağlamayı amaçlayan Ortak Geleceğimiz adlı bir rapor yayınladı. Brundtland raporu, sürdürülebilir kalkınmanın ilk tanımını, gelecek nesillerin kendi ihtiyaçlarını karşılama yeteneklerinden ödün vermeden bugünün ihtiyaçlarını karşılayan kalkınma olarak tanımlamıştır (Ghosh, Ray, & Nair, 2023). Afetler nedeniyle pek çok şirket de sürdürülebilirliğini devam ettirmesi açısından afetlere hazırlıklı olmak durumundadır. Önleme ve hafifletme önlemleri, kırılganlığı ve tehlikeyi azaltabilirken, doğal afetlerin meydana gelmesi kaçınılmazdır. Yeterli hazırlık, bu afetlerin olumsuz etkilerini önemli ölçüde azaltabilir. Bilgi, farkındalık, kaynaklar ve etkili bir çerçeve, bir topluluğun doğal afetlere karşı hazırlığının en önemli unsurlarıdır (Khan, 2008). Afet hazırlığı, afetle mücadele planının hazırlanmasını, afetin tahmin edilmesini ve uyarılmasını, afet sırasında ve sonrasında ihtiyaç

duyulan kaynakların korunmasını ve ilgili personelin eğitimini içerir. Afet hazırlığı, afet yönetimine yönelik daha geniş faaliyetlerin bir parçasıdır. Afet yönetimi, hazırlık, müdahale, iyileşme, değerlendirme, önleme ve hafifletme olmak üzere çeşitli aşamalarda veya seviyelerdeki faaliyetleri içeren döngüsel bir süreçtir. Her döngünün tamamlanmasıyla yeni dersler öğrenilir, yeni önlemler alınır ve insanlar bir sonraki afete daha iyi hazırlanır (Khan, 2008).

Tablo 7: Japonya'da 2014-2023 mali yılı afet önleme bütçesi*(milyar Japon yeni cinsinden)*



Kaynak: (Fernández, Disaster prevention budget in Japan from fiscal year 2014 to 2023, 2025)

2022 mali yılında Japonya'nın afet önleme bütçesi bir trilyon Japon yeninin üzerine çıkarak son on yılın en yüksek seviyesine ulaşmıştır. (Fernández, Disaster prevention budget in Japan from fiscal year 2014 to 2023, 2025).

Doğal afetler son derece maliyetli olabilir ve önlenmesi zordur. Bu nedenle, doğal afetlerle ilgili riskler ve bunların meydana gelme sıklığı, özellikle afetlere yatkın bölgelerde ve ülkelerde, ulusal ve yerel düzeydeki politika yapıcılar için sürekli olarak büyük endişe kaynağını oluşturmuştur. Acil bir durumda, yetersiz hazırlık, yaralanmalar, ölümler ve konut ve altyapıya verilen fiziksel hasar açısından afet hasarının bedeli artabilir. Afet hasarını azaltmak için hükümetler, etkili bir afet yönetim planının parçası olarak acil durum malzemelerinin hazırlanmasına önem vermeleri gerekmektedir (Onuma, Shin, & Managi, 2017).

Japonya'da son yıllarda, hasar gören tesislerin maliyetlerinin büyük çoğunluğu şiddetli yağışlar ve tayfunlardan, ardından da depremlerden kaynaklanmıştır. Sonuç olarak, Japon hükümetinin afet risk yönetimi bütçesi esas olarak afet yeniden inşasına, ardından da afet önlemeye ayrılmıştır. Afet önleme, hem setler inşa etmek ve depreme dayanıklı yapıları güçlendirmek gibi sert önlemlere hem de tehlike haritalaması ve afet eğitimi gibi yumuşak önlemlere öncelik

vermektedir (Fernández, Disaster prevention budget in Japan from fiscal year 2014 to 2023, 2025).

İklim değişikliği , küresel ısınmanın artan sıcaklıklara, daha yüksek deniz seviyelerine ve daha yoğun yağış ve kuraklıklara yol açmasıyla doğal afetleri yoğunlaştırabilir. Japonya'da, sık görülen şiddetli yağmurlar ve tayfunlar giderek daha fazla sosyal ve ekonomik hasara neden olmaktadır. Sıcak hava dalgaları nedeniyle artan sayıda sağlık sorunu ve ölümlerin yanı sıra, yüksek sıcaklıklar ve seller de ekinlerin büyümesini engelleyerek tarım sektöründe hasara yol açmaktadır. Hükümet, iklimle ilgili bu afetlerle başa çıkmak için afet önleme altyapısını ve şiddetli yağışlar için erken uyarı sistemlerini daha da güçlendirmek, hızlı tahliyeyi teşvik etmek ve sakinler için önleyici eylemlerde bulunmak gibi çalışmalar yürütmektedir. Ayrıca Japonya, karbon ayak izini azaltmak için yenilenebilir enerji ve nükleer enerji gibi karbon nötr enerji kaynaklarının payını artırmak konusunda da girişimlerde bulunmaktadır (Fernández, Disaster prevention budget in Japan from fiscal year 2014 to 2023, 2025).

3.SONUÇ

Sürdürülebilir afet eğitimini sağlamak ve insanların afetlere hazırlanabilmesi için farkındalığı sağlam bir şekilde oluşturmak amacıyla, bireyleri hem öz yardımlaşma hem de karşılıklı yardımlaşma konusunda eğitimin sürdürülebilirliğini sağlamak önemlidir. Bu nedenle, karşılıklı yardımlaşma için teknolojiler geliştirilirse, karşılıklı yardımlaşma kapasitesinin artması beklenebilir. Bu süreçte multimedya yoluyla öğrenmenin de afet eğitiminde sürecin bir parçası olduğunu göstermiştir. Yalnızca öz yardım yeteneklerini değil, aynı zamanda karşılıklı yardım yeteneklerini de geliştirmeyi amaçlayan eğitime katkıda bulunan mühendislik teknolojilerinin geliştirilmesi önemli ve anlamlıdır. Simülasyon ve oyunlaştırma, afetler gibi gerçekte deneyimlenmesi zor olan olaylar hakkında "farkındalık" kazanmanın etkili yöntemleri olarak kabul edilmektedir (Arakawa, Yamada, & Sugimori, 2024). Topluluk ve bireysel iyileşme arasındaki bağlantı, özellikle afetle ilgili zihinsel travmaya karşı savunmasız olan popülasyonlarda daha da belirginleşmektedir. Bir popülasyonun travmaya yatkınlığını belirlerken, dil ve iletişim ağları, önceki travmalara maruz kalma, toplumsal uyum ve karşılıklı bağımlılık ile demografik özellikler gibi değişkenleri dikkate almak önemlidir. Yaş, cinsiyet, sosyoekonomik durum ve kültürel kimlik de bir popülasyonun büyük bir travmatik olaya verdiği tepkiyi belirlemede önemli bir rol oynar (Rossé, 1993). Çalışmalarda afete3 maruz kalan bireylerin afete hazırlık sürecini daha ciddiyetle ele aldığını göstermektedir. Ayrıca, hassas topluluklarda afet riskini azaltma önlemleri önemli ölçüde iyileştirilmedikçe, evini

kaybetme veya güvenli olmayan inşaat sonucu yaralanma veya ölüm riski altında olan insan sayısı da artmaya devam edecektir (Harriss, Parrack, & Jordan, 2020). Afet sonrası karşılıklı yardım ve öz yardım çalışmalarının bilinçli bir şekilde yürütülmesi afet yönetim döngüsündeki müdahale ve iyileştirme süreçlerinin etkinliğinin arttırılmasında önemli bir rol oynayacağı bu kapsamda düşünülmektedir. Onuma vd. (2017) çalışmasında, afete hazırlık kapsamında, afetle ilgili deneyimi olan kişilerin, deneyimi olmayanlara kıyasla acil durum malzemeleri açısından daha iyi hazırlanmış olduklarını belirlemişlerdir. Afet deneyimi ile algılanan risk düzeyi arasında pozitif bir ilişki olduğu sonuna ulaşılmıştır. Ancak afet deneyiminin etkisinin afet türüne ve büyüklüğüne bağlı olduğunu da belirlemişlerdir. Fiziksel hasarın eşlik etmeyebileceği bir tahliye deneyimine kıyasla, hasar yaşamanın daha güçlü bir etkiye sahip olduğu görülmüştür. Japonya'da hane halkı düzeyinde acil durum malzemelerinin hazırlanmasındaki bölgesel farklılıklar, afet yönetimi açısından önemli sonuçlar doğurmaktadır. Nisan 2016'da *Kumamoto* vilayetinde meydana gelen deprem, 2011'deki Büyük Jeofizik Depremi'nden (GEJE) bu yana yaşanan en büyük deprem olarak belirtilmektedir. Afetin hemen ardından 180.000 kişi tahliye edilirken, diğerlerinin günlerce dış dünyayla bağlantısı kesilmiş uzak bir bölgede mahsur kalmışlardır. Tahliye edilenler ayrıca su, yiyecek ve diğer temel ihtiyaçları temin etmekte de zorluk yaşamışlardır. Sonuçlara göre, *Kumamoto* vilayetini de içeren *Kyushu bölgesi, Tohoku, Kanto* ve *Tokai* bölgelerine kıyasla nispeten daha az hazırlıklı olduğu belirlenmiştir. Bölgenin yıllık tayfunlar dışında ılıman bir iklime sahip olması ve büyük ölçekli riskin nispeten düşük olarak algılanması göz önüne alındığında, bölge sakinlerinin risk algılarının nispeten düşük olduğu sonucuna ulaşılmıştır. Bu durum da, bölge sakinlerinin diğer bölgelerin çoğuna kıyasla önemli ölçüde hazırlıksız olduğu bir dönemde afetle karşı karşıya kalmalarına neden olmuştur (Onuma, Shin, & Managi, 2017).

Genel olarak sonuçlar incelendiğinde, sürdürülebilirlik ekseninden afet yönetim süreçlerinin ele alınmasının önemli olduğu görülmektedir. Bütçe planlaması ile başlayan sürecin önce gerekli hazırlık eğitiminin farklı savunmasız gruplar üzerinde yeterli bütçe planlaması yapılarak savunmasız gruplar temelli bir güçlendirme çalışmasını temel alan afet hazırlık sürecinin oluşturulmasına ihtiyaç duyulmaktadır. Bununla birlikte öz yardımın afete hazırlıkta önemli rolünün saptanması ve bireylere afete hazırlık eğitiminde öz yardımın öneminden bahsedilmesi önemlidir. Öz yardımı takiben karşılıklı yardım ekseninde kurumların sürdürülebilirlik politikalarına afete hazırlık sürecine entegre edilmesine gereksinim duyulmaktadır. Afetlere

dirençli bir toplum oluşturulması kapsamında tüm bu süreçlerin önemli bir yerinin olduğunun kabul edilmesi afet yönetimini hazırlık sürecinde kritik bir önem taşımaktadır.

Gelecekte planlanacak çalışmalar kapsamında savunmasız grupların türlerine göre bir afet iletişim stratejisinin oluşturulması, yaş gruplarına göre oyunlaştırma tabanlı yazılımlar yardımı ile afet eğitiminin okul çağından itibaren eğitime entegre edilmesini sağlayacak stratejilerin geliştirilmesi afete hazırlık süreçlerinde bir hazırlık adımı olarak planlanabilir.

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BEDENİN NİHÂÎ MENZİLİ: *GÜLZÂR-I İRFÂN*'DA "TOPRAK/MEZAR"

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ÖZET

Klasik Türk Edebiyatı edebî metinlerinde önemli şahsiyetlerin doğum, sünnet, düğün, eğitim, tayin, azil ve tasavvufî hayatlarına dair biyografik bilgilerin kayıt altına alındığı görülmektedir. Biyografik hafıza metinleri olan bu eserlerde kayıt altınan alınan diğer bir hadise ise "ölüm" ile ilgilidir. Klasik Türk Edebiyatında kişilerin ölüm tarihleri ile ilgili kayıtlara şiirde tarih manzumeleri ve kasidelerde rastlanılırken nesirde ölüm tarihleri merkezinde teşekkül etmiş müstakil bir edebî tür olan vefeyât-nâmelerde bir şehirde yaşayan önemli şahsiyetlerin ölüm tarihleri ile ilgili bilgilerin edebî bir şekilde verildiği görülür.

Mehmed Fahreddin Bursavî tarafından kaleme alınan *Gülzâr-ı İrfân*, Bursa'da medfun bulunan padişah, şehzade, şeyhülislam, ulema, müderris, musikişinas ve şair gibi önemli şahsiyetlerin ölüm tarihlerinin ve medfun bulundukları yerlerin kayıt altına alındığı bir şehir vefeyât-nâmesidir. Vefeyât-nâmede bir ilim ve kültür merkezi olan Bursa topraklarında yetişen bu şahsiyetlerin ölümü ile birlikte dünyada kalan bedenlerinin Bursa topraklarına defnedilmesi bir şehrin şahsiyet inşasındaki ontolojik bağını izhar edecek niteliktedir. Bu bağlamda çalışmamızda öncelikle vefeyât-nâmede adı geçen şahsiyetlerin ölümü ile birbirinden ayrılan "ruh" ve "beden" unsurlarına dair benzetmeler, hususiyetler ve telakkîler üzerinde durulmuştur. Daha sonra bedenin medfun olduğu mekânı tasvir eden müspet ifadelerden ve "defin" söz varlığından istifade edilerek bedenin nihâî menzili olan toprak/mezar ile ilgili inanç, telakkî ve hususiyetler ele alınmış, vefeyât-nâmede geçen "rûh", "ten/cesed/beden", "hâk/türâb" ve "kabr/lahd/sandûka/mezâr/merkad/meşhed" kavramları bağlamsal olarak değerlendirilmiştir.

Anahtar kelimeler: Biyografi, vefeyât-nâme, mezar, nesir, söz varlığı

THE BODY'S FINAL DESTINATION: 'EARTH/GRAVE' IN THE *GÜLZÂR-I İRFÂN*

ABSTRACT

In classical Turkish literature, biographical information about important figures' births, circumcisions, weddings, education, appointments, dismissals, and mystical lives is recorded in literary texts. Another event recorded in these works, which are biographical memory texts, is related to 'death'. In Classical Turkish Literature, while records of individuals' dates of death are found in historical poems and odes, in prose, we see vefeyat-nameler, an independent

literary genre centred on dates of death, in which information about the dates of death of important figures living in a city is presented in a literary manner.

Gülzâr-ı İrfân, written by Mehmed Fahreddin Bursavî, is a city obituary book recording the dates of death and burial places of important figures such as sultans, princes, sheikh ul-Islam, ulema, professors, musicians and poets buried in Bursa. The fact that these figures, who grew up in Bursa, a centre of science and culture, were buried in Bursa upon their death reveals the ontological connection in the construction of a city's identity. In this context, our study primarily focuses on the metaphors, characteristics, and perceptions regarding the elements of 'spirit' and 'body' that separate each other with the death of the figures mentioned in the vefeyat-name. Subsequently, drawing on positive expressions describing the place where the body is buried and the lexical item 'burial,' beliefs, perceptions, and characteristics related to the soil/grave, the final destination of the body, are examined. The concepts of 'spirit,' 'flesh/body,' 'earth/dust,' and 'grave/coffin/tomb/mausoleum' mentioned in the vefeyat-name are evaluated contextually.

Keywords: Biography, vefeyat-name, grave, prose, lexical field

HİZMET İÇİ İNGİLİZCE ÖĞRETMENLERİNE YÖNELİK 21. YÜZYIL BECERİLERİ MESLEKİ GELİŞİM PROGRAMI TASARIMI

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ÖZET

Teknolojinin ilerlemesi, yapay zekânın profesyonel bağlamlarda artan rolü ve toplumsal karmaşıklığın artması, 21. yüzyıl ve sonrası için gerekli olan ileri yetkinliklere olan ihtiyacı artırdı. Eğitim araştırmaları 21. yüzyıl becerilerinin geliştirilmesine daha fazla önem vermeye başladı. 21. yüzyıl becerilerini öğretim uygulamalarına entegre etme konusunda hizmet içi İngilizce öğretmenlerine özel olarak tasarlanmış, sistematik olarak uygulanmış ve deneysel olarak değerlendirilmiş mesleki gelişim programları üzerine yapılan araştırmalar oldukça azdır. Bu boşluğu doldurmak amacıyla, 21. yüzyıl becerilerini İngilizce öğretim sürecine entegre etmek için bir mesleki gelişim programı, hizmet içi öğretmenlerin ihtiyaçları doğrultusunda tasarlanmış, uygulanmış ve katılımcıların geri bildirimleri ile değerlendirilmiştir. Programa katılan öğretmenler 21. yüzyıl becerilerini içeren ders planları tasarladılar, bu planları uyguladılar ve sınıf içi uygulamalarına dayalı yansıtıcı raporlar hazırladılar. Bulgular, öğretmenlerin İngilizce eğitiminde 21. yüzyıl becerilerinin önemini bilmelerine karşın, bu becerileri etkili bir şekilde uygulayabilmek için ek destek almaları gerektiğini göstermektedir. Genel olarak, çalışma öğretmenlerin 21. yüzyıl becerilerini anlamaları ve pratik olarak uygulamaları, pedagojik bakış açılarını ve sınıf uygulamalarını genişletmelerinde yapılandırılmış mesleki gelişimin kritik rolünü vurgulamaktadır.

Anahtar Kelimeler: 21. Yüzyıl Becerileri, Hizmet İçi İngilizce Öğretmenleri, Mesleki Gelişim Programı.

DESIGNING A PROFESSIONAL DEVELOPMENT PROGRAM FOR IN-SERVICE EFL TEACHERS ON 21ST-CENTURY SKILLS

ABSTRACT

The advancement of technology, the expanding roles of artificial intelligence in professional contexts, and heightened societal complexity have increased the need for advanced competencies relevant to the 21st Century and beyond. Educational research has placed growing emphasis on the development of 21st-Century Skills. Nevertheless, research that designs, systematically implements, and empirically evaluates professional development programs specifically for in-service EFL teachers on integrating 21st Century Skills into their

teaching practices remains scarce. With the aim of filling this gap, A Professional Development Program to integrate 21st Century Skills into English language teaching process was designed based on the in-service teachers' needs, implemented and evaluated through the reflections of the participants. After attending the program, participants designed lesson plans incorporating 21st-century skills, implemented these plans and produced reflective reports based on their classroom implementations. The findings indicate that although teachers recognize the importance of 21st-century skills in English language education, they need to receive additional support to apply these skills effectively. Overall, the study highlights the critical role of structured professional development in strengthening teachers' understanding and practical application of 21st-century skills, as well as in expanding their pedagogical perspectives and classroom practices.

Keywords: 21st Century Skills, In-Service English Teachers, Professional Development Program.

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ÖZET

Türk edebiyatında hikâye türünde yazdığı örneklerle tanınan Burhan Arpad (1910-1994), edebiyata ilk adımını *Servet-i Fünûn*'da yayımlanan "Güzel Hisarımda" başlıklı mensur şiiri ile atar. Bu adımdan sonra yazın hayatına dikkatle eğilen yazar özellikle hikâye türüne büyük ehemmiyet verir. *İnanç, Yığın, Adımlar, Yurt ve Dünya, Yürüyüş, Yeditepe, Türk Dili* ve *Varlık* gibi döneminin önemli dergilerinde hikâye, gezi yazısı ve eleştirileri yayımlanan Burhan Arpad'ın edebiyat sahasında çok sayıda ödülü de mevcuttur. Burhan Arpad'ın şehir insanının gündelik hayatını çeşitli yönleriyle anlattığı, dokuz hikâyeden oluşan ilk hikâye kitabı *Şehir-9 Tablo* ise 1940 yılında yayımlanır. Roman, hikâye, deneme, hatıra, gezi ve eleştiri yazıları bulunan Burhan Arpad'ın birçok sayıda çeviri kitabı da bulunmaktadır. 1940'lı yılların toplumcu gerçekçi edipleri arasında yer alan yazar, kurmaca metinlerinde realist bir tutumla sade bir anlatımı tercih eder. Burhan Arpad'ın 1962 yılında yayımlanan *İlk Gece* isimli kitabı, çeşitli tiyatro metinleri üzerine yazarın eleştirel düşüncelerini bir araya getirdiği bir eserdir. Eleştiri türünde tek kitabı olan *İlk Gece*'de Burhan Arpad hem Türk edebiyatından hem de dünya edebiyatından birçok tiyatro eseri hakkında görüşünü belirtir. Otuz beş yazının yer aldığı kitabını tiyatrocu dostlarına adayan Burhan Arpad, Türk tiyatrosu alanında; Sabahattin Kudret Aksal, Haldun Taner, Refik Erduran, Oktay Rifat, Güner Sümer, Abdülhak Hâmit, Celâl Esat Arseven, Salâh Cimcoz, Çetin Altan, Cevat Fehmi Başkut, Cahit Atay, Necati Cumalı, Orhan Asena ve Ekrem Reşit Rey gibi isimlerin tiyatro eserlerini inceler. Dünyaca ünlü birçok tiyatro eserine dair eleştiri yazısının da bulunduğu kitabında Burhan Arpad, sergilenen tiyatrolara dair teknik detaylara da söz konusu eleştiri metinlerinin girişinde yer verir. *İlk Gece* kitabında yazarın, 1956 yılından 1962 yılına kadar kaleme aldığı tiyatro eleştirileri, kronolojik bir çizgide ilerler. Bu çalışmada Burhan Arpad'ın *İlk Gece* isimli kitabı, tiyatro eleştirisi kapsamında incelenecek ve kitapta yer alan yazılar, yazarın üslûbu ve eleştiride ön plana çıkardığı dikkatleri bağlamında örneklendirilecek ve değerlendirilecektir. Burhan Arpad'ın söz konusu kitabı hem yazarının hem de döneminin eleştiri hassasiyetlerini okura sunmasının yanında, Türk edebiyatında tiyatro eleştirisi sahasında başvurulabilecek eserlerden biri olma niteliğindedir. Bu bağlamda söz konusu çalışmayla, hakkında sınırlı sayıda çalışma bulunan Burhan Arpad özelinde, tiyatro eleştirisi alanına da katkı sağlanması hedeflenmektedir.

Anahtar kelimeler: Burhan Arpad, Türk Edebiyatı, *İlk Gece*, tiyatro, eleştiri.

BURHAN ARPAD'S THEATRE CRITICISM

ABSTRACT

Burhan Arpad (1910-1994), known for his examples of short stories in Turkish literature, took his first step into literature with his prose poem titled "Güzel Hisarımda", published in Servet-i Fünûn. After this step, the author, who focused carefully on his writing career, gave particular importance to the short story genre. His short stories, travelogues, and criticisms were published in important magazines of his time such as *İnanç*, *Yığın*, *Adımlar*, *Yurt ve Dünya*, *Yürüyüş*, *Yeditepe*, *Türk Dili*, and *Varlık*. He also received numerous awards in the field of literature. His first short story collection, *Şehir-9 Tablo*, consisting of nine stories depicting various aspects of the daily life of city dwellers, was published in 1940. Burhan Arpad, who also wrote novels, short stories, essays, memoirs, travelogues and literary criticism, has also translated numerous books. A writer who was among the social realist writers of the 1940s, he preferred a simple narrative style with a realist approach in his fictional texts. Burhan Arpad's book, *İlk Gece*, published in 1962, is a work that brings together the author's critical thoughts on various theatrical texts. In *İlk Gece*, his only book of criticism, Burhan Arpad expresses his views on many theatrical works from both Turkish and world literature. Dedicated to his theater friends, this book, containing thirty-five essays, examines the works of prominent figures in Turkish theater such as Sabahattin Kudret Aksal, Haldun Taner, Refik Erduran, Oktay Rifat, Güner Sümer, Abdülhak Hâmit, Celâl Esat Arseven, Salâh Cimcoz, Çetin Altan, Cevat Fehmi Başkut, Cahit Atay, Necati Cumalı, Orhan Asena and Ekrem Reşit Rey. The book also includes critical essays on many world-renowned theatrical works, and Burhan Arpad provides technical details about the plays performed at the beginning of these critical essays. In the book *İlk Gece*, the author's theater criticisms, written between 1956 and 1962, are presented in chronological order. This study will examine Burhan Arpad's *İlk Gece* within the context of theater criticism, and the essays included in the book will be exemplified and evaluated in terms of the author's style and the points he emphasizes in his criticism. Burhan Arpad's book not only presents the author's and his era's critical sensibilities to the reader but also holds the distinction of being one of the valuable works in the field of theater criticism in Turkish literature. In this context, the aim of this study is to contribute to the field of theatre criticism, specifically focusing on Burhan Arpad, about whom there are a limited number of studies.

Keywords: Burhan Arpad, Turkish Literature, *İlk Gece*, theatre, criticism.

Giriş

1910 yılında Bursa'da doğan Burhan Arpad, Türk edebiyatında yazar ve çevirmen olarak anılır. Bu sıfatların yanına yıllarca sürdürdüğü basın hayatıyla birlikte muhabir, gazeteci ve köşe yazarı vasıflarını da eklemek yerinde olacaktır. Babasının ölümünün ardından çalışma hayatına erken atılmak zorunda kalan Arpad, 1925-1928 yılları arasında sinema makinistliği yapar. Sonrasında memuriyet hayatına atılan Arpad, *Memleket, Hürriyet* ve *Vatan* gazetelerinde çalışır. *İnanç, Yığın, Adımlar, Yurt ve Dünya, Yürüyüş, Yeditepe, Türk Dili* ve *Varlık* gibi döneminin ünlü dergilerinde başta hikâye olmak üzere çeşitli yazılar yazar (Necatigil, 1985, s. 45). Burhan Arpad, 1970 yılından hayatının sonuna kadar *Cumhuriyet* gazetesinde köşe yazarı olarak yer alır[37].

1945-1946 yılları arasında Arpad Yayınevi'ni kuran Burhan Arpad, eser yazımının yanında yayın hayatında, basım aşamasında da yer almak ister. Bunun yanında Berlin Film Festivali'nde (1961-1964) jürilik yapan Arpad, yazın hayatı kadar seyir zevkine dair eleştirel görüşleriyle de ön plana çıkar. *Gezi Günlüğü* isimli kitabı ile Türk Dil Kurumu'nun 1963 yılı deneme, eleştiri, gezi ödülünü kazanan Arpad'ın birçok sayıda ödülü mevcuttur (Arpad, 2001, s. 8). 1940 kuşağının Toplumcu gerçekçi yazarlarından olan Burhan Arpad, "*kuru denebilecek dümdüz bir anlatımla da lirizm yapılabileceğini*" göstermeyi amaçlar (TDEA, 1977, s. 160). Türk edebiyatında özellikle hikâye türünde verdiği eserlerle tanınan Burhan Arpad'ın, tiyatro türüne dair eleştirileri de bulunmaktadır. *İlk Gece* (1962) isimli kitabı, Burhan Arpad'ın Türk ve dünya edebiyatındaki çeşitli tiyatro eserleri üzerine yazdığı eleştirilerinin yer aldığı bir eserdir.

***İlk Gece* (1962)**

Burhan Arpad'ın tiyatrocu dostlarına armağan ettiği *İlk Gece* isimli kitabı 1962 yılında İstanbul'da Yeditepe Yayınları'ndan yayımlanır. Kitabın içerisinde otuz beş adet tiyatro tenkidi bulunmaktadır. Söz konusu tenkitlerin on beş tanesi Türk tiyatro eserlerine, yirmi tanesi ise dünya edebiyatından çeşitli tiyatrolara dairdir.

Tiyatro, yaşama dair her olguyu canlandırmayı amaçlayan edebi bir türdür. Konuşma ve harekete dayanan bu türde temsil edilebilme özelliği bulunur. Edebi bir tür olarak metin hâlinde yazılan ve okunan tiyatro eseri, bir sahnede, seyirci önünde, oyuncular, kostüm ve dekor aracılığıyla sergilenmesiyle bir gösteri gerçekleştirilmiş olur.

[37] İbrahim Özen, https://teis.yesevi.edu.tr/madde-detay/arpad-burhan, Erişim tarihi: 28.12.2025.

Türk edebiyatında tiyatro geçmişi çok eski tarihlere dayanan bir türdür. Geleneksel tiyatronun, özellikle Tanzimat dönemiyle birlikte yeniliğe, modernleşmeye açtığı kapıdan birçok yeni tiyatro denemeleri girer. Tanzimat döneminde oluşturulmak istenen ideal toplum düzenine ve verilmek istenen sosyal mesajlara yönelik oluşturulan tiyatro metinleri, ilerleyen süreçte toplumsal olandan sıyrılarak sanata yönelik endişelere odaklanır. Türk toplumunun geçirdiği zor bir dönemde çerçevesi çizilen Milli edebiyat sürecinde toplumun kaygı ve endişelerini dile getirme amacında olan ve bu bağlamda eserler veren Türk tiyatro yazarları halkı bilinçlendirmeyi ve yönlendirmeyi hedefler. Cumhuriyet döneminde tiyatro, yeni siyasi düzenin ve yeni bakış açılarının da etkisiyle yönünü farklı cephelere çevirecek, yeni tarzlarda ve üslûplarda tiyatro eserleri verilecektir. Türk edebiyatında, tiyatro sahasında eserlerin giderek artması, farklı üslûp ve yaklaşımlara zemin hazırlayacaktır.

Burhan Arpad, 1940 kuşağının Toplumcu gerçekçi yazarları arasında anılır. Yazılarında kimi zaman "Ahmet Hisarlı" kimi zaman da "Birisi" müstear isimlerini kullanan Burhan Arpad, hikâye ve gezi yazılarının yanında çeşitli gazete ve dergilerde oldukça fazla sayıda köşe yazısı yazar. Arpad, tüm bu yazılarının yanında, döneminin tiyatro eserlerine ve onlara yönelik eleştirilere de önemli bir yer ayırır. Çeşitli dünya ülkelerine yaptığı gezilerinde edindiği deneyimleri de tiyatro eleştirilerine dahil eden Arpad, okuruna karşılaştırmalı bir tiyatro bakış açısı sunar.

Burhan Arpad'ın söz konusu kitabındaki eleştirileri hem tiyatro metnine ve yazarına hem de sahnelenen tiyatro gösterisine ve sahneleyen ekibe yöneliktir. Tiyatro tenkitlerinin hepsine bakış açısını ve yorumunu yansıtan farklı başlıklar vermeyi ihmal etmeyen Arpad, tiyatro eserinin tanıtımını yaparak yazısına başlar. Üzerine tiyatro eleştirisi yaptığı eserin adını, yazarını, türünü, kaç perde olduğunu, sahneye koyan kişinin adını, oyuncularını, kostüm ve dekorun kime ait olduğunu ve oyunun nerede sahnelendiğini belirten Arpad, okuruna tüm teknik detayları sunar. Tiyatro eserinin kısa bir tanıtımının ardından onun hakkında yorumlarını sıralayan Arpad, tiyatro tenkitlerini birçok açıdan ele alır. 1956-1962 yılları arasında hem okuyarak hem de izleyerek deneyimlediği tiyatro eserlerini kitabına konu edinen yazar, Türk edebiyatından birçok isme yer verir.

İlk Gece isimli kitapta yer alan tiyatro eleştirilerinde Burhan Arpad'ın odaklandığı Türk tiyatro eserlerini şöyle sıralamak mümkündür. Sabahattin Kudret Aksal-*Tersine Dönen Şemsiye*, Haldun Taner-*Fazilet Eczanesi*, Refik Erduran-*İkinci Baskı*, Oktay Rifat-*Birtakım İnsanlar*, Güner Sümer-*Yarın Cumartesi*, Selâmi İzzet Sedes (A.Hâmit'ten)-*Sabur ve Sebat*, Celâl Esat

Arseven ve Salâh Cimcoz-*III. Selim,* Çetin Altan-*Mor Defter*, Cevat Fehmi Başkut-*Göç*, Cahit Atay-*Pusuda*, Necati Cumalı-*Nalınlar,* Refik Erduran-*Aman Avcı,* Orhan Asena-*Gecenin Sonu,* Dikran Çuhacıyan-*Leblebici Horhor*, Ekrem Reşit Rey-*Lüküs Hayat*.

Burhan Arpad'ın, hem metin hem de sahnelenen şekliyle birçok açıdan değerlendirdiği ve olumlu-olumsuz eleştirilerini yönlendirdiği tiyatro eserlerine dair görüşlerini aşağıdaki başlıklarda toplamak mümkündür.

Tiyatro Yazarının ve Sahneleyenin Başarısı

Burhan Arpad, tiyatro metinlerinin yazarının üslûbunu, tiyatro sahnesinin de sahneleyenin tarzını yansıttığını belirtir ve eğer ortada başarılı ya da başarısız bulunan bir şey varsa bunun o eseri ortaya koyana atfedilmesi gerektiğini belirtir. Bu bağlamda tiyatro yazarlarının önceki eserlerini de dile getiren ve yazarlık serüvenini değerlendiren Burhan Arpad, edebî başarıda devamlılık arar. Yazarların önceki eserleriyle karşılaştırmalar yapan Arpad, *İlk Gece* kitabında Refik Erduran'ın *İkinci Baskı* ve *Aman Avcı* isimli piyeslerine yönelik tiyatro eleştirisi yazar. Refik Erduran'ın ilk komedisi olan *Deli*'den itibaren sosyal çürümeyi başarılı ve cesurca ele aldığını belirten Arpad, *İkinci Baskı* piyesini *Aman Avcı*'dan daha başarılı bulur (s. 29). Böylelikle Burhan Arpad, bir yazarın birçok tiyatro metni üzerinden yazarlık başarısını sorgular.

Tiyatro Metni ile Sahnesinin Birbiriyle Uyumu

Burhan Arpad, *İlk Gece* kitabında estetik deneyim sürecinde okuyarak ve izleyerek deneyimlediği tiyatro eserlerinin metin ve oyun olarak uyumlarına dikkat eder. Burhan Arpad için tiyatro eserinin sahnelenirken metne bağlılığı ve tempo açısından uyumu oldukça önemlidir. Bu bağlamda, söz konusu kitapta yer alan eleştirilerden örnekler vermek mümkündür. Burhan Arpad, Sabahattin Kudret Aksal'ın *Tersine Dönen Şemsiye* isimli oyununun temposunu ölçüsüz bulur ve oyunun çok hızlı oluşunu eleştirir (s. 15). Yazar, Selâmi İzzet Sedes'in *Sabur ve Sebat* isimli eserini tiyatro sanatıyla hiçbir bağının olmadığı yönünde eleştirir ve oyunu oradan oraya sıçrayan bir temsil olarak görür (s. 35). Burhan Arpad, Celâl Esat Arseven ve Salâh Cimcoz'un *III. Selim* isimli piyesinin metnindeki diyaloglarını çok başarılı bulur ancak piyeste bu başarının sunulamadığını ve sahnelemenin kötü olduğunu savunur (s. 40).

Tiyatro Eserinin Türk Tiyatro Geleneğiyle Bağı

Tiyatro eleştirilerinde Burhan Arpad'ın dikkat ettiği bir başka husus da tiyatro metninin ve sahnelenen oyunun Türk tiyatro geleneğiyle bağını sorgular. Komedi türündeki eserlerin şive ve halk inanışlarına yer verip vermediğine, eğer içerikte varsa bu hususların oyuna nasıl yansıdığına dikkat eder. Bu bağlamda tiyatro eserlerinin yerelliğini tartar. Burhan Arpad'a göre Haldun Taner'in *Fazilet Eczanesi* isimli piyesinde kişiler yerli, olaylar bizdendir (s. 26). Bu beğeninin aksine yazar, Selâmi İzzet Sedes'in *Sabur ve Sebat* isimli tiyatro eserini ve dolayısıyla yazarını Avrupa kopyacısı olmak ve uydurmacılıkla eleştirir (s. 35). Arpad, Necati Cumalı'nın *Nalınlar* isimli tiyatro eserini de şive taklidi yapmakla eleştirir. Aşkı uğruna sevdiği kızı kaçırma teması Türk tiyatro geleneğinde önemli bir yer tutar (And, 2017, s. 19-20). Burhan Arpad, Necati Cumalı'nın başarı iddiasının içinin dolu olmadığını, kız kaçırma temasında olan tiyatronun taklitten öteye gidemediğini, cana yakın olmadığını ve gerçekçilik hususunda eleştirilmesi gerektiğini belirtir (s. 55-56).

Tiyatro Eserinin Belirtilen Tiyatro Türüne Uygunluğu

Burhan Arpad, tiyatro eserinin belirtildiği türe uygun olup olmadığına dikkat eder ve bu hususta eleştirilerini sunar. Yazarının ve sahneleyenin türe dair nitelendirmesinin içi boş mu dolu mu olduğunun cevabını arar Arpad. Cevat Fehmi Başkut'un *Göç* isimli piyesini, yazarın göç komedisi olarak nitelendirdiğini ancak kendisinin bu şekilde düşünmediğini (s. 51) belirten Burhan Arpad, Refik Erduran'ın *Aman Avcı* adlı piyesinin komedi şeklinde sunulduğunu ancak bu eseri belirli bir kalıba sokmanın mümkün olmadığını belki "düşün komedisi" olabileceğini belirtir (s. 58). Cahit Atay'ın *Pusuda* isimli tiyatro eserinin de komedi nitelendirmesinden çok uzak olduğunu düşünen Burhan Arpad, oyunda gülmediğini aksine üzüldüğünü ifade eder (s. 54).

Tiyatro Eserinin Tematik Başarısı

Tiyatro eserlerinin insana dair her olguyu konu edinebildiği gerçeğiyle ele alınan tiyatro eleştirilerinde Burhan Arpad, piyeslerin sunmak istediği temada başarıya ulaşma derecesini tartışır. Arpad, tiyatro eserinde sorgulanan hadisenin, verilmek istenen mesajın hedefine ulaşması aşamasında ele alınan konunun nelerle desteklendiğinin peşine düşer. Haldun Taner'in *Fazilet Eczanesi*'ni bu bağlamda çok başarılı bulan Arpad, bu oyunun sunmak istediği insan ve mahalle sevgisini oldukça başarılı şekilde sağladığını belirtir (s. 26). Aynı muhitte yaşayan insanların bir eczane etrafında buluşmaları onların eski bir İstanbul fotoğrafını sunmalarını

sağlar. Burhan Arpad, söz konusu piyesin "*1959-1960 başında İstanbul tiyatrolarında ramp ışığına çıkan*[38] *telif eserlerin en başarılısı*" (s. 27) olarak görür.

Tiyatro Yazarının Eserine Dair Yaptığı Saha Araştırması

Burhan Arpad, tiyatro eleştirmenliği açısından ele alınan *İlk Gece* isimli tiyatro eleştiri kitabındaki eserleri teknik açıdan da değerlendirir. Kitapta yer verdiği tiyatro eserlerinin yazarlarının saha araştırmasına ne derece önem verdiklerini inceler. Yazdıkları tiyatrolar üzerine araştırma ve okuma yapmasını beklediği yazarların emeğini ölçen Arpad, tiyatro sahasında bilinçli eser vermenin önemini vurgular. Cevat Fehmi Başkut'un *Göç* isimli tiyatro eserini mekân tercihi noktasında eleştiren Burhan Arpad, yazarın göç konusunu ve sorunlarını aktarmak isterken piyesine mekân olarak Şişli'yi değil Gültepe'yi seçmesi gerektiğini savunur. Arpad, uydurma Anadolu ve şehir kişilerine yer veren bu tiyatroda asıl amacın İstanbul'un göç sorununu aktarmak değil kâr elde etmek olduğunu belirtir (s. 52-53). Burhan Arpad, bu esere dair eleştirisinde bir adım ileriye gider ve bu piyese tiyatro tenkidinin bile yazılmaması gerektiğini savunur.

En Beğenilenler

İlk Gece isimli kitabında on beş tane Türk tiyatro eserinin eleştirisine yer veren Burhan Arpad'ın en çok beğendiği piyesler ise şöyle sıralanabilir. Haldun Taner'in *Fazilet Eczanesi* hem yerel unsurları başarılı sunması hem de oyuncuların başarısı yönüyle ön plana çıkar (s. 25-27). Refik Erduran'ın *İkinci Baskı* isimli tiyatrosunu ise sosyal çürümeyi yerme, oyuncuların etkili performansları (s. 27-29) açısından öven Arpad, Güner Sümer'in *Yarın Cumartesi* isimli piyesini hem genç bir yazarın kaleminden çıkması hem melodrama başvurmadan seyircilerin beğenisini kazanması hem de Kenter'lerin bu esere tiyatrolarında şans tanıyarak başarıyı yakalamaları açısından ön plana çıkarır (s. 31-33). Burhan Arpad, Ekrem Reşit Rey'in *Lüküs Hayat* isimli tiyatro eserine de özel bir yer ayırır. Son günlerde Berlin ve Viyana'da üç farklı operet izlediğini belirten Arpad, Lüküs Hayat'ın başarısını onlarla kıyaslar ve oldukça başarılı olduğu kanısına varır (s. 70-72).

Peki ya Oyunculuklar?

Burhan Arpad, üzerine tiyatro eleştirisi yazdığı oyunların sahnelenişinde yer alan oyunculara ve oyunculuklarına da değinir. Beğendiği oyuncuların yanında beğenmediği, eleştirdiği oyuncuları da belirten yazar özellikle Ekrem Reşit Rey'in *Lüküs Hayat* isimli oyunundaki tüm

[38] Sahnelenen. Ramp ışığı: Tiyatroda, sahnenin ön kenarı boyunca zemine yerleştirilen ve tepeden gelen ışıkları yumuşatmak amaçlı kullanılan ışıklardır.

oyuncuları beğenir (s. 72). Sabahattin Kudret Aksal'ın *Tersine Dönen Şemsiye* piyesinde Çolpan İlhan'ı "yapmacıklıkla" (s. 15) eleştiren Burhan Arpad, Refik Erduran'ın *İkinci Baskı* tiyatrosunda Altan Erbulak ve Erol Günaydın'ın oyunculuklarını över (s. 29). Güner Sümer'in *Yarın Cumartesi* isimli tiyatrosunda Çolpan İlhan'ı ayrı ve aykırı bulan ve eleştiren Arpad, Yıldız Kenter'i övmeyi de ihmal etmez (s. 32).

Sonuç

Türk edebiyatında hikâyeleri, gezi yazıları ve çevirdiği birçok eserlerle anılan Burhan Arpad'ın tiyatro türü ve türün sahnede icrası üzerine birçok yazısı mevcuttur. Yazarın *İlk Gece* (1962) isimli eseri tiyatro türüne hem metin hem de sahne özellikleri açısından yaklaştığı bir kitaptır. Tiyatrocu dostlarına armağan ettiği kitabında Burhan Arpad, toplamda otuz beş tiyatro tenkidine yer verir. Bu tiyatro eleştirilerinin on beş tanesi Türk edebiyatındaki tiyatro örneklerine dairdir. Bu çalışmada söz konusu kitapta yer alan Türk tiyatrosuna dair eleştiriler seçilerek Burhan Arpad'ın tiyatro eleştirmenliğinde dikkat ettiği hususlar belirlenmiştir. Burhan Arpad'ın tiyatro eleştirilerini; tiyatro yazarının ve tiyatro eserini sahneleyenin başarısı, tiyatro metni ile sahnelenen tiyatronun birbiriyle uyumu, tiyatro eserinin Türk tiyatro geleneğiyle olan bağı, tiyatro eserinin belirtilen türün özelliklerini taşıyıp taşımadığı, vermek istenilen mesajın tiyatro eserinde tematik açıdan sunulabilmesi, tiyatro yazarının eserine dair saha araştırması ve okumalar yapması, sahnelenen tiyatroda yer alan oyuncuların oyunculuklarının değerlendirilmesi ve söz konusu dönemde en çok beğenilen dönem tiyatro eserlerinin belirtilmesi şeklinde başlıklandırmak mümkündür. Söz konusu kitaptaki tiyatro tenkitlerinden verilen örneklerle Burhan Arpad'ın özelinde 1956-1962 yılları arasında sahnelenen tiyatro eserlerine yönelik dönemin tiyatro anlayışı ve eleştirilerine ulaşmak mümkündür. Bu bağlamda, dönemin tiyatro kanonuna ve hâkim olan tiyatro anlayışına da ulaşabilmek açısından Burhan Arpad'ın bu kitabı incelemeye değerdir. Burhan Arpad, dönem ve eser karşılaştırmaları ile tiyatro tenkidine dair kişisel görüşlerini desteklemeye ve okurunu doğru şekilde yönlendirmeye çalışır. Bu çalışmanın önemi, hikâyeciliği dışında üzerine fazla araştırma yapılmayan Burhan Arpad'ın tiyatro eleştirisi bağlamında tiyatro eserine bakış açısının sunulması ve yazarın Türk edebiyatı alanında sesinin duyurulmasından kaynaklıdır. Burhan Arpad hem farklı türlerde eserleri hem de edebiyatçı kimliğinin yanında gazeteciliğinin de vermiş olduğu çok yönlü bakış açısıyla Türk edebiyatında alana katkı sağlayan yazarlarımızdandır.

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ANA DİLİ OLARAK TÜRKÇE ÖĞRETİMİNİN GÜNCEL SORUNLARI: ÖĞRETİM PROGRAMI, MATERYAL VE UYGULAMA BOYUTLARI

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ÖZET

Ana dili olarak Türkçe öğretimi, bireyin dil becerilerinin gelişiminin yanı sıra düşünme, anlama ve ifade etme süreçlerinin yapılandırılmasında temel bir rol üstlenmektedir. Ancak son yıllarda Türkçe öğretiminde çeşitli yapısal ve uygulamaya dönük sorunların belirginleştiği görülmektedir. Bu çalışmanın amacı, ana dili olarak Türkçe öğretiminin güncel sorunlarını öğretim programı, ders materyalleri ve sınıf içi uygulamalar bağlamında ele almak ve bu sorunlara ilişkin eleştirel bir değerlendirme sunmaktır.

Çalışmada nitel araştırma yöntemlerinden doküman incelemesi kullanılmış; Millî Eğitim Bakanlığı Türkçe dersi öğretim programları, ders kitapları ve ilgili alan yazın sistematik olarak analiz edilmiştir. Elde edilen bulgular, öğretim programlarında beceri temelli yaklaşımın kuramsal düzeyde benimsendiğini, ancak uygulamada ölçme-değerlendirme süreçleriyle yeterince desteklenmediğini göstermektedir. Ders kitaplarında metin seçimi, etkinlik çeşitliliği ve dil becerileri arasındaki bütünlük açısından tutarsızlıklar tespit edilmiştir. Ayrıca sınıf içi uygulamalarda öğretmen merkezli yaklaşımların ağırlık kazandığı, eleştirel okuma, yaratıcı yazma ve sözlü ifade becerilerine ayrılan sürenin sınırlı kaldığı belirlenmiştir.

Sonuç olarak, ana dili olarak Türkçe öğretiminde program, materyal ve uygulama arasındaki uyumsuzlukların giderilmesi; öğretmenlere yönelik hizmet içi eğitimlerin güçlendirilmesi ve dil becerilerini bütüncül biçimde ele alan uygulamaların yaygınlaştırılması gerekmektedir. Bu bağlamda çalışma, Türkçe öğretiminin niteliğinin artırılmasına yönelik güncel ve uygulanabilir öneriler sunmaktadır.

Anahtar Kelimeler: Ana dili, Türkçe Öğretimi,öğretim programı, ders kitapları

CURRENT ISSUES IN TEACHING TURKISH AS A NATIVE LANGUAGE: CURRICULUM, MATERIALS, AND IMPLEMENTATION DIMENSIONS

ABSTRACT

Teaching Turkish as a mother tongue plays a fundamental role in the development of an individual's language skills, as well as in structuring their thinking, understanding, and expression processes. However, in recent years, various structural and practical problems have become apparent in Turkish language teaching. The aim of this study is to address the current problems of teaching Turkish as a mother tongue within the context of the curriculum, teaching

materials, and classroom practices, and to offer a critical evaluation of these problems. The study utilized document analysis, a qualitative research method; the Turkish language curricula of the Ministry of National Education, textbooks, and related literature were systematically analyzed. The findings indicate that while the skill-based approach is theoretically adopted in the curricula, it is not sufficiently supported by measurement and evaluation processes in practice. Inconsistencies were identified in textbooks regarding text selection, activity variety, and the integrity of language skills. Furthermore, it was determined that teacher-centered approaches predominate in classroom practices, and the time allocated to critical reading, creative writing, and oral expression skills remains limited. In conclusion, addressing the inconsistencies between the curriculum, materials, and practices in teaching Turkish as a mother tongue is crucial; It is necessary to strengthen in-service training for teachers and to expand practices that address language skills holistically. In this context, this study presents current and applicable suggestions for improving the quality of Turkish language teaching.

Keywords: Native language, Turkish language teaching, curriculum, textbooks

1. INTRODUCTION

The mother tongue is a fundamental tool that shapes individuals' ways of making sense of the world, their thinking processes, and their social relationships. From this perspective, mother-tongue education is not merely a subject area but a multidimensional process that directly influences individuals' cognitive, affective, and cultural development. Since the establishment of the Republic, the teaching of Turkish as a mother tongue has occupied a central place in educational policies; accordingly, curricula, textbooks, and teacher-training models have been continuously revised and renewed. Nevertheless, despite these structural reforms, the literature indicates that shared criticisms regarding the quality of Turkish language education continue to persist.

Today, the problems encountered in teaching Turkish as a mother tongue can be grouped under numerous headings, including the structure of curricula, teacher-training processes, instructional methods and techniques, approaches to assessment and evaluation, the quality of instructional materials, and the failure to develop language skills in a balanced manner. A significant proportion of these problems stems from the continued perception of Turkish as a "knowledge-based subject" and from the relegation of the skill dimension of language to a secondary position. However, the Turkish language course is not an area in which grammatical

rules are memorized; rather, it is a skill-oriented course aimed at developing individuals' abilities to comprehend, express, think, and articulate themselves effectively.

This paper addresses the current problems encountered in teaching Turkish as a mother tongue within the contexts of curricula, teacher education, fundamental language skills, assessment and evaluation processes, and social language use, and offers a holistic evaluation in light of national studies in the literature. The aim is not merely to list these problems, but to reveal their structural sources and thereby provide a solid foundation for discussions of possible solutions.

2. MATERIAL AND METHODS

2.1. Research Design

This study was designed as a **qualitative research** employing a **document analysis** approach. Qualitative research is particularly suitable for studies that aim to examine educational phenomena in depth and to interpret existing practices, policies, and instructional materials within their natural context. In line with this perspective, the present study focuses on identifying and interpreting the current issues in teaching Turkish as a mother tongue through a systematic examination of written and curricular sources.

2.2. Data Sources

The primary data sources of the study consist of official Turkish language curricula**,** textbooks**,** and instructional materials used in mother-tongue education at the primary and secondary school levels in Türkiye. In addition to these documents, the study also draws on the outcomes of curriculum, textbook, and instructional material analyses conducted within doctoral-level coursework. These analyses were carried out as part of structured academic training and involved systematic examination of Turkish language curricula and teaching materials based on predefined analytical frameworks. Incorporating these findings enabled the study to benefit from accumulated analytical insights and to strengthen the depth and scope of the evaluation.

2.3. Data Collection Process

Documents included in the study were selected based on their relevance to the teaching of Turkish as a mother tongue and their direct connection to the instructional components examined in this research, such as curricula, language skills, assessment practices, and teaching materials. The documents were reviewed in their original form, and no modifications were made to their content. The analysis focused on identifying recurring themes, structural patterns, and pedagogical orientations related to the teaching of Turkish.

2.4. Data Analysis

The data were analyzed using **descriptive analysis**, a qualitative analysis technique that aims to summarize and interpret data according to predetermined themes. In this study, the themes were derived from both the research questions and the conceptual framework of Turkish language education, including curriculum structure, teacher education, fundamental language skills, assessment and evaluation practices, instructional materials, and language use in social and media contexts. During the analysis process, relevant findings from the examined documents were systematically organized under these thematic categories and interpreted in relation to existing discussions in the national literature.

3. RESULTS AND DISCUSSION

3. 1. Problems Arising from Curricula

Turkish language curricula have been revised many times from the establishment of the Republic to the present day, and since 2005 in particular, a student-centered approach grounded in constructivism has been adopted. However, this paradigm shift has not fully produced the expected impact in practice. One of the main reasons for this situation is the mismatch between the theoretical framework of the curricula and classroom realities.

A significant proportion of the fundamental problems encountered in teaching Turkish as a mother tongue stem from the structural characteristics of the curricula. In Türkiye, Turkish language curricula have been renewed on the basis of the constructivist approach, especially since 2005, and with the 2018 and 2019 curricula, a skill-based instructional approach has been brought to the forefront. Most recently, the Türkiye Century Education Model, implemented in 2024, has introduced a value-oriented, holistic, and skill-focused educational vision. However, recent reviews in the national literature indicate that this vision has not been fully reflected in Turkish language curricula (Millî Eğitim Bakanlığı [MEB], 2024; Yurdakal, 2024).

Within the Turkish language curricula of the Türkiye Century Education Model, the balanced and integrated development of the four fundamental language skills—listening, speaking, reading, and writing—is emphasized. Nevertheless, document analyses reveal that although the discourse surrounding skills is strong at the rhetorical level, learning outcomes are largely structured at a cognitive level. In his examination of the 2024 Primary School Turkish Language Curriculum, Yurdakal (2024) notes that the curriculum has been expanded in scope; however, contemporary skills such as creative thinking and creative reading are included only to a limited extent, and the explanations regarding these skills remain insufficient. This finding indicates

that despite its quantitative expansion, the curriculum fails to achieve sufficient qualitative depth.

Another structural problem of the curricula concerns the incompatibility between the density of themes and learning outcomes and the allocated instructional time. Teachers, driven by the pressure to cover prescribed outcomes, tend to address texts and activities superficially, which weakens the skill-development function of Turkish language instruction. Similar problems have been highlighted in previous national studies on earlier curricula, emphasizing that curricular designs often fail to align with practical classroom realities. It appears that this issue largely persists in the curricula prepared within the framework of the Türkiye Century Education Model (Yurdakal, 2024).

A further structural issue in the curricula is the limited guiding function of the assessment and evaluation component. Although the Türkiye Century Education Model adopts a process-oriented assessment approach, Turkish language curricula provide only a limited number of concrete examples to support this perspective. While Yurdakal (2024) regards the inclusion of sample assessment forms as a positive development, he also points out that explanations regarding which skills these tools assess and how they should be implemented remain inadequate. As a result, teachers are inclined to rely on traditional assessment methods, making it difficult for process-based evaluation practices to become established.

Imbalances in the distribution of skills within the curricula constitute another important problem frequently criticized in the national literature. In her study examining the secondary school Turkish language curriculum from the perspective of digital literacy, Banaz (2024) reports that although digital concepts are extensively included in the curriculum, explanations concerning how these concepts should be pedagogically structured are limited. This suggests that while the curriculum conceptually responds to the demands of the contemporary era, it contains notable deficiencies in terms of practice-oriented guidance.

Similarly, Kara Özkan (2025), in her analysis of the Türkiye Century Education Model Secondary School Turkish Language Curriculum with respect to higher-order thinking skills, finds that although skills such as critical thinking, problem solving, and decision making are incorporated, their distribution across language skills is unbalanced. In particular, an emphasis on writing leads to the relative neglect of listening and speaking skills, which contradicts the goal of developing the four fundamental language skills in an integrated and holistic manner (Kara Özkan, 2025).

The study by Özden and Örge Yaşar (2025) focusing on speaking skills demonstrates that although the curriculum presents a strong theoretical framework, it may lose its functionality if not adequately supported by teacher guidance and classroom practices. This finding indicates that curricula involve problems not only at the content level but also in terms of implementation guidance (Özden & Örge Yaşar, 2025).

In conclusion, although the Türkiye Century Education Model presents a strong vision for Turkish language education, recent studies in the national literature show that many structural problems in the curricula largely persist. The excessive density of learning outcomes, imbalances in skill distribution, ambiguities in assessment and evaluation, and shortcomings in practice-oriented guidance constitute significant barriers to achieving high-quality and lasting learning in the teaching of Turkish as a mother tongue. In this respect, Turkish language curricula need to move beyond rhetorical innovations and be restructured in a way that places practice at the center, provides clear guidance for teachers, and genuinely supports skill-based instruction.

3. 2. Problems Arising from the Turkish Language Teacher Education Process

A substantial proportion of the problems experienced in teaching Turkish as a mother tongue are directly related to the teacher education process. The effective translation of the skill-based approach envisaged in curricula into classroom practices largely depends on Turkish language teachers' subject-matter knowledge, pedagogical competencies, and professional preparedness. However, studies in the national literature reveal that the process of training Turkish language teachers is characterized by structural and persistent problems.

A historical examination of the Turkish language teacher education process in Türkiye shows that, for many years, teacher training was built predominantly on a Turkish Language and Literature–oriented framework. Despite the fact that Turkish language teaching is essentially a field of skill instruction, this structure has led teacher candidates to be educated primarily through theoretical knowledge of language and literature. Emphasizes that teacher education policies in Türkiye have undergone frequent changes over time, and that these shifts have hindered the establishment of a stable, field-oriented teacher education model. As a result, Turkish language teachers often experience difficulties in implementing skill-based instruction in classroom settings.

Although Turkish language teaching undergraduate programs at the higher education level have been subject to various revisions over time, the literature criticizes these programs for their

insufficient emphasis on practice. In particular, the limited opportunities for teacher candidates to gain practical experience in teaching listening and speaking skills cause these skills to remain in the background after graduation. Çifçi (2011) points out that subject-specific pedagogy courses in Turkish language teaching programs remain limited in their capacity to develop practice-oriented competencies, which negatively affects teacher candidates' professional qualifications.

The Türkiye Century Education Model defines teachers not merely as transmitters of knowledge, but as active agents who guide the learning process, provide scaffolding, and foster student engagement (MEB, 2024). However, the lack of sufficient practical opportunities in teacher education programs to support this understanding creates a clear mismatch between the model and teachers' competencies. Graduating without adequate practical experience in areas such as assessment and evaluation, differentiated instruction, and process-based assessment limits the impact of curricula on classroom practices (Çifçi, 2011).

Another significant problem related to the teacher education process is the disconnection between pre-service and in-service training. Turkish language teachers may experience difficulties in adapting to newly introduced curricula and pedagogical approaches after graduation. (2021) notes that in-service training activities often remain at a theoretical level and are not structured in a way that directly guides teachers' classroom practices. This situation leads teachers to implement new curricula in a superficial manner.

Within the framework of the Türkiye Century Education Model, Turkish language teachers are expected to adopt an instructional approach that supports critical thinking, takes digital literacy into account, and addresses the four fundamental language skills in an integrated manner. However, the failure to systematically develop these competencies during the teacher education process widens the gap between curricular objectives and classroom implementation. In particular, there is a clear need to support teachers in areas such as assessment and evaluation, the teaching of speaking and listening skills, and process-based assessment practices (MEB, 2024).

In conclusion, the structural problems experienced in the Turkish language teacher education process make it difficult to translate the skill-based approach envisaged in curricula into effective classroom practices. In order to realize the vision assigned to Turkish language education by the Türkiye Century Education Model, teacher education programs need to be restructured in a practice-oriented, skill-based manner that is aligned with contemporary

pedagogical approaches. Otherwise, it will be inevitable that the structural reforms introduced in curricula remain insufficiently supported by teacher competencies.

3. 3. Problems Encountered in the Context of the Four Fundamental Language Skills

In the teaching of Turkish as a mother tongue, listening, speaking, reading, and writing skills are addressed within curricula as a holistic structure, and these skills are intended to be developed in a complementary manner. However, the national literature focusing on classroom practice reveals the presence of various structural and pedagogical problems in the teaching and assessment of the four fundamental language skills. These problems lead to imbalances among skills and make it difficult for Turkish language instruction to achieve its intended learning outcomes (Mert, 2014).

Problems related to listening skills Although listening constitutes a fundamental prerequisite for the development of other language skills, it is often neglected in Turkish language instruction. Research indicates that listening activities occupy a limited place in lessons and that the listening process is not addressed as a planned, purposeful, and measurable instructional process. Listening activities are frequently confined to the teacher's reading of texts aloud, while original listening materials and explicit instruction in listening strategies are used insufficiently (Akyol, 2018). This situation makes it difficult for students to develop higher-order listening skills such as selective listening, critical listening, and note-taking.

Problems related to speaking skills Speaking skills serve as a key indicator of students' ability to structure and express their thoughts orally. However, in classroom practices, the teaching of speaking skills is often limited to unplanned activities with a weak assessment dimension. Criteria such as fluency, lexical choice, and grammatical accuracy in students' oral performances are not addressed systematically, and speaking activities tend to involve primarily volunteer students (Mert, 2014). This situation may lead to pronounced differences among students in terms of speaking proficiency.

Problems related to reading skills Although reading is a skill that receives relatively greater emphasis in Turkish language instruction, classroom practices often address reading at a superficial level of comprehension. National studies show that reading activities are generally structured around reading texts aloud or silently followed by answering questions, while reading strategies such as prediction, inference, questioning, and establishing intertextual connections are not sufficiently taught (Akyol, 2018). This approach remains inadequate for developing students' critical reading and deep comprehension skills.

Problems related to writing skills Writing is regarded as the most complex of the four fundamental language skills and the one that requires the highest level of cognitive processing. Despite this, writing activities in Turkish language classes are frequently handled in a product-oriented manner, with limited attention given to stages such as planning, drafting, revising, and editing. Students' written texts often display a high frequency of grammatical and spelling errors, limited vocabulary use, and problems related to textual coherence. These factors negatively affect the development of writing skills and weaken students' attitudes toward writing.

Failure to ensure integration among skills An important dimension of the problems encountered in teaching the four fundamental language skills is the fragmented treatment of these skills. While listening, speaking, reading, and writing should be integrated within the same learning process, classroom practices often address them as separate and disconnected activities. The national literature emphasizes that this fragmented approach is inconsistent with the natural use of language and restricts students' ability to apply their language skills in authentic communicative contexts (Mert, 2014).

In conclusion, the problems encountered in teaching Turkish as a mother tongue in relation to the four fundamental language skills primarily concentrate on the neglect of listening and speaking skills, the weakness of strategy and process dimensions in reading and writing instruction, and the insufficient integration among skills. This situation undermines the skill-based and functional nature of Turkish language instruction and limits students' ability to use language effectively and consciously. The national literature clearly demonstrates that addressing the four fundamental language skills through a balanced, integrated, and process-oriented approach should be among the primary priorities of Turkish language education (Akyol, 2018; Mert, 2014).

3. 4. Problems Arising from Assessment and Evaluation Processes

In the teaching of Turkish as a mother tongue, assessment and evaluation constitute one of the fundamental components that directly determine the quality of the instructional process. However, the national literature reveals that assessment and evaluation practices in Turkish language classes are largely conducted within a result-oriented, product-based framework and are predominantly limited to traditional tools. This situation makes it difficult to monitor the development of listening, speaking, reading, and writing skills—among the core objectives of

Turkish language education—in a holistic and process-oriented manner (Şengül, 2020; Deniz & Keray, 2019).

Limitations of skill-based assessment Although Turkish language curricula aim to develop language skills in an integrated manner, assessment tools used in practice often fail to adequately reflect this approach. In particular, the limited availability of objective and standardized instruments for assessing listening and speaking skills leads to the frequent neglect of these skills. Research indicates that assessment and evaluation in Turkish language classes focus primarily on reading and writing skills, while listening and speaking are assessed largely through observation-based and unsystematic practices (Mert, 2014). This situation may result in an imbalance among students' language skills.

Dominance of traditional assessment tools Written examinations, multiple-choice tests, and short-answer questions are widely used in Turkish language education as assessment tools. However, these instruments have limited capacity to reveal students' ability to use language skills in context and to structure and express their thoughts effectively. National studies indicate that the use of alternative assessment and evaluation tools—such as portfolios, performance tasks, self-assessment, and peer assessment—remains at a low level, and that teachers' perceptions of their own competence in using these tools are limited (Deniz & Keray, 2019). Consequently, assessment processes move away from functioning as feedback mechanisms that support learning.

Lack of process-based assessment and feedback Language teaching is inherently process-oriented. Nevertheless, assessment in Turkish language classes is often perceived as a "final check" conducted at the end of the learning process, with insufficient emphasis placed on formative assessment practices that monitor students' development over time. Teachers' views suggest that assessment results are used mainly for grading purposes and that opportunities to provide students with high-quality feedback on their strengths and areas for improvement are limited (Bahar, 2023, 2017). This situation makes it difficult for students to become aware of their own learning processes and to consciously develop their language skills.

Problems related to the validity and reliability of assessment tools A significant proportion of the assessment instruments used in Turkish language classes are reported to lack sufficient alignment with curricular outcomes and to have limited capacity to represent the skills intended to be measured. In particular, the absence of clear and objective criteria in scoring rubrics used to evaluate written and oral expression may lead to subjective differences in assessment. The

national literature indicates that teachers do not receive adequate support in developing and using rubrics, allowing personal judgments to influence evaluation processes (Mert, 2014; Deniz & Keray, 2019).

Curriculum–assessment misalignment An important dimension of assessment-related problems concerns the misalignment between curricula and assessment practices. Although curricula emphasize skill-based, process-oriented, and multifaceted assessment approaches, centralized examination systems and school-level practices do not always support this perspective. As a result, teachers may be directed toward exam-oriented practices, pushing higher-order objectives of Turkish language education—such as interpretation, meaning-making, and critical thinking—into the background.

In conclusion, the national literature demonstrates that assessment and evaluation processes in Turkish language education are not sufficiently integrated with skill-based approaches, with prominent issues including the dominance of traditional assessment tools, the lack of process-based assessment and feedback, and problems related to the validity and reliability of assessment instruments (Şengül, 2020; Deniz & Keray, 2019; Bahar, 2023, 2017). These findings indicate that assessment and evaluation should be reconsidered not merely as tools for determining learning outcomes, but as essential instructional components that support and guide learning.

3. 5. Problems Arising from Textbooks and Instructional Materials

In the teaching of Turkish as a mother tongue, textbooks have long been regarded as the primary and sufficient instructional resource. However, the multidimensional nature of contemporary classroom environments necessitates a critical re-evaluation of this assumption. Studies in the literature reveal that textbooks do not always align with the aims and learning outcomes specified in curricula; that they struggle to present a coherent structure integrating texts, activities, and assessment components; and that they tend to render the instructional process heavily dependent on the textbook itself (Oryaşın, 2020). This situation may lead instruction to focus more on covering textbook content than on translating the skill-based approach of Turkish language education into effective classroom practice.

Problems related to text selection and text quality Texts used in Turkish language classes serve as the primary vehicles not only for content transmission but also for the development of language skills. Nevertheless, teacher and student perspectives indicate that textbook texts often fail to adequately address students' developmental levels, interests, and learning needs; that text

lengths are not always appropriate; and that the intensive use of foreign-origin words complicates comprehension processes (Doğan Güldenoğlu, 2023). In addition, imbalances are observed in terms of text types and thematic diversity. In particular, informational texts occupy a relatively limited place in textbooks, and informational text structures (e.g., sequence, cause–effect, comparison, problem–solution) are not distributed in a balanced manner (Türkben, 2018, 2020). This situation may hinder students' transition to academic literacy, especially at upper grade levels.

Problems related to activity design: imbalance between quantity and quality The large number of activities included in textbooks does not necessarily indicate their qualitative adequacy. Key criteria in this regard include the cognitive depth of activities, their contribution to language skill development, and their applicability in classroom contexts. Research based on teacher opinions shows that activities may fail to attract students' attention; that some activities are structurally lengthy and functionally ineffective; and that grammar-related activities, in particular, have limited power to support learning. Similarly, findings indicate that activities are insufficient in developing expressive skills, fail to adequately support higher-order cognitive processes such as analysis and synthesis, and do not effectively reflect curricular outcomes (Çalışkan, 2016, 2024). Furthermore, some questions and activity instructions are reported to be difficult for students and teachers to understand and are not always perceived as functional (Doğan Güldenoğlu, 2023). As a result, teachers spend a significant portion of instructional time on explanation and clarification, thereby reducing the time allocated to skill instruction.

Problems related to visual design and text–visual alignment Visuals used in Turkish language textbooks play an important role—particularly at the secondary school level—in preparing students for texts, facilitating meaning construction, and enhancing motivation. However, teacher opinions indicate that visuals are sometimes insufficient and aesthetically weak, and that they do not always provide effective preliminary support for text comprehension . The problem here lies not in the presence of visuals per se, but in the weakness of the pedagogical relationship established between visuals and texts. While visuals are expected to support texts and facilitate comprehension, they may at times become distracting or only weakly related to the text content.

Deficiencies in teacher guides, workbooks, and the integrated material ecosystem Even when textbooks are of high quality, classroom heterogeneity—such as differences in reading

speed, vocabulary knowledge, home language environments, technology use, and attention profiles—increases the need for differentiated instructional materials. Nevertheless, field studies indicate that despite claims of providing guidance for teachers, textbooks often fail to fulfill this function in practice, offering limited direction regarding activity implementation steps, alternative examples, and classroom adaptations (Oryaşın, 2020). This situation increases teachers' workload in producing their own materials and may deepen inequalities between classrooms with high and low material development capacity.

Problems related to the pace of updating materials While language is a dynamic structure that continuously evolves, textbooks possess a more static and institutional character. Contemporary students encounter a rapidly changing vocabulary in daily life and digital environments. When textbooks fail to adequately reflect this change, students may perceive the language presented in textbooks as artificial or distant, and teachers may feel compelled to seek supplementary resources to provide up-to-date examples. Teacher opinions reveal that texts do not always align with students' readiness levels and are insufficient in fostering reading habits . This finding suggests that text selection should be guided not only by literary criteria but also by contemporary reader profiles and actual language use practices.

In conclusion, the national literature indicates that problems related to Turkish language textbooks and instructional materials concentrate on issues of text quality and diversity, the cognitive level and clarity of activities, the pedagogical function of visual design, and the insufficiency of guiding and differentiating support provided to teachers (Oryaşın, 2020; Doğan Güldenoğlu, 2023; Türkben, 2018, 2020; Sarıkaya, 2023; Çalışkan, 2016, 2024). These findings clearly demonstrate that the mere presence of textbooks is insufficient; rather, textbooks must evolve into functional material systems that holistically support the instructional process.

3. 6. Reflections of Media Language, Everyday Use, and Social Media Language on Turkish Language Education

One of the prominent problem areas that has come to the forefront in recent years in the teaching of Turkish as a mother tongue is the marked gap between the language use to which students are exposed in everyday life and digital environments and the "standard Turkish" presented in school contexts. Media language, everyday spoken language, and especially social media language directly influence students' linguistic awareness; however, this influence often manifests in directions that do not align with the language skills targeted in instructional settings. The literature emphasizes that students' language use habits are increasingly shaped

by out-of-school linguistic input, giving rise to new pedagogical challenges in Turkish language education.

The impact of media language on standard Turkish Television programs, digital broadcasting platforms, and online news content function as powerful language models due to their extensive reach. Nevertheless, the frequent occurrence of careless expressions, intensive use of foreign-origin words, slang, and grammatical deviations in media language constitutes a problematic linguistic input, particularly for children and young audiences. Research indicates that the distancing of media language from standard Turkish creates a basis for similar deviations to appear in students' written and oral expressions. In this respect, while media language reflects the vitality and diversity of language on the one hand, it may also transform into an influential domain that weakens the language norms taught in schools.

The disconnection between everyday spoken language and the language of instruction Everyday spoken language is context-sensitive, rapid, and often flexible in its use of rules. In contrast, the language targeted in Turkish lessons prioritizes clarity, consistency, and adherence to established norms. Students do not always consciously distinguish between these two linguistic levels and may directly transfer habits of everyday speech into written expression. Indeed, studies reveal that students' written texts frequently include structures characteristic of spoken language, elliptical sentences, and context-dependent expressions (Sever, 2021). This situation reduces the quality of written expression and increases teachers' corrective workload.

The spread of social media language and its effects on written expression Social media environments, with their structures that promote brief, rapid, and often visually oriented communication, have profoundly transformed language use. Abbreviations, phonetic spellings, the neglect of punctuation, and deliberate deviations from syntactic rules are among the defining features of social media language. Intensive exposure to this form of language may produce persistent negative effects on students' writing skills. National studies show that students employ abbreviations and formal distortions specific to social media language in compositions and written exam texts (Sayın, 2024). This tendency weakens the stages of planning, organizing, and revising that are fundamental to effective writing.

Lack of language awareness and critical linguistic consciousness Another factor contributing to the deepening of language-related problems originating from media and social media is students' limited awareness of the consequences of their linguistic choices. The insufficient emphasis placed on media literacy and critical language awareness in Turkish

language education makes it difficult for students to internalize the need to use different forms of language in different contexts. However, the literature stresses that developing students' ability to regulate their language use according to context, purpose, and audience should be among the primary objectives of mother tongue education (Sever, 2021; Karaman, 2020).

In conclusion, media language, everyday spoken language, and social media language constitute a powerful sphere of influence that cannot be ignored in Turkish language education. The national literature demonstrates that this influence leads to deviations from standard Turkish in students' oral and written expression skills, formal and semantic problems in the writing process, and a weakening of language awareness (Sever, 2021; Sayın, 2024). In this context, Turkish language education should adopt an approach that does not exclude media and social media language, but rather critically analyzes these language forms and guides students toward context-appropriate language use.

CONCLUSION

In conclusion, the current issues in teaching Turkish as a mother tongue emerge as a multi-layered set of structural and pedagogical challenges that mutually reinforce one another. Despite repeated reforms and the adoption of student-centered, skill-based orientations, the national literature consistently points to a persistent gap between curricular discourse and classroom implementation. The Türkiye Yüzyılı Maarif Modeli has articulated an ambitious, holistic vision; yet the problems identified in curriculum density, uneven skill distribution, and limited implementation guidance suggest that reform has often remained at the level of design rather than being translated into sustained instructional transformation (MEB, 2024; Yurdakal, 2024).

A second key conclusion concerns the centrality of teacher capacity in making skill-based instruction operational. The evidence reviewed indicates that Turkish language teacher education has long carried a predominantly theoretical orientation, while practice-based competencies—particularly those needed for the systematic teaching and assessment of listening and speaking—remain underdeveloped. Moreover, the weak alignment between pre-service preparation and in-service professional learning restricts teachers' ability to adapt to changing curricular expectations and to implement process-oriented assessment and differentiated instruction with confidence. In this respect, improving outcomes in Turkish language education depends not only on revising curricula but also on building coherent,

practice-rich professional pathways that support teachers across their career trajectory (Çifçi, 2011; , 2021; MEB, 2024).

Third, the findings underscore that the four fundamental language skills are not being developed in a balanced, integrated, and process-oriented manner. Listening and speaking tend to be marginalized in everyday classroom routines, while reading and writing are frequently addressed through product-focused practices that insufficiently foreground strategy instruction, drafting, revision, and formative feedback. These patterns are compounded by assessment traditions that privilege standardized, outcome-based instruments over authentic, skill-sensitive approaches, thereby narrowing what is taught and what is valued in instructional practice. Without a robust assessment culture grounded in clear criteria, rubrics, and formative feedback, it is difficult to monitor growth in language competence or to sustain meaningful learning trajectories (Mert, 2014; Deniz & Keray, 2019).

Finally, contemporary Turkish language education must be understood within the broader ecology of language use shaped by media and digital communication. The widening gap between school-based standard Turkish and the linguistic inputs students encounter in everyday life—especially through social media—creates new demands for critical language awareness and context-appropriate language use. Rather than excluding these language forms, an effective instructional approach requires integrating media literacy and critical linguistic consciousness into mother-tongue education, enabling students to navigate registers, audiences, and purposes with flexibility and precision. Taken together, the literature suggests that sustainable improvement will require an integrated reform agenda: curricula that prioritize feasibility and guidance, teacher education that foregrounds practice and continuity, assessment systems aligned with skill development, and classroom pedagogy that connects school language to contemporary communicative realities (Karaman, 2020; Sever, 2021).

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YABANCI DİL OLARAK TÜRKÇE ÖĞRETİMİNDE GÜNCEL SORUNLAR: PROGRAM, MATERYAL VE UYGULAMA AÇISINDAN BİR DEĞERLENDİRME

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ÖZET

Yabancı dil olarak Türkçe öğretimi, son yıllarda göç hareketleri, akademik hareketlilik ve kültürel diplomasi politikaları doğrultusunda hızlı bir gelişim göstermiştir. Ancak bu nicel büyümeye karşın, alanda çeşitli yapısal ve pedagojik sorunların devam ettiği görülmektedir. Bu çalışmanın amacı, yabancı dil olarak Türkçe öğretiminde karşılaşılan güncel sorunları öğretim programları, ders materyalleri ve öğretim uygulamaları bağlamında incelemektir.

Çalışmada nitel araştırma yöntemlerinden doküman incelemesi ve betimsel analiz kullanılmış; Avrupa Dilleri Ortak Başvuru Metni (CEFR), Türkçe öğretim programları, ders kitapları ve alan yazındaki güncel çalışmalar temel alınmıştır. Bulgular, programların büyük ölçüde CEFR ile uyumlu biçimde yapılandırılmasına rağmen, hedef dil düzeyleri arasında beceri geçişlerinin yeterince dengeli sağlanamadığını ortaya koymaktadır. Ders materyallerinde kültürel aktarımın zaman zaman yüzeysel kaldığı, gerçek iletişim bağlamlarını yansıtan özgün metin ve etkinliklerin sınırlı olduğu belirlenmiştir.

Öğretim uygulamaları açısından ise öğretmen yeterlikleri, sınıf içi çokdillilik, farklı ana dillere sahip öğrenen gruplarıyla çalışma ve ölçme-değerlendirme süreçleri öne çıkan sorun alanlarıdır. Ayrıca dijital materyallerin ve teknoloji destekli öğretim araçlarının pedagojik bir çerçeveye dayalı olarak sistematik biçimde kullanılmadığı görülmektedir.

Sonuç olarak, yabancı dil olarak Türkçe öğretiminde program, materyal ve uygulama boyutlarının bütüncül bir anlayışla yeniden ele alınması; öğretmen eğitimi, kültürel içerik ve ölçme-değerlendirme süreçlerinin güçlendirilmesi gerekmektedir. Bu çalışma, alandaki güncel sorunlara yönelik farkındalık oluşturmayı ve çözüm odaklı tartışmalara katkı sunmayı amaçlamaktadır.

Anahtar Kelimeler: Yabancı dil olarak Türkçe, Türkçe öğretimi, CEFR, öğretim materyalleri, kültürel aktarım

CURRENT ISSUES IN TEACHING TURKISH AS A FOREIGN LANGUAGE: AN EVALUATION FROM THE PERSPECTIVE OF CURRICULUM, MATERIALS, AND IMPLEMENTATION.

ABSTRACT

Teaching Turkish as a foreign language has experienced rapid growth in recent years, driven by migration movements, academic mobility, and cultural diplomacy policies. However, despite this quantitative growth, various structural and pedagogical problems persist in the field. The aim of this study is to examine current problems encountered in teaching Turkish as a foreign language within the context of curricula, teaching materials, and teaching practices. The study utilizes qualitative research methods, specifically document analysis and descriptive analysis; the Common European Framework of Reference for Languages (CEFR), Turkish language teaching programs, textbooks, and current studies in the literature are used as the basis. The findings reveal that although the programs are largely structured in accordance with the CEFR, the skill transitions between target language levels are not sufficiently balanced. It was determined that cultural transmission in teaching materials is sometimes superficial, and there is a limited number of original texts and activities reflecting real communication contexts. In terms of teaching practices, teacher competencies, classroom multilingualism, working with learner groups with different native languages, and assessment processes are prominent problem areas. Furthermore, it is observed that digital materials and technology-supported teaching tools are not used systematically within a pedagogical framework. In conclusion, a holistic approach to re-evaluating the curriculum, materials, and application dimensions of teaching Turkish as a foreign language is necessary; teacher training, cultural content, and assessment processes need to be strengthened. This study aims to raise awareness of current issues in the field and contribute to solution-oriented discussions.

Keywords: Turkish as a foreign language, Turkish language teaching, CEFR, teaching materials, cultural transfer.

PROMOTİNG THE FORMATİON OF SOLO GARLİC AT LOW ALTİTUDE BY SPRAYİNG COUMARİN AND APPLYİNG LİQUİD FERTİLİZER AT DİFFERENT RATES

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Abstract.
Despite its benefit and good price, solo garlic has never been produced commercially in Indonesia. It is mainly because no information of how to produce solo garlic is available. The objective of this experiment was to promote the formation and growth of solo garlic clove by spraying Coumarin solution to the garlic crop grown at low elevation fertilized with organic liquid fertilizer. The experiment used a randomized complete block design (2 factor, 5 reps). The first factor was coumarin (C) solutions (0, 1500, 3000, 4500 ppm) and the second factor one liquid organic fertilizer (0, 1.5, 3.0, 4.5 ml/L). Regular garlic seeds were planted in a black polybag containing 5 kg of a mix of top soil and cow manures (4:1, v/v). The crops were sprayed with coumarin 50 ml per crop at 3, 5, 7 weeks after planting. The results showed that all crops produced solo garlic even though liquid organic fertilizer gave no significant effect on crop growth and yield, so did its interaction with coumarin. However, coumarin showed significant effect on clove volume and diameter, in which the best concentration was found in 3000 ppm. We concluded that 3000 ppm coumarin was the best concentration to promote solo garlic formation and growth.
Keywords: clove formation, fertilizer, growth retardant, single clove garlic,

CHALLENGES AND OPPORTUNİTİES OF VİRTUAL CLASSROOMS İN EDUCATİON:AN EMPİRİCAL STUDY

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Abstract

The growing adoption of virtual classrooms has brought significant changes to the teaching–learning process. The present study aims to empirically examine the challenges and opportunities associated with virtual classrooms in education. A descriptive survey method was employed, and data were collected from 120 students and teachers from educational institutions using a structured questionnaire. The study focused on key challenges such as internet connectivity issues, lack of technical skills, reduced classroom interaction, and difficulties in assessment, as well as opportunities including flexible learning, easy access to learning resources, improved digital skills, and enhanced learner autonomy. The data were analysed using simple statistical techniques such as percentage and mean analysis. The findings reveal that while participants faced several challenges in adapting to virtual classrooms, they also recognized their potential in supporting continuity of learning and expanding educational access. The study concludes that effective training, reliable technological infrastructure, and institutional support are essential to maximize the benefits of virtual classrooms and minimize their limitations.

Keywords:Virtual Classrooms, Online Learning, Empirical Study, Educational Technology, Teaching–Learning Process.

EFFECT OF ADDİNG OKRA CALYX POWDER ON THE SENSORY PROPERTİES AND NUTRİTİONALVALUE OF WHEAT BİSCUİTS

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Abstract

This study aimed to evaluate the chemical and nutritional properties of Iraqi okra pods (summer season) and to explore their potential use as a functional ingredient to enhance the nutritional and health value of biscuits. Analysis revealed that okra pod powder contains a high percentage of carbohydrates (58.23%) and dietary fiber (22.66%), along with a good protein content (8.25%) and a significantly low fat content (1.22%). Active compounds (HPLC): Important flavonoid compounds were identified at high concentrations, most notably rutin (101.5 ppm), quercetin (95.0 ppm), kaempferol, and apigenin. Antioxidant activity: The pod extract demonstrated high free radical inhibition activity (DPPH test), outperforming vitamin C at all concentrations used, with an inhibition rate of 78.74% at a concentration of 500 ppm. The biscuits were fortified with okra pod powder at different addition percentages (20%, 40%, and 60%) and compared to a control sample (0%). The results were as follows: Sensory Acceptance: Low and medium addition percentages were sensorily acceptable. Effect on Characteristics: High percentages (60%) led to a significant decrease in taste, color, and appearance scores, while freshness remained the most stable characteristic. Okra pods are a rich source of fiber and antioxidant bioactive compounds. The study concludes that they can be successfully used in the production of functional foods (fortified biscuits) with high nutritional value, with the recommendation to control the addition percentages to maintain the product's sensory characteristics .

Key word : Okra Calyx , Wheat Biscuits, the Sensory Properties and Nutritional

EVOLUTİON OF AUGMENTATİON İNDEX AND PULSE WAVE VELOCİTY DURİNG PREGNANCY İN PREGNANT WOMEN WHO PRACTİCE PHYSİCAL ACTİVİTY

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Abstract
Introduction
In this paper we tried to assess hemodynamic parameters and arterial stiffness in pregnant women before and after a physical training program and to demonstrate that structured training program improves the hemodynamic parameters.
Material and Method
This study was follow-up and included 40 patients between the years 2017-2018 admitted within Obstetrics and Gynaecology Departments of "Pius Brînzeu" Emergency Clinical Hospital Timişoara who performed a training program under the guidance of an obstetrician in collaboration with a cardiologist and physiotherapist in a multidisciplinary team. We assessed Aix and PWV as arterial stiffness parameters to quantify the improvement of arterial rigidity and cardiovascular risk before and after physical training and we tried to evaluate the correlation of their evolution throughout the pregnancy.
Conclusion
Physical training, coordinated with the obstetrician and the cardiologist, improved hemodynamic parameters of the pregnant woman during pregnancy. The arterial stiffness parameters improved due to physical training. In the last part of our study we studied through regression analysis the Aix brachial and the SD PWVao values in the second trimester (Trim II) and the third trimester (Trim III). We noticed major differences between these two time periods but we also tested if these variables interrelated. For this, we performed a regression analysis, in which we considered the values from Trim II as predictors and the values from Trim III as a response. We concluded that the association between the Aix brachial values in the second and third trimester of pregnancy was a positive strong extremely significant one and the one between the SD PWVao values was a weak negative and insignificant. Thus, statistically speaking, Aix brachial values decreased constantly for the whole sample, but for the SD PWVao values the decreasing process did not have the same dynamics for the whole sample.
Keywords: pregnancy, arterial stiffness, pulse wave velocity, augmentation index, cardiovascular risk, physical training

HEMŞİRELİK EĞİTİMİNDE YAPAY ZEKÂ

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ÖZET

Sağlık hizmetlerinde dijital dönüşümün hız kazanmasıyla birlikte yapay zekâ (YZ) uygulamaları, hemşirelik eğitiminde yenilikçi öğretim ve öğrenme yaklaşımlarının geliştirilmesinde önemli bir araç hâline gelmiştir. Yapay zekâ; öğrenme analitiği, akıllı simülasyon sistemleri, sanal hasta uygulamaları ve uyarlanabilir öğrenme platformları aracılığıyla hemşirelik öğrencilerinin bilişsel, psikomotor ve klinik karar verme becerilerini desteklemektedir.

Yapay zekâ tabanlı simülasyonlar ve sanal gerçeklik destekli senaryolar, öğrencilerin klinik uygulamalara güvenli bir ortamda hazırlanmasını sağlamakta ve hata yapma kaygısını azaltmaktadır. Yapay zekâ destekli değerlendirme araçları ise objektif geri bildirim sağlayarak öğrencilerin klinik yeterliliklerinin izlenmesine olanak tanımaktadır.

Hemşirelik eğitiminde yapay zekâ kullanımının önemli avantajları arasında eğitimin standardizasyonu, klinik deneyim eksikliklerinin giderilmesi ve eğitimde eşitliğin desteklenmesi yer almaktadır. Bununla birlikte etik sorunlar, veri gizliliği, teknolojik altyapı yetersizlikleri ve eğitimcilerin yapay zekâ okuryazarlığına ilişkin eksiklikler uygulamada karşılaşılan başlıca sınırlılıklar olarak bildirilmektedir. Bu nedenle hemşirelik müfredatlarına yapay zekâ ve dijital sağlık okuryazarlığını kapsayan derslerin entegre edilmesi ve eğiticilerin bu alanda desteklenmesi gerekmektedir.

Sonuç olarak, yapay zekâ uygulamaları hemşirelik eğitiminde öğrenme süreçlerini güçlendiren ve klinik yeterliliği artıran önemli bir potansiyel sunmaktadır. Etkili ve sürdürülebilir bir kullanım için pedagojik, etik ve teknolojik boyutların bütüncül bir yaklaşımla ele alınması önerilmektedir.

Anahtar Kelimeler: Hemşire, eğitim, yapay zekâ

ARTIFICIAL INTELLIGENCE IN NURSING EDUCATION

ABSTRACT

With the acceleration of digital transformation in healthcare, artificial intelligence (AI) applications have become an important tool in developing innovative teaching and learning approaches in nursing education. Artificial intelligence supports nursing students' cognitive,

psychomotor, and clinical decision-making skills through learning analytics, intelligent simulation systems, virtual patient applications, and adaptive learning platforms.

Artificial intelligence based simulations and virtual reality-supported scenarios enable students to prepare for clinical practice in a safe environment and reduce their fear of making mistakes. AI-supported assessment tools provide objective feedback, allowing for the monitoring of students' clinical competence.

The significant advantages of using artificial intelligence in nursing education include standardization of education, addressing clinical experience gaps, and promoting equality in education. However, ethical issues, data privacy, technological infrastructure deficiencies, and educators' lack of artificial intelligence literacy are reported as the main limitations encountered in practice. Therefore, it is necessary to integrate courses covering artificial intelligence and digital health literacy into nursing curricula and to support educators in this area.

In conclusion, artificial intelligence applications offer significant potential to enhance learning processes and increase clinical competence in nursing education. For effective and sustainable use, it is recommended that pedagogical, ethical, and technological dimensions be addressed through a holistic approach.

Keywords: Nurse, education, artificial intelligence

KRONİK HASTALIKLARIN YÖNETİMİNDE TELE-SAĞLIK UYGULAMALARI VE HEMŞİRELİK

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ÖZET

Kronik hastalıklar, uzun süreli izlem, düzenli bakım ve hasta katılımı gerektiren durumlar olup sağlık sistemleri üzerinde önemli bir yük oluşturmaktadır. Son yıllarda tele-sağlık uygulamaları, kronik hastalıkların yönetiminde bakımın sürekliliğini sağlamak ve hizmete erişimi artırmak amacıyla yaygın biçimde kullanılmaya başlanmıştır. Tele-sağlık; uzaktan hasta izlemi, görüntülü görüşmeler, mobil sağlık uygulamaları ve dijital eğitim platformları gibi çeşitli uygulamaları kapsamaktadır. Bu süreçte hemşireler, tele-sağlık tabanlı bakım modellerinin planlanması ve uygulanmasında kilit bir rol üstlenmektedir.

Hemşire liderliğinde yürütülen tele-sağlık uygulamalarının diyabet, hipertansiyon, kronik obstrüktif akciğer hastalığı ve kalp yetmezliği gibi kronik hastalıklarda klinik sonuçları iyileştirdiği bildirilmektedir. Uzaktan hasta izleme sistemleri sayesinde hemşireler; kan şekeri, kan basıncı ve semptom verilerini düzenli olarak takip edebilmekte, erken müdahalede bulunabilmekte ve hastaların tedaviye uyumunu artırabilmektedir. Ayrıca mobil uygulamalar aracılığıyla verilen bireyselleştirilmiş eğitimler, hastaların öz-yönetim becerilerini güçlendirmekte ve yaşam kalitesini olumlu yönde etkilemektedir. Tele-sağlık uygulamaları, hasta-hemşire etkileşimini artırarak psikososyal destek sağlamada da etkili bir araçtır. Görüntülü danışmanlık ve mesajlaşma sistemleri, hastaların sağlık profesyonellerine hızlı erişimini mümkün kılmakta ve sağlık hizmeti memnuniyetini artırmaktadır. Bununla birlikte dijital okuryazarlık düzeyinin yetersizliği, veri güvenliği kaygıları ve teknik altyapı sorunları tele-sağlık uygulamalarının etkinliğini sınırlayan faktörler arasında yer almaktadır.

Sonuç olarak, tele-sağlık uygulamaları kronik hastalıkların yönetiminde hemşirelik bakımını destekleyen etkili ve yenilikçi bir yaklaşım sunmaktadır. Tele-sağlık uygulamalarının etkili ve sürdürülebilir olabilmesi için hemşirelerin bu süreçlere aktif olarak dâhil edilmesi ve kurumsal politikalarla desteklenmesi gerektiğini vurgulamaktadır.

Anahtar Kelimeler: Kronik hastalıklar, tele-sağlık, hemşire

TELEHEALTH APPLICATIONS AND NURSING IN THE MANAGEMENT OF CHRONIC DISEASES

ABSTRACT

Chronic diseases are conditions that require long-term monitoring, regular care, and patient participation, placing a significant burden on healthcare systems. In recent years, telehealth applications have been widely adopted to ensure continuity of care and increase access to services in the management of chronic diseases. Telehealth encompasses various applications such as remote patient monitoring, video consultations, mobile health applications, and digital education platforms. In this process, nurses play a key role in the planning and implementation of telehealth-based care models.

It has been reported that telehealth applications led by nurses improve clinical outcomes in chronic diseases such as diabetes, hypertension, chronic obstructive pulmonary disease, and heart failure. Thanks to remote patient monitoring systems, nurses can regularly track blood sugar, blood pressure, and symptom data, intervene early, and increase patient adherence to treatment. In addition, personalized education provided through mobile applications strengthens patients' self-management skills and positively affects their quality of life. Telehealth applications are also an effective tool for providing psychosocial support by increasing patient-nurse interaction. Video consultation and messaging systems enable patients to quickly access healthcare professionals and increase satisfaction with healthcare services. However, insufficient digital literacy, data security concerns, and technical infrastructure issues are among the factors limiting the effectiveness of telehealth applications.

In conclusion, telehealth applications offer an effective and innovative approach that supports nursing care in the management of chronic diseases. It emphasizes that for telehealth applications to be effective and sustainable, nurses must be actively involved in these processes and supported by institutional policies.

Keywords: Chronic diseases, telehealth, nurse

"PSİKİYATRİK BAKIMDA YAPAY ZEKA TABANLI KLİNİK KARAR DESTEK SİSTEMLERİ: PSİKİYATRİ HEMŞİRELİĞİ UYGULAMALARI PERSPEKTİFİNDEN SİSTEMATİK DERLEME"

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ÖZET

Ruh sağlığı hizmetlerinde klinik karar verme; risk değerlendirmesi, semptom izlemi, kriz yönetimi, bakımın sürekliliği ve hasta güvenliği açısından kritik bir süreçtir. Son yıllarda elektronik sağlık kayıtları, dijital izlem verileri ve büyük veri analitiğindeki gelişmeler, psikiyatrik bakımda yapay zekâ (YZ) tabanlı klinik karar destek sistemlerinin (KKDS) kullanımını giderek görünür kılmaktadır. Bu sistemler, intihar/kendine zarar riski, ajitasyon ve şiddet riski, yeniden yatış/relaps olasılığı, tedavi uyumu gibi klinik açıdan önem taşıyan alanlarda hemşirelere uyarı, sınıflandırma ve risk değerlendirmesi sunabilmektedir. Bununla birlikte, psikiyatri hemşireliğinde bakım planlama, gözlem yapma, risk izleme, triyaj ve dokümantasyon gibi temel süreçleriyle KKDS entegrasyonunun hemşire iş yükü, karar kalitesi, ekip içi iletişimi, ve veri mahremiyeti gibi boyutlarda tartışma alanları oluşturmaktadır. Bu bağlamda çalışmada, psikiyatri hemşireliği bakım uygulamalarında yapay zeka tabanlı klinik karar destek sistemlerinin sistematik olarak incelenmesi amaçlanmıştır. Çalışma, konu ile ilgili yayınların veri tabanlarında geriye dönük taranması ile yapılmıştır. Çalışmalar Eylül-Aralık 2025 tarihleri arasında İstanbul Üniversitesi internet erişim ağı üzerinden Pubmed, Science Direct, Medline, CINAHL, Ulakbim, TPD, Google Akademik ve diğer veri tabanları taranarak gerçekleştirilmiştir. İncelemeye dâhil edilme kriterleri: Çalışmanın psikiyatrik bakım bağlamında YZ tabanlı bir klinik karar destek sistemi/algoritması (makine öğrenmesi, derin öğrenme, doğal dil işleme vb.) içermesi, psikiyatri hemşireliği uygulamalarına doğrudan veya dolaylı etkisinin raporlanabilir olması, tam metnine ulaşılabilen araştırma makalesi olması, yayın dilinin Türkçe ya da İngilizce olması ve 2010–2025 yılları arasında ulusal/uluslararası hakemli bir dergide yayınlanmış olmasıdır. Bu inceleme sonuçlarında, YZ tabanlı klinik karar destek uygulamalarının potansiyel yararları kadar hasta güvenliği ve etik boyutlarının da belirgin olduğu; özellikle yanlış ya da negatif uyarılar**,** algoritmik yanlılık, açıklanabilirlik**,** veri mahremiyeti ve klinik sorumluluk paylaşımına ilişkin risklerin çalışmalarda tekrar eden temalar olarak öne çıktığı görülmüştür.

Anahtar Kelimeler: Klinik karar destek, psikiyatrik bakım, psikiyatri hemşireliği, yapay zekâ

"ARTIFICIAL INTELLIGENCE BASED CLINICAL DECISION SUPPORT SYSTEMS IN PSYCHIATRIC CARE: A SYSTEMATIC REVIEW FROM THE PERSPECTIVE OF PSYCHIATRIC NURSING PRACTICE"

ABSTRACT

Clinical decision-making in mental health services is critical for risk assessment, symptom monitoring, crisis management, continuity of care and patient safety. In recent years, advances in electronic health records, digital monitoring data and big data analytics have made the use of AI-based clinical decision support systems (CDSS) in psychiatric care increasingly visible. These systems can alert nurses to clinically important areas such as suicide/self-harm risk, agitation and violence risk, readmission/relapse probability, and treatment compliance, and provide classifications and risk assessments. However, integrating CDSS into core psychiatric nursing processes such as care planning, observation, risk monitoring, triage and documentation raises issues regarding nurse workload, decision quality, team communication and data privacy. Against this backdrop, the present study aims to systematically examine AI-based CDSS in psychiatric nursing care practices. The study was conducted by retrospectively searching databases of publications related to the subject. The literature search was performed via the Istanbul University internet access network between September and December 2025 using Pubmed, Science Direct, Medline, CINAHL, Ulakbim, TPD, Google Scholar, and other databases. Inclusion Criteria: The study should include an AI-based clinical decision support system/algorithm (machine learning, deep learning, natural language processing, etc.) within the context of psychiatric care, and its direct or indirect impact on psychiatric nursing practices should be reportable. Additionally, criteria included full-text accessibility, publication in Turkish or English, and being published in a national/international peer-reviewed journal between 2010 and 2025. This review reveals that, although AI-based clinical decision support applications offer potential benefits, patient safety and ethical considerations are also important. In particular, the studies highlighted recurring themes related to risks such as false or negative alerts, algorithmic bias, explainability, data privacy and shared clinical responsibility.

Keywords: Clinical decision support, psychiatric care, psychiatric nursing, artificial intelligence

KRONİK OBSTRÜKTİF AKCİĞER HASTALIĞI TANISI ALAN BİREYLERDE SAĞLIK KONTROL ODAĞI VE ÖZ ETKİLİLİK ARASINDAKİ İLİŞKİ

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ÖZET

Araştırma, kronik obstrüktif akciğer hastalığı tanısı alan bireylerde sağlık kontrol odağı ve öz etkililik arasındaki ilişkinin belirlenmesi amacıyla kesitsel, tanımlayıcı ve ilişki arayıcı türde yapılmıştır. Araştırma, Türkiye'nin Doğusunda bir ilin üniversite hastanesinin göğüs hastalıkları kliniğine tedavi gören hastalarında Şubat-Haziran 2022 tarihleri arasında yürütülmüştür. Araştırmada örneklem seçimi yapılmadan araştırmaya katılmayı kabul olan 42 hasta ile çalışma tamamlanmıştır. Araştırma verileri hastalar için hazırlanan sosyo-demografik özelliklerini içeren Tanıtıcı Bilgi Formu, Çok Boyutlu Sağlık Kontrol Odağı ölçeği (ÇBSKOÖ) ve Kronik Obstrüktif Akciğer Hastalığı (KOAH) Öz-Etkililik Ölçek Formları kullanılmıştır. Araştırma katılan hastaların yaş ortalaması 59,19 ±12,46 olduğu, %59,5'i kadın olduğu, %83.3'ünün evli olduğu, %38,1'inin ilkokul mezunu olduğu, %64,3'ünün çalışmadığı, %64,3'ünün KOAH dışında başka kronik hastalığının olmadığı ve %54,8'inin günlük yaşamı sürdürmede destek almadığı belirlenmiştir. Araştırmaya katılan hastaların ÇBSKOÖ alt boyut puan ortalamaları sırasıyla; İç Kontrol 27,90±3,09, Şans Kontrol, 24,07±3,85, Güçlü Başkaları 28,11±3,06 olduğu belirlenmiştir. Hastaların KOAH Öz-Etkililik toplam puan ortalaması 3,67±0,81 olduğu, alt boyut puan ortalamaları sırasıyla; Olumsuz Etki 3,61±0,98, Duygusal Durum 3,46±1,30, Fiziksel Çaba 4,44±0,57, Hava-Çevre Etkisi 3,78±0,79, Davranışsal Risk Faktörleri 2,91±0,97 olduğu belirlenmiştir. Çalışmamızda elde edilen sonuçlara göre hastaların ÇBSKOÖ şans kontrol alt boyut puan ortalaması ile KOAH Öz-Etkililik toplam puan ortalaması arasında istatistiksel olarak pozitif yönde orta düzeyde anlamlı bir ilişki olduğu saptandı ($p< 0.05$). *Sonuç olarak,* araştırmamızda ÇBSKOÖ Güçlü Başkaları alt boyutu puan ortalamasının yüksek olması hastaların sağlıklarını kontrol etmek için sağlık profesyoneline başvurmayı odaklandıklarını göstermektedir. Araştırmamıza katılan hastaların KOAH Öz-Etkililik toplam puan ortalamasının yüksek olduğu, hastaların solunum güçlüğü ile baş etmeye ve korunmaya ilişkin kendilerine olan güvenlerinin arttığını göstermektedir. Hastaların

hastalıktan kurtulmada şansın önemli olduğunu ve Öz-Etkililiği etkilediği belirlenmiştir. Bu çalışmanın daha büyük örneklem grubu ile yapılması önerilmektedir.

Anahtar Kelimeler; Hasta, Kronik Obstrüktif Akciğer Hastalığı, Sağlık Kontrol Odağı, Öz Etkililik

THE RELATIONSHIP BETWEEN HEALTH CONCERN AND SELF-EFFICACY IN INDIVIDUALS DIAGNOSED WITH CHRONIC OBSTRUCTIVE PULMONARY DISEASE

ABSTRACT

The research was executed as a cross-sectional, descriptive, and exploratory study to ascertain the correlation between health locus of control and self-efficacy in persons diagnosed with chronic obstructive pulmonary disease. The research was carried out from February to June 2022 involving patients at the chest illnesses clinic at a university hospital in an eastern Turkish region. The research had 42 patients who consented to participate without any sample selection. Data were gathered by an Introductory Information Form that included the socio-demographic characteristics of the patients, the Multidimensional Health Locus of Control Scale (MHLC), and the Chronic Obstructive Pulmonary Disease (GOPD) Self-Efficacy Scale Forms. The mean age of participants in the research was 59.19 ±12.46 years; 59.5% were female, 83.3% were married, 38.1% had finished elementary education, 64.3% were jobless, 64.3% had no chronic conditions apart from GOPD, and 54.8% did not need assistance in their daily activities. The average scores for the subscales of the GOPD Self-Efficacy Scale among the study participants were as follows: Internal Control: 27.90 ± 3.09; Chance Control: 24.07 ± 3.85; Strong Others: 28.11 ± 3.06. The average overall GOPD Self-Efficacy score of the patients was 3.67±0.81, with the mean subscale values as follows: Negative Impact: 3.61±0.98; Emotional State: 3.46±1.30; Physical Effort: 4.44±0.57; Air-Environment Effect: 3.78±0.79; Behavioural Risk Factors: 2.91±0.97. Our investigation revealed a statistically significant moderate positive association between patients' average chance control subscale scores on the MHLC and their average total self-efficacy scores on the GOPD Self-Efficacy Scale ($p < 0.05$). *In conclusion,* the elevated mean score for the MHLC Strong Other subscale in our research indicates that patients prioritize contacting healthcare experts for health management. The elevated mean total score for GOPD Self-Efficacy among the patients in our research signifies an enhancement in their confidence to manage and safeguard themselves against respiratory challenges. Patients have concluded that chance plays a significant role in surviving the condition and influences Self-Efficacy. This investigation should be undertaken with a bigger sample size.

Keywords: Patient, Chronic Obstructive Pulmonary Disease, Health Control Centre, Self-Efficacy

GİRİŞ

Önlenmesi ve tedavi edilmesi mümkün olan Kronik Obstrüktif Akciğer Hastalığı (KOAH), , görülme sıklığı ve yüksek mortalite oranları nedeniyle önemli bir sağlık sorunu olmaktadır (Mannino ve ark., 2015; WHO, 2024). KOAH; hava yollarında kalıcı ve ilerleyici obstrüksiyon ile karakterize olup dispne, kronik öksürük ve balgam gibi semptomlara yol açmakta, bireylerin fiziksel fonksiyonlarını ve günlük yaşam aktivitelerini önemli ölçüde sınırlandırmaktadır (Neşe, 2023; Kara, 2019). Dünyada üçüncü ölüm nedeni olan KOAH, tüm ölümlerin %5.5'ni oluşturmakta Ülkemizde ise tüm ölümlerden üçüncü sırada solunum sistemi hastalıkları yer almakta ve bu ölümlerin %61.5'i KOAH nedeni ile gerçekleşen ölümler olduğu belirtilmektedir (Halk Sağlığı Genel Müdürlüğü (HSGM), 2025)

KOAH yalnızca fiziksel kapasiteyi değil, aynı zamanda bireylerin psikolojik ve sosyal işlevselliğini de olumsuz etkilemekte, bireylerde kaygı, depresyon ve özgüven kaybına yol açabilmektedir (Yohannes et al., 2017). Bu durum, bireylerin kendi sağlıklarını yönetme konusundaki inançlarını zayıflatarak öz-etkililik düzeylerinde azalmaya neden olabilmektedir. Öz-etkililik, bireyin belirli bir davranışı başlatma ve sürdürme konusundaki kendi yeterliliğine olan inancı olarak tanımlanmakta olup, kronik hastalık yönetiminde temel psikososyal belirleyicilerden biri olarak kabul edilmektedir (Bandura, 1997). KOAH hastalarında düşük öz-etkililik düzeyi; fiziksel aktiviteden kaçınma, günlük yaşam aktivitelerinde bağımlılığın artması ve sağlıkla ilişkili yaşam kalitesinin azalması ile ilişkilidir (Selzler ve ark., 2020).

Kronik hastalıklarda sağlık davranışlarını açıklamada kullanılan önemli kavramlardan biri olan sağlık kontrol odağı, bireyin sağlığıyla ilgili sonuçların kaynağını bulmaya çalışan psikolojik bir yapı olarak tanımlanmaktadır (Wallston ve Wallston, 1981). Bireylerin, sağlık durumlarının kendi davranışlarıyla şekillendirmesine iç sağlık kontrol odağı; şans, kader veya sağlık profesyonelleri gibi dış faktörlere şekillendirmesine dış sağlık kontrol odağı olarak ifade edilmektedir (Dalkılıç, 2024)..

KOAH gibi uzun süreli ve karmaşık yönetim gerektiren kronik hastalıklarda, hastaların sağlık kontrol odağı yönelimlerinin belirlenmesi ve öz-etkililiklerinin desteklenmesi bakım sonuçlarının iyileştirilmesi açısından büyük önem taşımaktadır. Sağlık kontrol odağı, davranışların başlatılmasında etkili olurken; öz-etkililik, bu davranışların sürdürülebilirliğini sağlamaktadır. Bu nedenle hemşirelerin bakım sürecinde bu iki kavramı birlikte

değerlendirmeleri, birey merkezli ve etkili bakım planlarının oluşturulmasına katkı sağlayacaktır. Bu bağlamda bu çalışmanın amacı, KOAH hastalarında öz-etkililik ile sağlık kontrol odağı arasındaki ilişkinin incelenmesidir.

ARAŞTIRMA

Araştırmanın Tipi

Bu araştırma, KOAH tanısı alan bireylerde sağlık kontrol odağı ve öz etkililik arasındaki ilişkinin incelenmesi amacıyla tanımlayıcı ve ilişkisel nitelikte yapıldı.

Araştırmanın Yeri ve Zamanı

Araştırma, Türkiye'nin Doğusunda bir ilin üniversite hastanesinin göğüs hastalıkları kliniğine tedavi gören hastalarında Şubat-Haziran 2022 tarihleri arasında yürütüldü. Araştırmada, örneklem seçimi yapılmamış olup katılmayı kabul eden 42 hasta ile çalışma tamamlandı.

Veri toplama araçları

Tanıtıcı Bilgi Formu: Literatür doğrultusunda hazırlanan form, hastaların yaş, cinsiyet, medeni durumu, eğitim düzeyi, çalışma durumu, KOAH tanısının süresi, başka kronik hastalığının olma durumu ve günlük yaşamınızı sürdürürken herhangi birisinden destek alma gibi toplam 8 sorudan oluştu.

Çok Boyutlu Sağlık Kontrol Odağı Ölçeği (ÇBSKOÖ);Wallston ve ark.,(1978) tarafından geliştirilen, ölçeğin Türkçe geçerlilik güvenirliliği Üstündağ-Budak tarafından yapılmıştır (Ustündağ-Budak ve Mocan-Aydin, 2005; Wallston, Strudler Wallston ve DeVellis, 1978). Ölçek 18 madde ve 3 alt boyuttan oluşmaktadır.

KOAH Öz-Etkililik Ölçeği (COPD Self-Efficacy Scale-CSES); Ölçek, Wigal ve arkadaşları (1991) tarafından geliştirilen ölçeğin Türkçe geçerlilik ve güvenirlik çalışması ise Kara ve Mirici tarafından yapılmıştır (Kara ve Mirici, 2002; Wigal, Creer ve Kotses, 1991). Ölçek, 34 madde ve 5 alt ölçekten oluşmaktadır.

Araştırmanın Etik Boyutu

Araştırmada veri toplama sürecinden önce çalışmanın yapıldığı üniversite hastanesinden 31.12.2021 tarih ve 204651 sayı ile kurum izni alındı. Daha sonra çalışmanın etik onayı ise bir üniversitenin Girişimsel Olmayan Klinik Araştırmalar Etik Kurulundan 21.01.2022 tarih ve 25 sayılı karar ile alındı. Anketlerin uygulanmadan önce hastalardan yazılı ve sözlü onam alındı.

Verilerin Analizi

Tanımlayıcı veriler için ortalama, standart sapma ve yüzde kullanıldı. Ölçek puanlar ortalama, standart sapma kullanıldı. İki sürekli değişken arasındaki ilişkinin gücünün ve yönünün bir ölçülmesinde Pearson's correlation kullanıldı.

BULGULAR ve TARTIŞMA

Araştırma katılan hastaların %59,5'i kadın olduğu, %83.3'ünün evli olduğu, %38,1'inin ilkokul mezunu olduğu, %64,3'ünün çalışmadığı, %64,3'ünün KOAH dışında başka kronik hastalığının olmadığı ve %54,8'inin günlük yaşamı sürdürmede destek almadığı belirlendi. Hastaların yaş ortalaması 59,19 ±12,46 olduğu ve KOAH hastalık süresi ortalaması 10,50 ±7,59 olduğu belirlendi (Tablo 1).

Table 1. Hastaların Sosyo-Demografik Özelliklerin Dağılımı

Değişken (N=42)	**n**	**%**
Cinsiyet		
Kadın	17	40,5
Erkek	25	59,5
Medeni durum		
Evli	35	83,3
Bekar	7	16,7
Eğitim düzeyi		
Okuryazar değil	14	33,3
İlkokul	16	38,1
Lise	12	28,6
Çalışma Durumu		
Evet	15	35,7
Hayır	27	64,3
Kronik Hastalık Durumu (KOAH dışında)		
Evet	15	35,7
Hayır	27	64,3
Günlük Yaşamı Sürdürmede Destek Alma Durumu		
Evet	19	45,2
Hayır	23	54,8
	X̄±SS	
Yaş (Yıl)	59,19 ±12,46	
Hastalık Süresi (Yıl)	10,50 ±7,59	

Araştırmaya katılan hastaların ÇBSKOÖ alt boyut puan ortalamaları sırasıyla; İç Kontrol 27,90±3,09, Şans Kontrol, 24,07±3,85 ve Güçlü Başkaları 28,11±3,06 olduğu belirlendi. Hastaların, KOAH Öz-Etkililik toplam puan ortalaması 3,67±0,81 olduğu, alt boyut puan ortalamaları sırasıyla; Olumsuz Etki 3,61±0,98, Duygusal Durum 3,46±1,30, Fiziksel Çaba4,44±0,57, Hava-Çevre Etkisi 3,78±0,79 ve Davranışsal Risk Faktörleri 2,91±0,97 olduğu belirlendi (Tablo 2).

Tablo 2. Hastaların Ölçek Puan Ortalamaları (n=42)		
	Min-Max. Puan	**Ortalama±SS**
KOAH Öz-Etkililik		
Olumsuz Etki	1,17-5,00	3,61±0,98
Duygusal Durum	1,00-9,50	3,46±1,30
Fiziksel Çaba	2,60-5,00	4,44±0,57
Hava-Çevre Etkisi	1,83-5,00	3,78±0,79
Davranışsal Risk Faktörleri	1,00-4,33	2,91±0,97
Toplam Puan	2,00-5,62	3,67±0,81
ÇBSKOÖ		
İç Kontrol	20,00-33,00	27,90±3,09
Şans Kontrol	17,00-34,00	24,07±3,85
Önemli Diğer Kişiler	21,00-32,00	28,11±3,06

Tablo 3. ÇBSKOÖ Alt Boyut Ölçek Puanları ile KOAH Öz-Etkililik Toplam Puan Ortalamaları Arasındaki İlişki (n=42)

Değişkenler	**1.**	**2.**	**3.**
1. KOAH Öz-Etkililik			
2. ÇBSKOÖ: İç Kontrol	-.135		
3. ÇBSKOÖ: Şans Kontrol	.403**	-.071	
4. ÇBSKOÖ: Güçlü Başkaları	.038	.024	.175

**Pearson's correlation: p<0.001(two-tailed test)

Çalışmamızda elde edilen sonuçlara göre hastaların ÇBSKOÖ şans kontrol alt boyut puan ortalaması ile KOAH Öz-Etkililik toplam puan ortalaması arasında istatistiksel olarak pozitif yönde orta düzeyde anlamlı bir ilişki olduğu saptandı (p< 0.05) (Tablo 3).

Literatürde yapılan bir çalışmada iç sağlık kontrol odağına sahip bireylerin sağlıkla ilişkili davranışları başlatma ve sürdürme konusunda daha aktif oldukları bildirilmektedir (Cobb-Clark ve ark., 2014). Diyabetli bireylerle yapılan çalışmalarda da iç kontrol odağı ve yüksek öz-etkililiğin, öz bakım yönetimi ve tedaviye uyum üzerinde olumlu etkileri olduğu gösterilmiştir (Albargawi ve ark., 2017; Sharoni ve Wu, 2012).

Öz-etkililik düzeyi yüksek olan hastaların ise semptomlarla daha etkili baş ettikleri, tedaviye uyumlarının daha iyi olduğu ve hastane yatış oranlarının daha düşük olduğu bildirilmektedir (Mitchell ve ark., 2014). Wang, ve ark; (2022) kronik hastalığı olan bireylerde yaptığı araştırmada, sağlık kontrol odağının, öz-yönetim davranışları ve öz-etkililik arasındaki etkileşimi anlamlı şekilde etkilediği bildirilmiştir. Kronik hastalık bağlamında öz-etkililiğin belirleyicileri üzerine yapılan diğer güncel çalışmalarda ise aile sağlığı, sosyal destek ve sağlık okuryazarlığının öz-etkililik üzerinde olumlu etkileri olduğu bulunmuştur (Luo ve ark., 2024).

KOAH ile ilgili yapılan çalışmalarda, doğrudan sağlık kontrol odağını ölçmemekle birlikte, öz-etkililiğin artırılmasına yönelik müdahalelerin hastaların günlük yaşamda semptom

kontrolü ve tedaviye uyum gibi davranışlarını güçlendirdiği belirtilmektedir. Literatürde yapılan çalışmalarda kronik obstrüktif akciğer hastalığı olan hastaların tedaviye uyumunu kolaylaştırmaya ve yaşam kalitesini iyileştirmeye yönelik verilen sağlık eğitimlerin öz yeterlilik becerilerini artırmaya katkıda bulunduğu belirtilmektedir (Özel, Korkut ve Gürpınar, 2025; Tülüce ve Kutlutürkan, 2018).

SONUÇ

Araştırmada, ÇBSKOÖ diğer kişiler alt boyutu puan ortalamasının yüksek olması hastaların sağlıklarını kontrol etmek için sağlık profesyoneline başvurmayı odaklandıklarını göstermektedir. Hastaların KOAH Öz-Etkililik toplam puan ortalamasının yüksek olduğu, hastaların solunum güçlüğü ile baş etmeye ve korunmaya ilişkin kendilerine olan güvenlerinin arttığını göstermektedir. Hastaların, KOAH öz etkililik fiziksel alt boyutunun en yüksek, davranışsal risk faktörleri ise en düşük puan ortalamalarına sahip olduğu saptandı. Hastaların hastalıktan kurtulmada şansın önemli olduğunu ve öz-etkililiği etkilediği belirlenmiştir. Bu çalışmanın daha büyük örneklem grubu ile yapılması önerilmektedir.

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HASTA MERKEZLİ BAKIMDA KÜLTÜREL DUYARLILIK VE KLİNİK UYGULAMALARA YANSIMALARI

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ÖZET

Hasta merkezli bakım, bireyin fiziksel, psikolojik, sosyal ve kültürel ihtiyaçlarını bütüncül bir yaklaşımla ele alan, etik temellere dayalı profesyonel bir sağlık hizmeti olarak tanımlanmaktadır. Bu yaklaşım, yalnızca hastalığın tedavisine odaklanmakla kalmayıp, bireyin değerleri, inançları ve yaşam deneyimlerini de bakım sürecine dahil etmeyi gerektirmektedir. Hemşirelik bakımının kalitesi, bireyin kültürel değerleriyle ele alınmasıyla doğrudan ilişkili olmakta ve hasta güvenliği, memnuniyeti ile bakım etkinliği üzerinde belirleyici bir rol oynamaktadır. Kültürel duyarlılık, hemşirenin kendi kültürel bakış açısını fark etmesi ve farklı kültürel yapılarla etkileşiminde saygı temelinde hareket etmesi olarak tanımlanmaktadır. Kültürel açıdan duyarlı bakım, hasta ile hemşire arasında güveni güçlendirmekte, iletişimi geliştirmekte ve bakım sürecine aktif katılımı teşvik etmektedir. Ancak kültürel farklılıkların göz ardı edilmesi iletişim sorunlarına, bakımda uyumsuzluklara ve etik ikilemlere yol açabilmektedir. Klinik uygulamalarda kültürel duyarlılığın benimsenmesi, bakım planlarının bireyselleştirilmesini ve sağlık hizmetlerinin eşitlikçi bir biçimde sunulmasını sağlamaktadır. Hemşirelerin karar alma süreçlerinde kültürel unsurları dikkate almaları, bakımın etkinliğini artırmakta ve sağlık sonuçlarının iyileştirilmesine katkı sunmaktadır. Sonuç olarak, hasta merkezli bakımda kültürel duyarlılığın eğitim ve uygulamalara sistematik biçimde entegre edilmesi, nitelikli, güvenli ve sürdürülebilir bakımın sağlanması açısından kritik öneme sahip olmaktadır.

Anahtar Kelimeler: Hasta merkezli bakım, hemşirelik, kültürel duyarlılık, klinik uygulama, bireyselleştirilmiş bakım

CULTURAL SENSITIVITY IN PATIENT-CENTRED CARE AND ITS REFLECTIONS IN CINICAL PRACTICE

ABSTRACT

Patient-centered care is characterized as a professional healthcare service grounded on ethical principles that comprehensively meets the individual's physical, psychological, social, and cultural requirements. This method involves not just addressing the sickness but also integrating the individual's values, beliefs, and life experiences into the care process. The caliber of nursing care is intrinsically linked to the recognition of an individual's cultural values and

significantly influences patient safety, contentment, and the efficacy of treatment. Cultural sensitivity is described as the nurse's acknowledgment of their own cultural viewpoint and their respectful engagement with other cultural frameworks. Culturally sensitive care enhances trust between the patient and nurse, facilitates communication, and promotes active engagement in the care process. Neglecting cultural differences may result in communication issues, discrepancies in treatment, and ethical challenges. Embracing cultural sensitivity in clinical practice guarantees the customization of treatment plans and the equitable provision of healthcare services. The incorporation of cultural elements by nurses in decision-making enhances care efficacy and leads to better health outcomes. Thus, the systematic incorporation of cultural sensitivity into education and practice in patient-centered care is essential for delivering high-quality, safe, and sustainable care.

Keywords: Patient-centred care, nursing, cultural sensitivity, clinical practice, personalised care

GİRİŞ

Hasta merkezli bakım, bireyin fizyolojik, psikolojik, sosyal ve kültürel ihtiyaçlarını holistik yaklaşımla ele alan bakım olarak tanımlanmaktadır (Zhao ve ark., 2016; Lusk ve Fater, 2013). Bu holistik yaklaşımda hasta sadece hastalık ile değil aynı zamanda değerleri, inançları, yaşam tarzı ve kültürel özellikleriyle de değerlendirilmektedir. Hasta merkezli bakımda, sağlık profesyonellerinin amacı bireyi kendi yaşantısı içinde ve beklentilerini temel alarak bakım planını düzenlemektir (Schellinger ve ark., 2018; Bergeson ve Dean, 2006; Engebretson, 2003).

Sağlık profesyonelleri kendi kültürel algısını farkında olması ve farklı kültürel değerlerle saygı gösterebilme yetkinliği kültürel duyarlılık olarak tanımlanmaktadır (Kaihlanen, Hietapakka ve Heponiemi, 2019; Shepherd ve ark., 2019). Bu durum hastanın kültürel kimliğini tanınarak uygun bakım sunulmasını sağlamaktadır. Kültürel yeterlilik, kültürel bilgi ve kültürel farkındalık gibi çok boyutlu özellikleri içinde barındıran bir kavram olan kültürel duyarlılık, hemşirenin kendi önyargılarını tanımasını ve hastanın kültürel değerlerini anlamasını kolaylaştırdığı belirtilmektedir (Henderson, ve ark., 2018; Cai, 2016). Hasta merkezli bakımda kültürel duyarlılığın temelini oluşturan model ve kuramlar bulunmaktadır. Hemşirelikte kültürel duyarlılığı açıklayan Campinha-Bacote'nin Kültürel Yeterlilik Süreci Modeli ve Leininger'in Transkültürel Hemşirelik Kuramı kültür temelli bakımın önemini vurgulayarak bakımın kalitesi üzerindeki etkisini vurgulamaktadır (Botelho

ve Lima, 2020; Değer, 2018; Tanrıverdi, 2017). Bu kültürel duyarlık temelli yaklaşım klinik uygulamalarda hasta memnuniyetinden bakım kalitesine kadar etkileri görülmektedir.

Hasta merkezli bakımda kültürel duyarlılık, hasta ile hemşire arasındaki iletişimin güçlenmesine ve hastanın inançlarını, değerlerini, dilini ve sağlık algısını daha doğru biçimde anlaşılması katkı sağlamaktadır (Alhazmy ve ark., 2024; Tucker ve ark., 2015). Kültürel duyarlılık, özellikle göçmenlerde hasta topluluklarında hasta güvenliğini ve bakıma uyumunu artırmaktadır (Chauhan ve ark., 2020). Yapılan çalışmalar kültürel duyarlılık eğitimlerinin hemşirelerde iletişim becerilerini artırdığı, hasta ile hemşire arasındaki güven düzeyini yükselttiğini göstermektedir (Akhtar, 2024; Majumdar ve rak., 2004). Ayrıca kültürel duyarlılık, sağlık hizmetlerinde karşılaşılan sağlık eşitsizliklerini azaltmaya katkı sağlayarak hastaların sosyal ve kültürel ihtiyaçları daha iyi karşılanmaktadır (Tucker ve ark., 2015; Saha, Beach ve Cooper, 2008).

Klinik Uygulamalara Yansımaları

İletişim; Kültürel duyarlılık, klinik uygulamalarda en çok iletişim süreçlerinde kendini göstermekte ve hemşire-hasta iletişimi kültürel farklılıklar nedeniyle sıkça kesintiye uğramaktadır (Charzyńska-Gula ve ark., 2024; Crawford, Candlin ve Roger, 2017). Bu durum çoğunlukla dil, sağlık inançları ya da aile dinamikleri nedeni ile olabilmektedir (Hart ve Mareno, 2014). Kültürel duyarlılık yönelik eğitim programları ile hemşireler, bu engelleri aşarak iletişimlerini güçlendirerek, hasta bakım kalitesini artırmaktadırlar (Kaihlanen, Hietapakka ve Heponiemi, 2019).

Hasta Güvenliği; Kültürel açıdan duyarlı bakım, hasta güvenliğini artırırken kültürel duyarlılık eksikliğinin bakımda yanlış anlamalara, tedavi planına uyumsuzluklara ve hatta tıbbi hatalara yol açmaktadır (Stubbe, 2020; Shepherd, 2019). Ayrıca kültürel duyarlı bakım hemşirenin hasta risklerini daha iyi değerlendirmesine ve uygun müdahaleler planlamasına imkan sağlamaktadır (Shepherd, 2019; Douglas ve ark., 2014).

Eğitim Programları; Hemşirelik eğitiminde kültürel duyarlılık, yalnızca teorik bilgi ile değil aynı zamanda uygulamalı deneyimleri kapsamaktadır. Ayrıca kültürel eğitimler, hem öğrenciler hem de klinik hemşireler için klinik deneyim kazanmalarına ve kültürel becerilerini artırmalarına katkı sağlamaktadır (Gradellini ve ark., 2021; Ruddock ve Turner, 2007).

Sağlık Hizmetlerine Erişimde Eşitsizlikler; Sağlık hizmetlerine erişimde eşitsizliklerle mücadelede önemli bir yere sahip olan, kültürel açıdan duyarlı hemşirelik yaklaşımı,

dezavantajlı grupların bakım gereksinimleri karşılanmasını sağlamaktadır (Douglas ve ark., 2014; Williamson ve Harrison. 2010).

Literatürde yapılan çalışmalar, kültürel duyarlılığın hasta merkezli bakımda oldukça önemli bir faktör olduğunu göstermektedir (Alhazmy ve ark., 2024; Botelho ve Lima, 2020; Değer, 2018; Tanrıverdi, 2017; Tucker ve ark., 2015). Kültürel farkındalık hemşirelerin hasta beklentilerini daha doğru anlamasına yardımcı olurken, bilgi ve beceri düzeyinin artmasını ve hasta ile etkileşimi güçlendirilmesini sağlamaktadır (Alhazmy ve ark., 2024; Shepherd, 2019; Hart ve Mareno, 2014).

SONUÇ

Hasta merkezli bakımda kültürel duyarlılık, bireyselleştirilmiş ve kaliteli bakımın temel taşlarından biri olarak vurgulanmaktadır. Kültürel duyarlılık, iletişimi ve hasta güvenliğini sağlayarak sağlık bakımında eşitsizliklerini azaltarak bakımın kalitesini artırmaktadır. Bu nedenle, hemşirelik eğitim programlarında ve klinik uygulamalarda kültürel duyarlılık eğitimleri artırılması sağlanmalıdır. Ayrıca, çok kültürlü toplumlara daha etkin bakım sunulmasını sağlayacak stratejiler geliştirmesi önerilebilir.

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BEYİN ve SİNİR CERRAHİSİ UYGULANAN HASTALARDA CERRAHİ DÖNEM SUSUZLUĞA BAĞLI RAHATSIZLIKLARIN BELİRLENMESİ

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ÖZET

Bu çalışma, beyin ve sinir cerrahisi uygulanan hastalarda cerrahi dönem susuzluğa bağlı yaşanan rahatsızlık düzeylerini ve etkileyen faktörleri belirlemek amacıyla kesitsel ve tanımlayıcı tipte gerçekleştirilmiştir. Araştırma, Şubat 2025 ile Nisan 2025 tarihleri arasında Gaziantep Şehir Hastanesi Beyin ve Sinir Cerrahi Servisi'nde tedavi gören 127 hasta ile yürütülmüştür. Veriler "Tanıtıcı Bilgiler Formu", "Cerrahi Dönem Susuzluğa Bağlı Rahatsızlık Ölçeği (CDSBRÖ)" ve "Numerik Derecelendirme Ölçeği (NRS)" kullanılarak toplanmıştır. Verilerin analizinde tanımlayıcı istatistiklerin yanı sıra t-testi, ANOVA, Pearson korelasyon analizi kullanılmış; güvenirlik katsayısı (Cronbach's Alpha) 0.70 olarak saptanmıştır.Araştırma bulgularına göre; hastaların yaş ortalaması 49.87±14.88 yıl, cerrahi açlık süresi ortalama 17.68±2.57 saattir. Susuzluk şiddeti (NRS) ve susuzluğa bağlı rahatsızlık (CDSBRÖ) puanlarının kliniğe geliş anından itibaren 120. dakikaya kadar istatistiksel olarak ileri düzeyde anlamlı bir artış gösterdiği ($p<0.001$) ve zamanın susuzluk artışı üzerinde %90 oranında belirleyici olduğu saptanmıştır. Literatürden farklı olarak; cerrahi açlık ve anestezi süresinin susuzluk şiddeti üzerinde anlamlı bir etkisi bulunmazken ($p>0.05$); 8.5 numara endotrakeal tüp kullanılan hastaların, kadın hastaların ve sürekli ilaç kullananların susuzluk ve rahatsızlık puanlarının anlamlı düzeyde yüksek olduğu belirlenmiştir ($p<0.05$). Ayrıca NRS ve CDSBRÖ arasında saptanan çok güçlü pozitif korelasyon ($r>0.90$), susuzluğun hastada yarattığı fiziksel ve psikolojik distresin ayrılmaz bir bütün olduğunu kanıtlamıştır. Sonuç olarak; perioperatif susuzluk, açlık süresinden bağımsız olarak gelişen ve özellikle büyük çaplı havayolu ekipmanları ile şiddetlenen akut bir konfor bozukluğudur. Hemşirelerin, özellikle riskli gruplarda susuzluğu erken dönemde değerlendirmeleri ve kanıta dayalı girişimlerle yönetmeleri önerilmektedir.

Anahtar Kelimeler: Ameliyat Sonrası Dönem, Hasta Konforu, Hemşirelik, Susuzluk, Postoperatif Semptom Yönetimi.

DETERMINATION OF THIRST-RELATED DISCOMFORT DURING THE SURGICAL PERIOD IN PATIENTS UNDERGOING NEUROSURGERY

ABSTRACT

This study was conducted with a cross-sectional and descriptive design to determine the levels of discomfort related to perioperative thirst and the affecting factors in patients undergoing neurosurgery. The research was carried out with 127 patients treated at the Neurosurgery Clinic of Gaziantep City Hospital between February 2025 and April 2025. Data were collected using the "Descriptive Information Form," "Perioperative Thirst Discomfort Scale (PTDS)," and "Numeric Rating Scale (NRS)." In data analysis, descriptive statistics, t-test, ANOVA, and Pearson correlation analysis were used; the reliability coefficient (Cronbach's Alpha) was determined to be 0.70. According to the research findings, the mean age of the patients was 49.87±14.88 years, and the mean surgical fasting duration was 17.68±2.57 hours. It was determined that Thirst Intensity (NRS) and Thirst Discomfort (PTDS) scores showed a statistically highly significant increase from the moment of arrival at the clinic until the 120th minute ($p<0.001$), and time was a 90% determinant factor on the increase of thirst. Contrary to the literature, while surgical fasting and anesthesia duration had no significant effect on thirst intensity ($p>0.05$); it was determined that thirst and discomfort scores were significantly higher in patients intubated with size 8.5 endotracheal tubes, female patients, and those using chronic medication ($p<0.05$). Furthermore, the very strong positive correlation found between NRS and PTDS ($r>0.90$) demonstrated that the physical and psychological distress caused by thirst is an inseparable whole. In conclusion, perioperative thirst is an acute comfort disturbance that develops independently of fasting duration and is exacerbated particularly by large-sized airway equipment. It is recommended that nurses assess thirst in the early period, especially in high-risk groups, and manage it with evidence-based interventions.

Keywords: Nursing, Patient Comfort, Postoperative Period, Thirst, Postoperative Symptom Management.

TROCHANTER TERTIUS: BİR FEMUR VARYASYONU

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ÖZET

Femur'un extremitas proximalis'inde trochanter major ve trochanter minor olmak üzere 2 çıkıntı bulunmaktadır. Varyasyonel olarak bu iki çıkıntıya ek trochanter tertius adı verilen üçüncü bir çıkıntı görülebilir. Bu yapı; tuberositas glutea'nın üst ucunda, trochanter major'un altında bulunur. Bu oluşumun tanımı standartize edilmediği için bazı araştırmacılar sadece belirgin çıkıntıları, bazıları ise tuberositas glutea'da bulunan hafif de olsa tüm yükseltileri bu sınıfa dahil eder. Bu çalışmada üniversitemizin Anatomi anabilim dalına ait kemik koleksiyonunda bulunan, rutin eğitim materyali olarak kullanılan 21 adet Femur incelenmiştir. Sadece tuberositas glutea'nın üst ucunda bulunan belirgin yükselti ve çıkıntılar trochanter tertius olarak kabul edilmiştir. İncelenen 21 femur'dan 3'ünde (%14,3) trochanter tertius varlığı tespit edilmiştir. Görülme sıklığı; araştırmacıların trochanter tertius tanımlarının tam olarak örtüşmemesi, kullanılan kemik koleksiyonu veya etnik köken farklılıklarına bağlı olarak çalışmalar arasında oldukça değişkenlik göstermektedir. Trochanter tertius'un gelişiminin bir sebebi olarak m. gluteus maximus'un liflerinin bir bölgede yoğunlaşması veya kasın derin liflerine aşırı mekanik kuvvet uygulanması söylenebilir. Trochanter tertius, radyolojik görüntülerde femur proksimalinde bir yoğunluk artışı şeklinde görülebilir. Patolojik durumlarla karıştırılmaması ve doğru radyolojik ve anatomik değerlendirme yapmak açısından bilinmesi değerlidir.

Anahtar kelimeler: Trochanter tertius, varyasyon, femur

TROCHANTER TERTIUS: A VARIATION OF THE FEMUR

ABSTRACT

The proximal extremity of the femur presents two bony prominences, namely the greater trochanter (trochanter major) and the lesser trochanter (trochanter minor). As a variation, an additional third prominence known as the trochanter tertius may be present. This structure is described as a distinct bony projection located on the superior end of the gluteal tuberosity (tuberositas glutea), inferior to the greater trochanter. However, the definition of the trochanter tertius has not been fully standardized in the literature. While some authors consider only

prominent and well-defined projections as a trochanter tertius, others include even mild elevations observed on the gluteal tuberosity.

In this study, 21 femora belonging to the bone collection of the Department of Anatomy of our university and routinely used as educational materials were examined. Only prominent elevations and projections located at the superior end of the gluteal tuberosity were accepted as trochanter tertius. The presence of a trochanter tertius was identified in 3 of the 21 femora examined (14.3%).

Variations in the reported incidence of the trochanter tertius among studies have been attributed to differences in definition criteria, characteristics of bone collections, and ethnic background. The development of the trochanter tertius has been suggested to be related to localized concentration of fibers of the gluteus maximus muscle or increased mechanical stress applied to its deep fibers. On radiological imaging, this variation may appear as a localized increase in bone density in the proximal femur. Awareness of the trochanter tertius is important to avoid misinterpretation as a pathological condition and to ensure accurate anatomical and radiological evaluation.

Keywords: Trochanter tertius, variation, femur

ZNNI KAPLI ELEKTROT YÜZEYINDEKI POLY(ANİLİNE-CO-N-METİLPİROL) FİLMİN KOROZYON DAVRANIŞI

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Özet

Poly(aniline-co-N-metilpirol) film ZnNi kaplı karbon çelik elektrot yüzeyine 0.025 M anilin + 0.025 M o-anisidin içeren 0.30 M okzalik asit çözeltisinde ZnNi alaşım karbon çelik yüzyine dönüşümlü voltametri tekniği ile sentezlenmiştir. Kopolimer ile kaplı olan ZnNi kaplı CS elektrotların karakterizasyonu AC empedans spektroskopisi tekniği, doğrusal taramalı voltametri ve anodik polarizasyon eğrileri ile gerçekleştirilmiştir. Korozyon test sonuçları poly(aniline-co-N-metilpirol) fimin 168 saatlik bekleme süresinde korozif ajanlara karşı önemli bariyer özellik sergilediğini göstermiştir.

Anahtar Kelimeler: Poly(aniline-co-N-metilpirol), ZnNi, korozyon

CORROSİON BEHAVİOUR OF POLY(ANİLİNE-CO-N-METHYPYRROLE) FILM ON ZNNI PLATED ELECTRODE

Abstract

Poly(aniline-co-N-methypyrrole) film was synthesized with cyclic voltammetry technique from 0.025 M aniline + 0.025 M N-methylpyrrole containing 0.30 M oxalic acid solution on ZnNi plated carbon steel electrode. The characterization of ZnNi deposited CS electrode with copolymer film in 3.5% NaCl solution was investigated with AC impedance spectroscopy technique, linear sweep voltammetry, and anodic polarization curves. The corrosion test results revealed that Poly(aniline-co-N-methylpyrrole) exhibited significant barrier properties against attack by corrosive agents for a period of 168 hours.

Keywords: Poly(aniline-co-N-methypyrrole), ZnNi, Corrosion

1. GİRİŞ

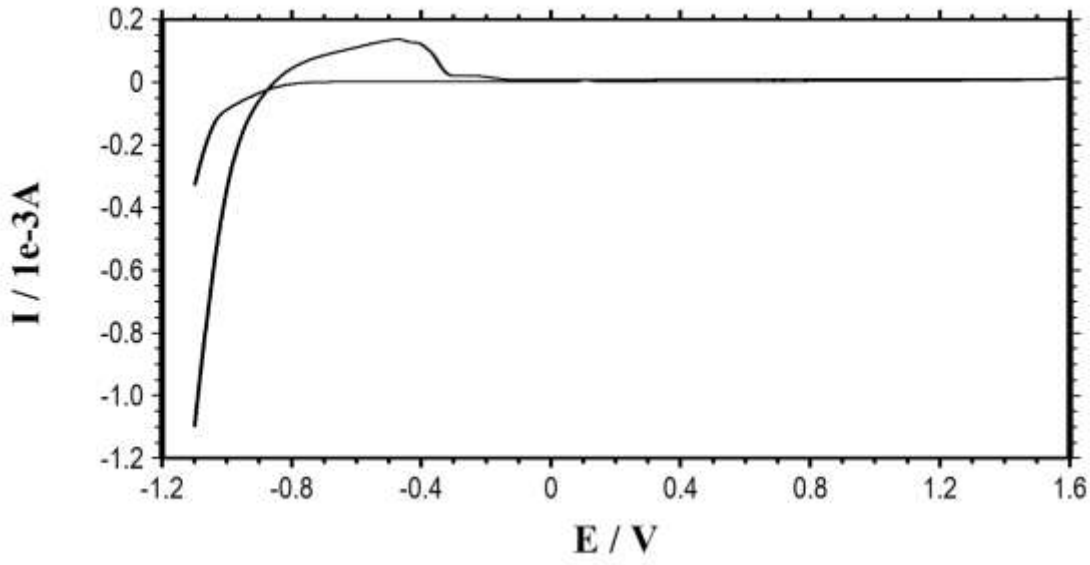
Metalik kaplamalar yükseltgenebilir metalleri koruma yöntemlerinden biridir. Günümüzde Çinko alaşım kaplamalarla çeliğin korozyonunu önlemesine yönelik çalışmalar yapılmakta olup bu çalışmaların önemli bir kısmında yalın çinko ile yapılan kaplamalara göre daha iyi sonuçlar elde edilmiştir [1-4]. İletken polimerlerin çinko alaşımların yüzeyine kaplanması ile ise korozyona karşı dayanım daha da artırılabilmektedir [5-7]. Bu çalışmada Poli(anilin-co-N-metilpirol) (PANI-co-PNMP) kopolimer filmi ZnNi kaplı karbon çelik (CS/ZnNi) yüzeyine kaplanarak antikorozif özelliği incelenmiştir.

2. MATERYAL VE METOD

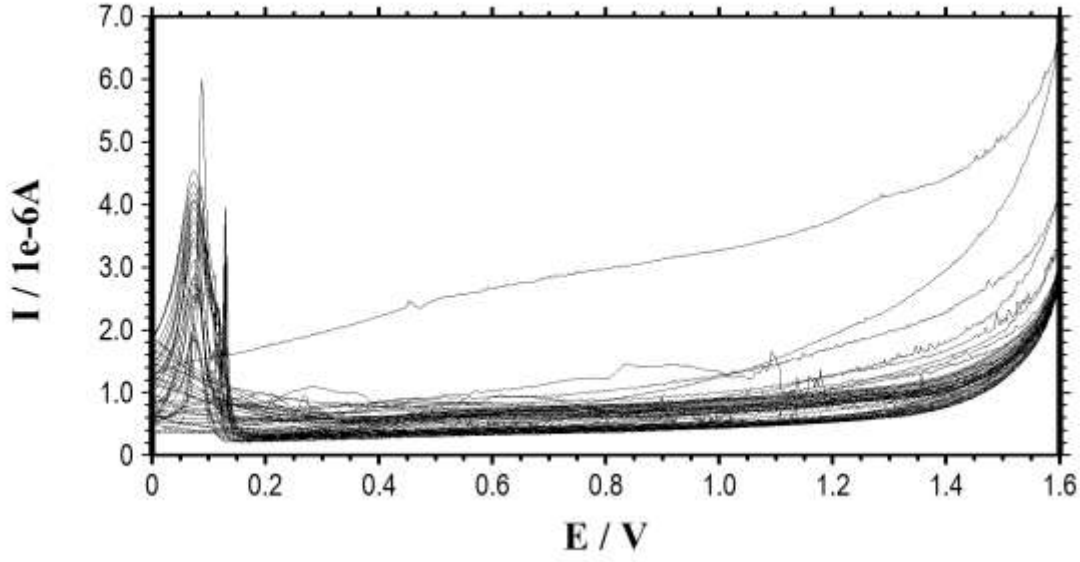
Elektrokimyasal ölçümler üç elektrot tekniği kullanılarak tek hücrede gerçekleştirilmiştir. Karşı elektrot olarak yüzey alanı 0.18 cm^2 olan platin levha, referans elektrot olarak da Ag/AgCl (3 M, KCl) kullanılmıştır. Çalışmada kullanılan yüzey alanı 0.05 cm^2 olan silindirik karbon çelik elektrotların elementel bileşimi kütlece % 0.0561 C, % 0.4498 Mn, % 0.0103 P, % 0.0036 S, % 0.1409 Si ve % 99.3394 Fe'dir. Elektrokimyasal ölçümler CHI 660E elektrokimyasal analiz cihazı kullanılarak yapılmıştır. ZnNi kaplama banyosu içeriği 200 gl^{-1} $ZnSO_4.7H_2O$, 140 gl^{-1} $NiSO_4.6H_2O$, 20 gl^{-1} H_3BO_3, 2 gl^{-1} $CH_3C_6H_4SO_3H.H_2O$ olup kaplama 400 saniye boyunca 1 mA sabit akımda pH'ı yaklaşık 5.5 olan sülfat banyosunda yapılmıştır [8]. AC empedans ölçümleri elektrotların korozif çözeltiye bırakılmalarından sonra farklı zaman dilimlerinde açık devre potansiyellerinde 10^5 Hz ile 10^{-3} Hz frekans aralığında 7 mV genlik kullanılarak gerçekleştirilmiştir. Anodik polarizasyon eğrileri ise 168 saat sonra ölçülen denge potansiyelinden başlanarak anodik yönde 1.80 V'ye kadar 4 mVs^{-1} tarama hızı ile elde edilmiştir.

3. BULGULAR VE TARTIŞMA

CS/ZnNi elektrodun 0.025 M aniline + 0.025 M N-metilpirol içeren 0.30 M okzalik asit çözeltisinde elde edilen birinci voltammogram eğrisi Şekil 1'de verilmiştir. Şekil 1'de -1.10 V ile 1,80 V potansiyel aralığında alınan eğrilerde anodik taramada görülen geniş pik oksidasyon/pasivasyon pikidir. Bu pik yüzeydeki çinko ve nikel iyonlarının çözünmesi ve çözeltideki okzalat iyonları ile birleşip yüzeyin pasifleşmesine karşılık gelmektedir. Şekil 2 sentez için elde edilen film gelişim eğrilerini göstermektedir.



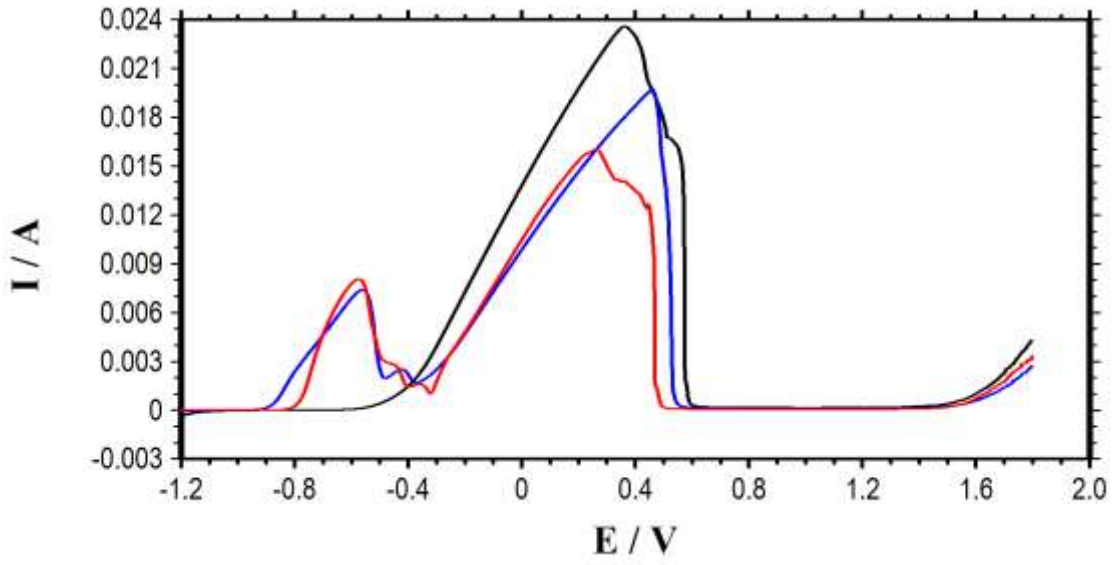
Şekil 1. CS/ZnNi elektrodun 0.025 M aniline + 0.025 M N-metilpirol içeren 0.30 M okzalik asit çözeltisinde elde edilen birinci voltammogram eğrisi



Şekil 2. CS/ZnNi elektrodun 0.025 M aniline + 0.025 M N-metilpirol içeren 0.30 M okzalik asit çözeltisinde elde edilen film gelişim eğrileri

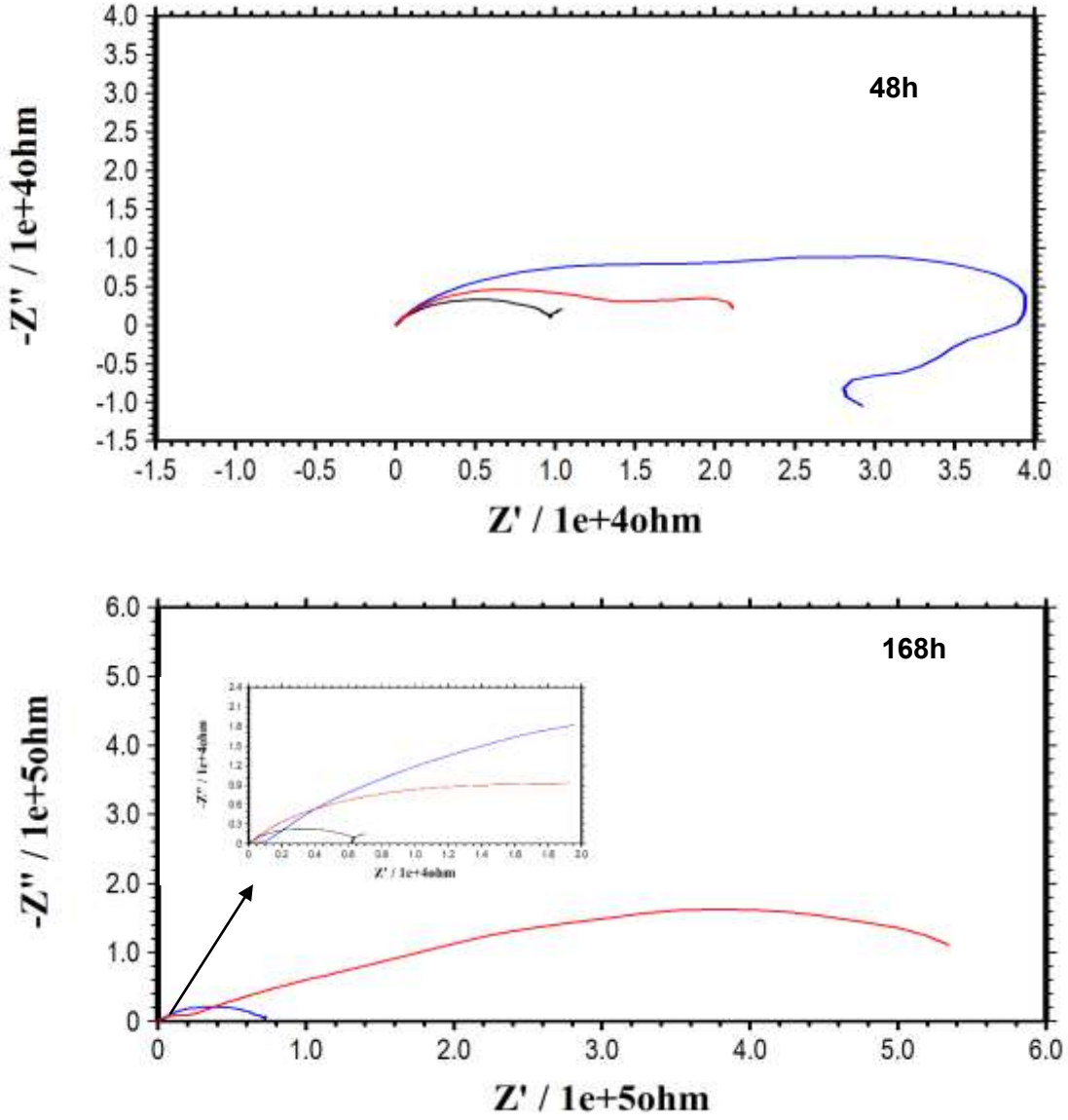
Şekil 3 de CS, CS/ZnNi ve CS/ZnNi/PANI-co-PNMP elektrotların 0.5 g/L EDTA içeren 0.50 M sodyum sülfat çözeltisindeki doğrusal taramalı voltametri (LCV) eğrileri görülmektedir. Bu eğrilerde yaklaşık olarak -1.0 V ile -0.4 V aralığında görülen eğriler Zn ve Ni'in EDTA ile kompleks oluşturmasına karşılık gelmektedir. CS için bu pik görülmeyip CS/ZnNi ve CS/ZnNi/PANI-co-PNMP elektrotlar için bu pikin görülmesi CS/ZnNi/PANI-co-PNMP

elektrot için kopolimer tabakanın altında ZnNi metalik kaplamanın bulunduğuna işaret etmektedir.



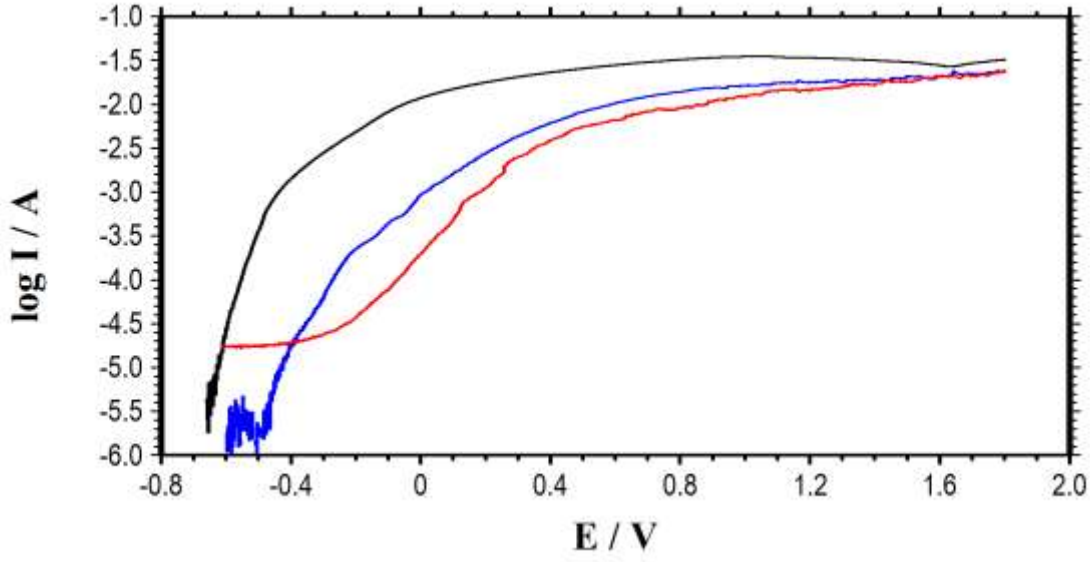
Şekil 3. CS, CS/ZnNi ve CS/ZnNi/PANI-co-PNMP elektrotların 0.5 g/L EDTA içeren 0.50 M sodyum sülfat çözeltisindeki LCV eğrileri

CS, CS/ZnNi ve CS/ZnNi/PANI-co-PNMP elektrotların 48, 96 ve 168 saatlik ölçümler sonunda elde edilen Nyquist eğrileri Şekil 4'de verilmiştir. Bu eğrilerde CS/ZnNi/PANI-co-PNMP elektrodun polarizasyon direncinin 168 saat sonunda CS ve CS/ZnNi elektrotlara göre yüksek olduğu görümektedir. Bu durum ZnNi kaplı elektrot yüzeyindeki kopolimer filmden kaynaklanmaktadır.



Şekil 4. CS, CS/ZnNi ve CS/ZnNi/PANI-co-PNMP elektrotların % 3.5'lik NaCl çözeltisinde 48, 96 ve 168 saat sonundaki Nyquist eğrileri

CS, CS/ZnNi ve CS/ZnNi/PANI-co-PNMP elektrotların % 3.5'lik NaCl çözeltisinde 168 saat sonundaki anodik polarizasyon eğrileri Şekil 5'de verilmiştir. Bu eğrilerde en düşük akım değerlerine sahip elektrodun CS/ZnNi/PANI-co-PNMP olduğu belirlemiştir. Bu durum PANI-co-PNMP kopolimer filmin etkin bariyer özelliği ile ilişkilendirilmiştir.



Şekil 5. CS, CS/ZnNi ve CS/ZnNi/PANI-co-PNMP elektrotların % 3.5'lik NaCl çözeltisinde 168 saat sonundaki anodik polarizasyon eğrileri

SONUÇLAR

Bu çalışmada poli(anilin-co-N-metilpirol) kopolimer filmi dönüşümlü voltametri tekniği ile CS/ZnNi yüzeyine sentezlenmiştir. Poli(anilin-co-N-metilpirol) kaplı CS/ZnNi elektrodun korozyon performansının CS ve CS/ZnNi elektrottan daha iyi olduğu belirlenmiştir.

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ZNFE KAPLI KARBON ÇELIK YÜZEYINDEKI POLİ(N-METİLPİROL-CO-N-METİLANİLİN)

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Özet

Poli(N-metilpirol-co-N-metilanilin), 0.02 M N-metilpirol + 0.02 M N-metilanilin içeren 0.30 M okzalik asit çözeltisinde ZnFe alaşımı kaplı karbon çelik yüzeyine dönüşümlü voltametri tekniği sentezlendi. Yüzeyine polimer film kaplı olan ZnFe kaplı karbon çelik elektrodun karakterizasyonu AC empedans spektroskopisi, doğrusal taramalı voltametri ve anodik polarizasyon eğrileri ile karakterize edildi. Korozyon test sonuçları poli(N-metilpirol-co-N-metilanilin)'in korozyona karşı etkili bir koruma sağlamadığını gösterdi.

Anahtar Kelimeler: Poli(N-metilpirol-co-N-metilanilin), ZnFe, korozyon, empedans

POLY(N-METHYPYRROLE-CO-N-METHYLANİLİNE) ON ZNFE PLATED CARBON STEEL

Abstract

Poly(N-methypyrrole-co-N-methylaniline) was synthesized with cyclic voltammetry technique from 0.02 M N-methylpyrrole + 0.02 M N-methylaniline containing 0.30 M oxalic acid solution on ZnFe plated carbon steel (CS) electrode. The characterization of ZnFe deposited CS electrode with copolymer film in 3.5% NaCl solution was investigated with AC impedance spectroscopy technique, linear sweep voltammetry, and anodic polarization curves. Corrosion test results have shown that Poly(N-methylpyrrole-co-N-methylaniline) does not provide effective corrosion protection.

Keywords: Poly(N-methypyrrole-co-N-methylaniline), ZnFe, corrosion, impedance

1.GİRİŞ

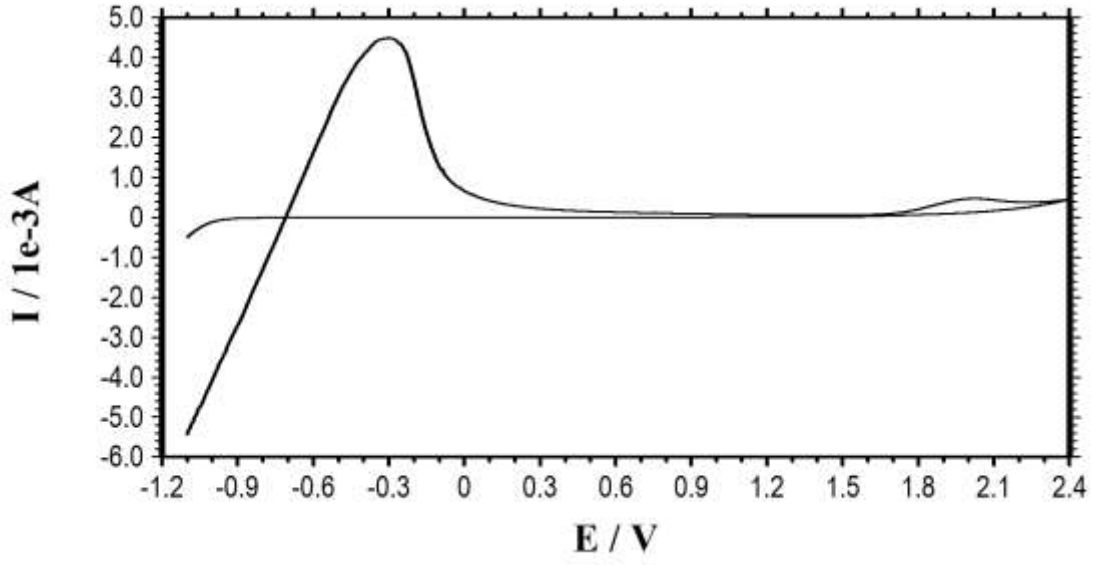
Çinko kaplama çeliğin korozyonunu önlemede kullanılan metalik kaplamalardandır. Çinko alaşımları ile çeliğin korozyonunu önleme üzerine yapılan çalışmalar yalın çinko ile yapılan kaplamalara göre daha iyi olabilmektedir [1-5]. Son yıllarda bu alaşım kaplamaların yüzeyinin iletken polimer filmlerle kaplanıp daha iyi koruma sağlamaya yönelik olan çalışmalar yapılmaktadır [6-7]. Bu çalışmada karbon çeliğinin önce ZnFe alaşımı ile kaplanması daha sonra kaplı olan bu yüzeye poli(N-metilpirol-co-N-metilanilin) filmi sentezlenerek antikorozif özelliğinin incelenmesi amaçlanmıştır.

2. MATERYAL VE METOD

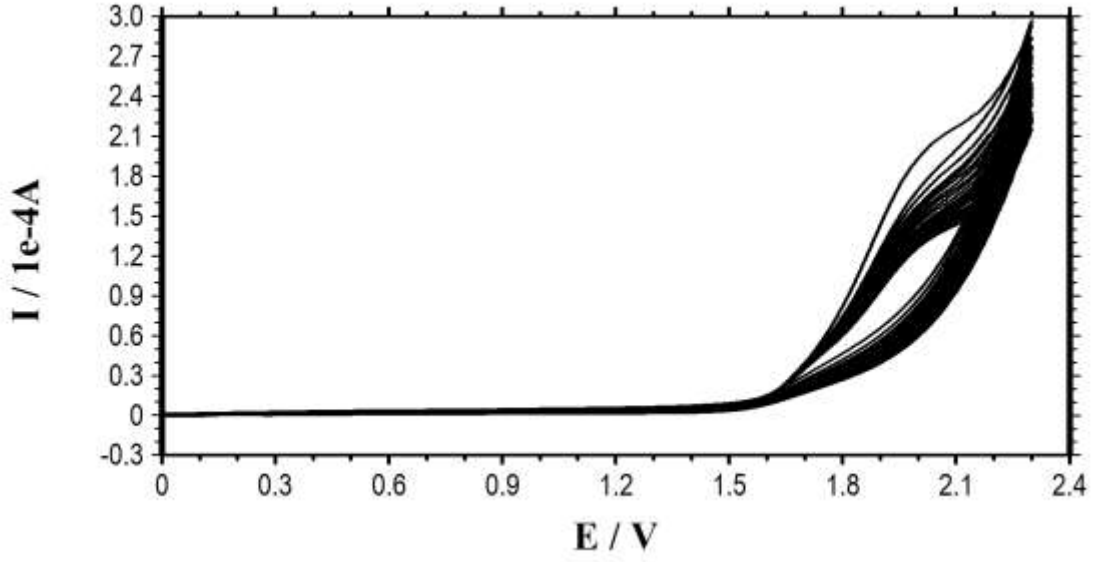
Elektrokimyasal çalışmalar CHI660E cihazı kullanılarak üç elektrot tekniği ile tek hücrede yapılmıştır. Karşı elektrot platin, referans elektrot ise Ag/AgCl'dür. ZnFe kaplama banyosunun ph'ı 4 olup banyo bileşimi kütlece % 23.14 $ZnSO_4$, 10.93 $FeSO_4$, 24.97 $Na_3C_6H_5O$, 15.98 H_3BO_3, 24.97 glisin içermektedir [8]. Poli(N-metilpirol-co-N-metilanilin) (PNMP-co-PNMA) sentezi 0.30 M okzalik asit çözeltisinde dönüşümlü voltametri tekniği kullanılarak gerçekleştirilmiştir. Elektrokimyasal empedans apektroskopisi ölçümleri elektrotların % 3,5'lik NaCl çözeltisine daldırılmasından sonra açık devre potansiyellerinin dengeye ulaşmasının ardından 10^5 Hz ile 10^{-3} Hz frekans aralığında 7 mV genlik kullanılarak gerçekleştirilmiştir.

3. BULGULAR VE TARTIŞMA

ZnFe kaplı CS elektrodun 0.02 M N-metilpirol + 0.02 M N-metilanilin içeren 0.30 M okzalik asit çözeltisindeki dönüşümlü voltammogram eğrileri Şekil 1 ve Şekil 2'de verilmiştir. Şekil 1'de -0.90 V ile 0.80 V potansiyel aralığında görülen pik oksidasyon/pasivasyon piki olup elektrot yüzeyindeki çinko ve demirin çözünmesi ve çözünen iyonların elektrolit çözeltideki okzalat iyonlarıyla birleşmesi sonucu yüzeyin pasifleşmesine karşılık gelmektedir. Şekil 2 dar potansiyel aralığında sentez için elde edilen film gelişim eğrilerini göstermektedir.

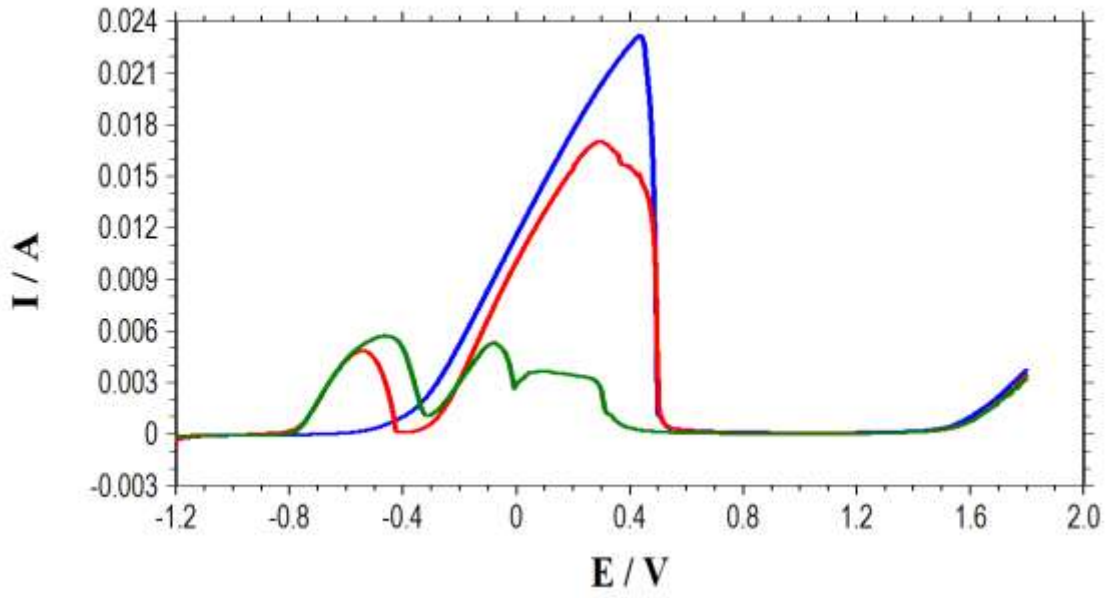


Şekil 1. ZnFe kaplı karbon çelik elektrodun 0.02 M N-metilpirol + 0.02 M N-metilanilin içeren 0.30 M okzalik asit çözeltisindeki birinci voltammogram eğrisi



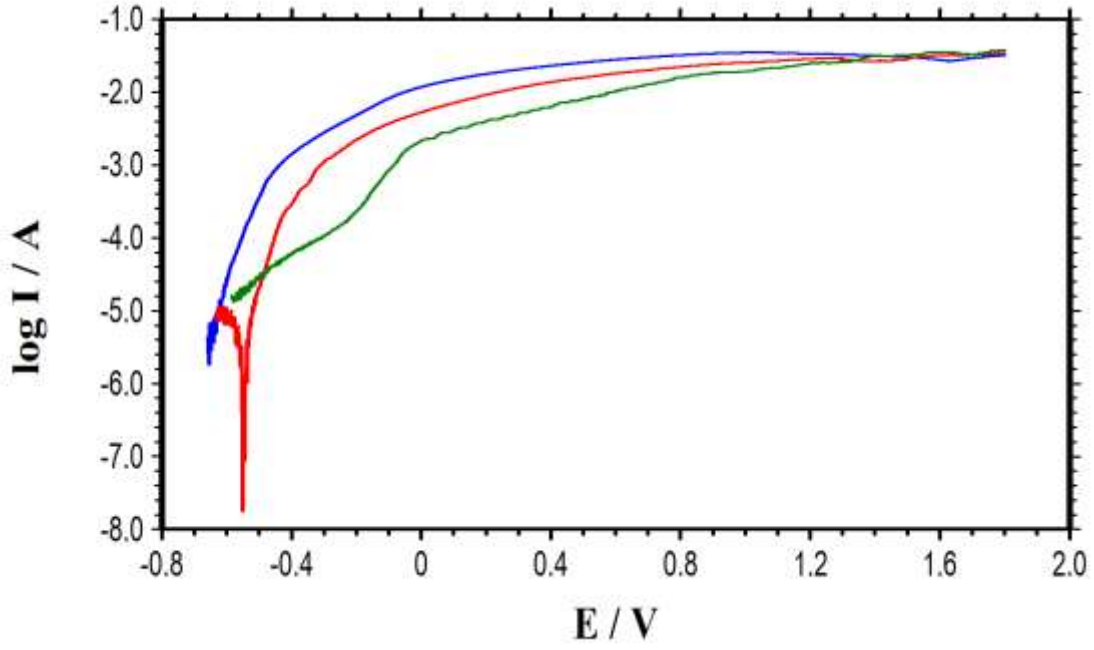
Şekil 2. ZnFe kaplı CS elektrodun 0.02 M N-metilpirol + 0.02 M N-metilanilin içeren 0.30 M okzalik asit çözeltisindeki film gelişim eğrileri

CS, CS/ZnFe ve CS/ZnFe/PNMP-co-PNMA elektrotların 0.05 M EDTA içeren 0.50 M sodyum sülfat çözeltisindeki doğrusal taramalı voltametri eğrileri Şekil 3'de verilmiştir. Şekil 3'deki eğrilerde CS/ZnFe ve CS/ZnFe/ PNMP-co-PNMA için yaklaşık -0.80 ile -0.35 V arasında görülen pikler çözünen çinkonun EDTA ile kompleks yapmasına karşılık gelen piklerdir. Bu pik CS elektrot için görülmemiştir. Bu durum kopolimer kaplı elektrodun altında metalik kaplamanın olduğunu göstermektedir.



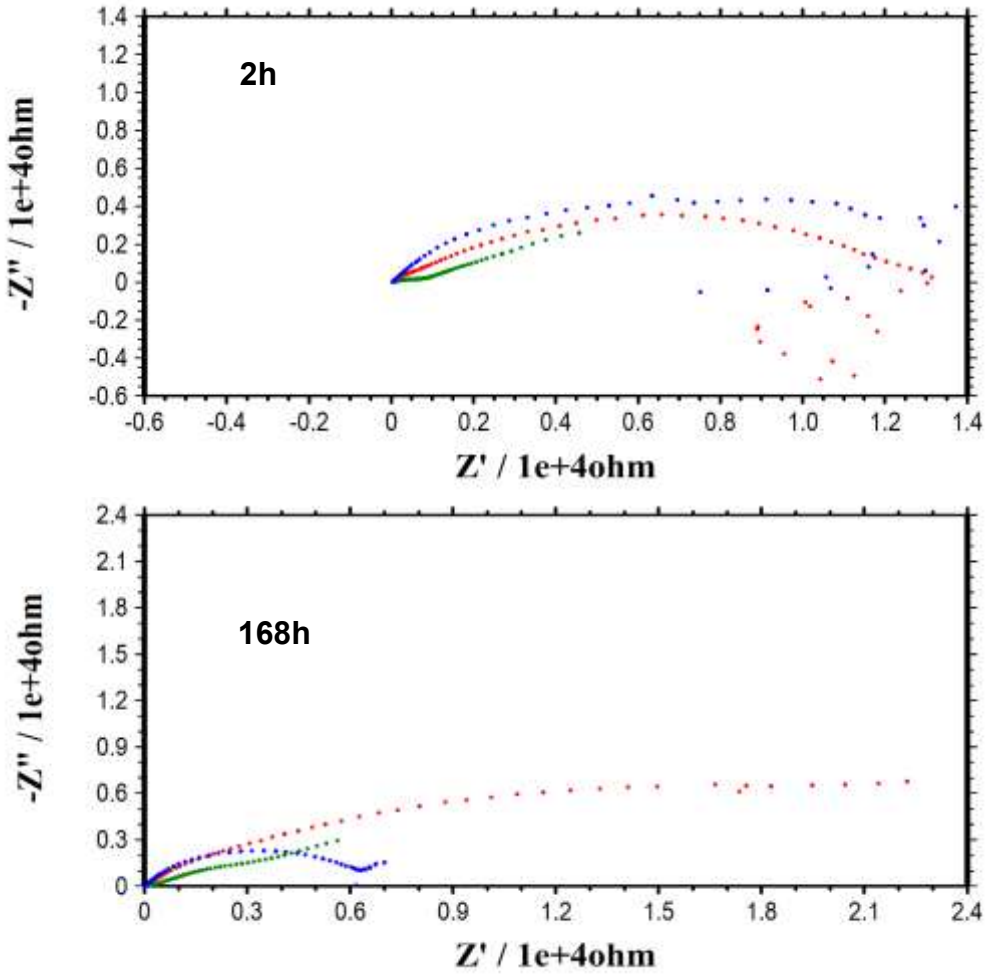
Şekil 3. CS, CS/ZnFe ve CS/ZnFe/PNMP-co-PNMA elektrotların 0.05 M EDTA içeren 0.50 M sodyum sülfat çözeltisindeki doğrusal taramalı voltametri eğrileri

CS, CS/ZnFe ve CS/ZnFe/PNMP-co-PNMA elektrotların korozif ortamda 168 saat bekledikten sonraki anodik polarizasyon eğrileri Şekil 4'de verilmiştir. Şekil 4'deki anodik polarizasyon eğrilerinde CS/ZnFe/PNMP-co-PNMA elektrodun akım değerlerinin CS elektrottan düşük olduğu görülmüştür.



Şekil 4. CS, CS/ZnFe ve CS/ZnFe/PNMP-co-PNMA elektrotların % 3.5'lik NaCl çözeltisinde 168 saat sonundaki anodik polarizasyon eğrileri

CS, CS/ZnFe ve CS/ZnFe/PNMP-co-PNMA elektrotların elektrokimyasal empedans spektroskopisinden elde edilen Nyquist eğrileri Şekil 5'de verilmiştir. Bu eğrilerde 168 saat sonunda CS/ZnFe/PNMP-co-PNMA elektrodun polarizasyon direncinin diğer elektrotlardan daha düşük olduğu görülmüştür. Bu durum PNMP-co-PNMA filmin etkinliğinin iyi olmadığına işaret etmektedir.



Şekil 5. CS, CS/ZnFe ve CS/ZnFe/PNMP-co-PNMA elektrotların % 3.5'lik NaCl çözeltisinde 2 ve 168 saat sonundaki Nyquist eğrileri

SONUÇLAR

Bu çalışmada CS/ZnFe yüzeyine 0.3 M okzalik asit çözeltisinde dönüşümlü voltametri tekniği ile sentezlenen PNMP-co-PNMA kaplamanın polarizasyon direncinin düşük olduğu belirlenmiştir. ZnFe kaplı CS elektrodun korozyonuna karşı etkili olmadığı tespit edilmiştir.

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SAĞLIK EĞİTİMİNDE TERS YÜZ ÖĞRENME YAKLAŞIMI: LİTERATÜR DERLEMESİ

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ÖZET

Sağlık eğitimi hem teorik bilginin hem de psikomotor becerilerin kazandırılmasını hedefleyen bir öğretim sürecidir. Bu süreçte bilginin ve becerinin etkili biçimde öğrenilmesi, kalıcı hâle getirilmesi ve doğru şekilde anlaşılması büyük önem taşımaktadır. Bu gereksinimler doğrultusunda, son yıllarda sağlık eğitiminde geleneksel öğretim yaklaşımlarının ötesine geçen çeşitli ve yenilikçi birçok öğretim yöntem, teknik ve modelleri ön plana çıkmıştır. Bu çalışmaların çıkış noktası çoğunlukla geleneksel öğrenmenin yetersiz kaldığı düşüncesinden kaynaklanmaktadır. Geleneksel öğrenme modelinde dersler öğretmen merkezli yürütülmekte ve çoğunlukla temel bilgilere odaklanılmaktadır. Üst düzey bilişsel becerilere ayrılan sürenin sınırlı olması nedeniyle bu becerilerin, öğretmen desteğiyle öğrencinin bireysel çabalarıyla geliştirilmesi beklenmektedir. Ancak öğrenme sürecinin büyük ölçüde bireysel sorumluluğa bırakılması, etkili ve kalıcı öğrenmeyi zorlaştırabilmektedir. Bu noktada etkili ve kalıcı bir öğrenme ortamı için öğrenci merkezli eğitim modelleri karşımıza çıkmaktadır. Bunlardan biri de ters yüz öğrenme modelidir. Ters yüz öğrenme modeli, geleneksel eğitim yöntemlerinin sınırlarını aşarak, öğrencilerin öğrenme sürecini daha etkin yönetmelerine olanak tanır. Ters yüz öğrenme, eğitim ortamlarını olumlu etkileyen, teknolojinin etkin kullanımı ve yüz yüze etkinliklerle öğrenmeyi kolaylaştırmaktadır. Bu modelde, öğrenci temel düzeydeki bilgiye sınıf dışında, eğitimci tarafından paylaşılan materyalleri kullanarak ulaşmakta, sınıf içi zamanı ise tartışma, uygulama ve sorun çözme gibi üst düzey becerilere ayırmaktadır. Öğrenciler geleneksel anlayışta öğrenmek için sınıfta zaman harcarken, ters yüz öğrenme modelinde sınıf içi etkinlikler için ayrılan zaman sınıf dışına taşınmaktadır. Eğitimde kullanılan yöntemlerin çeşitlendirilmesi ve öğrenci merkezli modellerin benimsenmesi, sağlık profesyonellerinin mesleki yeterliliklerini artırmada önemli bir strateji olarak karşımıza çıkmaktadır. Literatür incelendiğinde ters yüz öğrenme modeli temelli yapılan çalışmalarda modelin, bilgiyi ve beceriyi öğretmede etkili ve kalıcı bir yöntem olduğu aynı zamanda öğrenme motivasyonunu ve eğitim memnuniyetini arttırdığı sonuçları sıklıkla bildirilmektedir.

Anahtar Kelimeler: Sağlık eğitimi, ters yüz öğrenme, öğrenci

FLİPPED LEARNİNG APPROACH İN HEALTH EDUCATİON: A LİTERATURE REVİEW

ABSTRACT

Health education is a teaching process that aims to develop both theoretical knowledge and psychomotor skills. In this process, the effective learning of knowledge and skills, ensuring their retention, and achieving an accurate understanding are of great importance. In line with these needs, in recent years, a wide range of innovative teaching methods, techniques, and models that go beyond traditional instructional approaches have come to the forefront in health education. The emergence of these approaches is largely based on the view that traditional learning methods are insufficient. In the traditional learning model, courses are delivered using a teacher-centered approach and primarily focus on basic knowledge. Due to the limited time allocated to the development of higher-order cognitive skills, these skills are expected to be developed through students' individual efforts with teacher support. However, placing the responsibility for higher-level learning largely on students' individual responsibility may hinder effective and lasting learning. At this point, student-centered educational models emerge as an important approach to creating effective and sustainable learning environments, one of which is the flipped learning model. The flipped learning model goes beyond the limitations of traditional teaching methods and enables students to manage their learning processes more actively. By facilitating learning through the effective use of technology and face-to-face activities, flipped learning positively influences educational environments. In this model, students acquire basic-level knowledge outside the classroom through materials provided by the instructor, while classroom time is devoted to higher-order skills such as discussion, practice, and problem-solving. While students spend classroom time acquiring knowledge in traditional approaches, the flipped learning model shifts this process to out-of-class time, allowing in-class time to be used more effectively for active learning activities.Diversifying teaching methods and adopting student-centered models represent an important strategy for enhancing the professional competencies of healthcare professionals. A review of the literature indicates that studies based on the flipped learning model frequently report that this model is an effective and sustainable method for teaching knowledge and skills, while also increasing learning motivation and educational satisfaction.

Keywords: Health education, flipped learning, student-centered learning

1. GİRİŞ

Ters Yüz Öğrenme Modeli, teknolojinin eğitimle daha iç içe geçtiği ve yeni kuşağın öğrenme beklentilerinin değiştiği bir dönemde, öğrenciyi merkeze alan bir yaklaşım olarak öne çıkmaktadır. Günümüzde öğrencilerin ilgi, ihtiyaç ve öğrenme hızlarının birbirinden farklılaşması, eğitimin daha bireysel hâle gelmesini zorunlu kılmakta; bu durum da öğrenme sürecini teknolojiyle destekleyen modellere olan gereksinimi artırmaktadır. Öğrencinin kendi öğrenme sorumluluğunu üstlenmesine olanak tanıyan Ters Yüz Öğrenme Modeli, bu gereksinimlere yanıt vermesi nedeniyle giderek daha fazla benimsenmiş ve pek çok alanda eğitim programlarına dâhil edilmiştir (Hayirsever & Orhan, 2018). Özellikle sağlık eğitiminde, sınıf içi zamanın daha verimli kullanılması, bilginin kalıcılığının artması, aktif ve keyifli öğrenmenin desteklenmesi ve ders materyallerine istenildiği zaman erişilebilmesi gibi avantajları sayesinde son yıllarda kullanımının belirgin biçimde arttığı görülmektedir.

2. TERS YÜZ ÖĞRENME MODELİ

Ters Yüz Öğrenme Modeli, öğrencilerin konu anlatımını ders öncesinde video, sunum ya da dijital içerikler aracılığıyla öğrenmesini, sınıf içi zamanı ise soru-cevap, tartışma ve uygulamaya dayalı etkinliklerle geçirmesini esas alan bir öğretim yaklaşımıdır. Bu modelde öğrenci kendi öğrenme hızını yönetirken, öğretmen sınıf içinde rehberlik eden ve öğrenmeyi derinleştiren bir rol üstlenir. Böylece dersler daha aktif, anlaşılır ve kalıcı hâle gelir. Ters yüz öğrenme modelinin sağlık eğitiminde kullanılabilmesi için modelin uygulama Ters Yüz Öğrenme Modelinin sağlık eğitiminde etkili biçimde kullanılabilmesi için planlama, uygulama ve değerlendirme aşamalarının bilinçli ve uyumlu şekilde yürütülmesi gerekmektedir (Toykok ve ark., 2021). Planlama aşamasında eğitimci, öğrenci grubunun bilişsel düzeyi, öğrenme stilleri, motivasyonu ve teknolojiye erişimini dikkate alarak öğretim hedeflerini ve içerik kapsamını belirlemeli; bu hedeflere uygun sınıf dışı ve sınıf içi materyal ile dijital platformları seçmelidir (Toykok ve ark, 2021). Uygulama süreci, öğrencilerin temel bilgilere kendi hızlarında erişebildiği sınıf dışı etkinliklerle başlamakta ve sınıf içinde vaka analizleri, tartışmalar ve uygulamaya dayalı etkinliklerle derinleştirilmektedir; bu kapsamda kısa ve etkileşimli materyallerin kullanılması, ilerleme raporlarının izlenmesi ve Web 2.0 araçlarından yararlanılması önerilmektedir (Danver, 2016; Bredow ve ark., 2021; Eyikara, 2021). Değerlendirme aşamasında ise öğrenme çıktılarının belirlenmesi amacıyla ön test–son test uygulamaları, beceri testleri ve platform verilerinin yanı sıra öğrenci geri bildirimlerinin dikkate

alınması, eğitimin etkililiğinin ortaya konulması ve gelecekteki uygulamaların geliştirilmesine katkı sağlamaktadır (Long ve ark., 2017; Torres-Martín ve ark., 2022; Talbert, 2017).

3. MODELİN SAĞLIK EĞİTİMİNDE KULLANIMI

Sağlık bilimleri eğitiminde ters yüz öğrenme modelinin uygulanmasının, öğrencilerin akademik başarılarını ve eğitimden duydukları memnuniyeti artırdığı birçok çalışmada vurgulanmaktadır. Bu konuda en kapsamlı kanıtlardan biri, 28 çalışmayı kapsayan meta-analizinde sunulmuş, ters yüz öğrenme yaklaşımının geleneksel öğretim yöntemlerine kıyasla öğrenme çıktıları üzerinde anlamlı düzeyde daha etkili olduğu bildirilmiştir (Hew ve Lo 2018). Hemşirelik öğrencileriyle yapılan bireysel çalışmada, ters yüz öğrenme modeli uygulanan öğrencilerin akademik başarılarının ve eğitim memnuniyetlerinin geleneksel yöntemle eğitim alan öğrencilere göre daha yüksek olduğu belirlenmiştir (Kim ve Jang 2017). Benzer şekilde 151 hemşirelik öğrencisinin dahil edildiği çalışmada tters yüz öğrenme grubunda öğrencilerin motivasyonlarının, öğrenme kapasitelerinin ve eğitim memnuniyetlerinin anlamlı biçimde arttığı saptanmıştır (Yung-Su Kim'in 2024). 37 ebelik öğrencisiyle yürütülen başka bir araştırmada, temel tıp bilimleri derslerinde ters yüz öğrenme yönteminin akademik başarıyı ve eğitim memnuniyetini artırdığı bildirilmiştir (Oktorina ve ark., 2023). Benzer şekilde, 90 ebelik öğrencisiyle yapılan çalışmada, temel doğum bakımı öğretiminde ters yüz öğrenme modelinin öğrencilerin öğrenme düzeylerini anlamlı ölçüde yükselttiği belirlenmiştir (Hamzah ve ark., 2021). Sağlık eğitimi alanındaki mevcut literatür incelendiğinde, ters yüz öğrenme modelinin öğrenciler tarafından benimsendiği, öğrenmeyi ve öğrenme isteğini pekiştirdiği ve yeni nesilin öğrenme ihtiyaçlarına cevap veren öğrenci bir model olduğu görülmektedir (Francis ve O'Brien, 2019; Hamzah ve ark., 2021; Ilgaz, 2023; Kim ve Jang, 2017; Kim, 2024; Oktorina ve ark., 2023)

4. SONUÇ

Ters Yüz Öğrenme Modeli, sağlık eğitiminde öğrenme sürecini daha anlamlı ve etkili hâle getiren güçlü bir yaklaşım sunmaktadır. Öğrencilerin bilgiyi kendi hızlarında edinmelerine ve sınıf içinde bu bilgiyi aktif olarak kullanmalarına olanak tanıması hem öğrenmenin kalıcılığını artırmakta hem de mesleki becerilerin gelişimini desteklemektedir. Bu yönüyle model, sağlık eğitiminde öğrenci merkezli ve nitelikli öğrenme ortamlarının oluşturulmasına önemli katkılar sağlayacağı düşünülmektedir.

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KLİNİK BECERİ EĞİTİMİNDE YAPILANDIRILMIŞ ÖĞRETİM MODELLERİ: PEYTON'UN DÖRT ADIMLI ÖĞRETİM MODELİ

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ÖZET

Sağlık meslekleri eğitiminde klinik beceriler uzun yıllardır "bir gör, bir yap" yaklaşımı ile öğretilmektedir. Bu geleneksel yöntemde öğrencilerden, beceriyi bir kez gözlemlendikten sonra uygulamaları beklenmektedir. Karmaşık becerilerin bir kere gözlenmesi ya da uygulanmasıyla öğrenme yeterli düzeyde olmamakta ve hasta güvenliği riske girmektedir. Ayrıca bu yöntem aktif katılım gibi yetişkin eğitimi ilkelerini içermemektedir. Geleneksel yöntemle eğitim alan öğrencilerin klinik becerileri etkili, yeterli ve özgüvenli biçimde uygulamakta zorlandıkları bildirilmektedir. Bu durum ise klinik beceri eğitiminde öğrencilerin çoklu gözlem, uygulama temelli öğrenme ve öğrenilenlerden çıkarım yapmayı destekleyecek yapılandırılmış eğitim yaklaşımlarına olan gereksinimi göstermektedir. Rol play, simülasyona dayalı eğitimler ve gerçek hasta uygulamaları gibi birçok yöntem yaygın olarak kullanılmakla beraber aktif öğrenmeyi destekleyen yapılandırılmış öğretim modellerine ilgi artmıştır. Son yıllarda karmaşık becerilerin öğretiminde yapılandırılmış bir yöntem olan Peyton'un Dört Adımlı Öğretim Modeli sıklıkla kullanılmaya başlanmıştır. Peyton Modeli gösterim/izleme, açıklama/yapı bozum, anlama ve uygulama/değerlendirme olmak üzere dört adımdan oluşmaktadır. Modelin ilk adımında, eğitimci herhangi bir açıklama yapmaksızın uygulamanın tüm basamaklarını gösterir. Öğrenci ise süreci gözlemler. Modelin ikinci adımında, eğitimci tüm uygulama basamaklarını gerekçeleriyle birlikte açıklayarak uygular. Üçüncü adımda, öğrenciler eğitimciyi yönlendirerek uygulama tekrar edilir. Modelin son adımında ise öğrenciler beceriyi uygular ve eğitimci öğrenciyi değerlendirir. Bu model, bilişsel ve psikomotor öğrenmeyi destekleyerek kalıcı öğrenmenin sağlanmasını amaçlamaktadır. Literatür incelendiğinde tıp, hemşirelik ve kadın doğum alanlarında yapılan çalışmalar, Peyton Modelinin hızlı ve kalıcı öğrenmeyi, başarıyı, beceri düzeyini, özgüveni ve eğitim memnuniyetini artırdığını göstermektedir.

Anahtar Kelimeler: Sağlık eğitimi, beceri eğitimi, Peyton Modelİ

STRUCTURED INSTRUCTIONAL APPROACHES IN CLINICAL SKILLS TRAINING: PEYTON'S FOUR-STEP TEACHING MODEL

ABSTRACT

Clinical skills in health professions education have long been taught using the "see one, do one" approach. In this traditional method, students are expected to perform a skill after observing it only once. However, observing or performing complex skills a single time is insufficient for achieving an adequate level of learning and may place patient safety at risk. Moreover, this approach does not incorporate adult learning principles such as active participation. It has been reported that students trained using traditional methods experience difficulties in performing clinical skills effectively, competently, and with confidence. This situation highlights the need for structured educational approaches in clinical skills training that support multiple observations, practice-based learning, and reflection on learning experiences. Although various methods such as role play, simulation-based education, and real patient practice are widely used, interest in structured teaching models that promote active learning has increased. In recent years, Peyton's Four-Step Teaching Model, a structured approach for teaching complex skills, has been increasingly utilized. The Peyton Model consists of four steps: demonstration/observation, deconstruction/explanation, comprehension, and performance/evaluation. In the first step, the instructor demonstrates all steps of the procedure without providing any explanation, while the student observes the process. In the second step, the instructor performs the procedure again, explaining each step along with its rationale. In the third step, the student guides the instructor through the procedure, prompting its repetition. In the final step, the student performs the skill independently, and the instructor evaluates the performance. This model aims to promote lasting learning by supporting both cognitive and psychomotor learning processes. A review of the literature indicates that studies conducted in medicine, nursing, and midwifery have demonstrated that the Peyton Model enhances rapid and sustained learning, academic achievement, skill performance, self-confidence, and learner satisfaction.

Keywords: Health education, skills training, Peyton Model

1.GİRİŞ

Sağlık meslekleri eğitiminde klinik becerilerin kazanımı mesleki yeterliliğin temel bileşenidir. Klinik beceriler "bir sağlık profesyoneli tarafından doğrudan hasta bakımını içeren veya hasta bakımını etkileyen eylemler" olarak tanımlanmaktadır. Bu kapsamda tanım; hasta öyküsü alma, fizik muayene yapma, klinik değerlendirme ve tanısal akıl yürütme, klinik prosedürleri

yetkinlikle uygulama, etkili iletişim, ekip çalışması ve profesyonel tutumu gibi unsurlar temel bileşenler içerisinde yer almaktadır (Emam ve ark., 2024). Psikomotor uygulama temelli bu becerilerin geliştirilmesi, eğitim sürecinin etkinliğinin artmasına ve dolaylı olarak hasta sonuçlarının iyileşmesine katkı sağlamaktadır (Breuning ve ark., 2025).

1.1.Geleneksel Klinik Beceri Öğretim Yaklaşımları ve Sınırlılıkları

Sağlık meslekleri programlarında psikomotor beceri eğitiminde, Dr. Halsted tarafından önerilen ve yaygın olarak kullanılan "gör-yap" yaklaşımı benimsenmektedir (Breuning ve ark., 2025; Giacomino ve ark., 2020). Bu geleneksel yaklaşımda, beceri eğitimi iki temel aşamadan oluşmaktadır. İlk aşamada, beceri eğitimci tarafından gösterim yoluyla sunulmakta, beceriler sınırlı yorum veya öğretimle gösterilmektedir. İkinci aşamada ise öğrenciler beceriyi uygularken eş zamanlı olarak eğitmenden geri bildirim almaktadır (Breuning ve ark., 2025). Bu yaklaşımda öğrencilerden, beceriler bir kez gözlemlendikten sonra uygulaması beklenmektedir. Halsted yaklaşımı eğitimde sıklıkla kullanılmaya devam edilse de aktif öğrenme basamaklarını yeterince içermediğinden dolayı yetişkin eğitimiyle örtüşmediği düşünülmektedir. Bunun yanında özellikle karmaşık becerilerin bir kez gözlemlenmesi veya uygulanmasının öğrenme için yeterli olmadığı ve bu durumun hasta güvenliği açısından risk oluşturabileceği düşünülmektedir (Giacomino ve ark., 2025). Bu durumun aksine, beceri kazanımının ve uzun vadeli kalıcılığın sağlanması, tekrarlanan ve bilinçli uygulamaları içeren yapılandırılmış bir öğrenme sürecini gerektirmektedir (Breuning ve ark., 2025; Sherif ve ark., 2025). Öğrencilerin beceriyi bir kere görüp uygulamasına dayalı yaklaşımlar yerine "birçok kez görme, sonuçlardan öğrenme ve birçok kez yapma" ilkelerini vurgulayacak şekilde yapılandırılmış yaklaşımlar gerekmektedir. Bu tür yaklaşımlarla, klinik beceriler daha iyi öğrenilecek ve kalıcılığı daha iyi sağlanacaktır (Emam ev ark., 2024).

1.2.Klinik Beceri Öğretiminde Yapılandırılmış Modeller

Beceri eğitiminde motor süreçlerin etkili biçimde öğrenilmesi ve tekrarlanabilirliğin en üst düzeyde olması için, eğitmenlerin benimseyebileceği, öğrencilerin kabul gördüğü ve sürdürülebilir öğrenme çıktıları sağlayan öğretim yöntemlerine ihtiyaç vardır (Münster ve ark., 2026; Leitmann ve ark., 2020). Bu doğrultuda, becerilerin kazanımını desteklemek amacıyla çeşitli öğretim modelleri geliştirilmiştir. Prosedürel becerilerin kazanımını artırmak amacıyla beceri laboratuvarları, rol yapma, simülasyon temelli öğrenme ve yatak başı uygulamalar gibi çeşitli öğretim teknikleri kullanılmaktadır. Beceri öğretimde yaygın olarak kullanılan bir diğer teknik ise Peyton Modeli'dir. Modelde yapılandırmacı yaklaşımla becerinin gözlenmesi ve

davranışçı yaklaşımla geri bildirim ve tekrarlanması birleştirilerek öğrenme sürecini güçlendirmektedir (Emam ve ark., 2024).. Bu derlemenin amacı, sağlık meslekleri eğitiminde klinik ve psikomotor becerilerin öğretiminde Peyton'un dört aşamalı öğretim modelinin kuramsal temellerini, uygulama basamaklarını ve etkililiğine ilişkin güncel literatürü incelemektir.

2.PEYTON MODELİ VE DÖRT AŞAMALI ÖĞRETİM SÜRECİ

Peyton Modeli son yıllarda sağlık eğitiminde becerilerin öğretimi için popülerlik kazanmıştır (Cenaj ve ark., 2025). Walker ve Peyton (1998) tarafından becerilerin kazanılmasına yönelik bir öğretim yaklaşımı olarak sunulan bu model, birbirini izleyen 4 aşamadan oluşmaktadır.

- Birinci Adım (gösterim): Bu aşamada eğitmen, beceriyi normal hızda ve herhangi bir açıklama yapmadan baştan sona uygular.
- İkinci Adım (Yapı Bozum): Eğitmen, beceri adımlarını yeniden uygularken her adımı ayrıntılı biçimde açıklar. Bu sayede beceriler daha küçük ve anlaşılır alt bölümlere ayrılarak öğrenme kolaylaşır.
- Üçüncü Adım (Anlama): Öğrenci, becerinin her bir basamağını sözel olarak ifade eder ve eğitmeni yönlendirir. Eğitmen ise öğrencinin yönlendirmesi doğrultusunda beceriyi uygular.
- Dördüncü Adım (Uygulama): Öğrenci, beceri adımlarını açıklayarak bağımsız biçimde uygular. Eğitmen öğrencinin performansını değerlendirir ve geri bildirim yapar (Giacomino ve ark., 2020; Münster ve ark., 2016; Cenaj ve ark., 2025).

Modelin ilk iki adımı sosyal öğrenme kuramına dayanmakta ve daha az karmaşık becerilerin kazandırılmasını desteklemektedir. Ancak karmaşık becerilerin kazandırılmasında bağlamsallaştırma ve teorik bilginin pratik davranışlara dönüştürülmesi kapasitesinin geliştirilmesi gerekmektedir (Cenaj ve ark., 2025). Bu kazanım ise modelin 3. adımı ile hızlandırılmaktadır. Modelin en önemli adımı olarak kabul edilen 3. adımda yönlendirme süreci öğrencinin ilk iki adımı hatırlamasını ve beceri kazanımın pekişmesini sağlar (Giacomino ve ark., 2020; Leitmann ve ark., 2020).

İlk iki adımda öğrenci bilgiyi izler ve algılar bu durum ise bilginin pasif olarak edilnilmesini sağlar. Ancak bu şekilde öğrenilen bilgi kalıcı öğrenme için yeterli değildir (Münster ve ark., 2016). Üçüncü adımda, öğrenciler aktif bir fiziksel hareket olmaksızın becerinin zihinsel bir temsilini geliştirme olanağı bulur ve süreç zihinsel uygulama unsurları içerir. Bilgiler, çalışma

belleğinde aktif olarak işlenir. Bu aktif zihinsel işlem sayesinde bilgileri organize eder, depolar ve uzun süreli belleğe iletir (Münster ve ark., 2016; Giacomino ve ark., 2020). Bu adımda öğrenci öğrenmesi beklenen beceri üzerinde derinlemesine düşünme ve aktif hatırlama sürecine katılması teşvik edilerek bilginin kalıcılığı artmaktadır (Cenaj ve ark., 2025). Dördüncü adım da modelin önemli adımlarından birisidir. Bu adımda, eğitmen öğrenciye yapılandırılmış geri bildirimlerde bulunarak öğrenme sürecini ve beceri performansının geliştirilmesini destekler (Giacomino ve ark., 2020). Seifert ve arkadaşlarının (2020), cerrahi beceri kazanımı için Peyton ve geleneksel modelinin video tabanlı versiyonlarını karşılaştırdıkları randomize kontrollü çalışmada Peyton modelinin, özellikle karmaşık prosedürel beceriler için kısa vadeli öğrenme sonuçlarını önemli ölçüde iyileştirdiğini saptanmıştır (Seifert ve ark., 2020). Peyton Modeli ve geleneksel yöntemin karşılaştırıldığı bir başka randomize kontrollü çalışmada yatak başı ultrason psikomotor becerilerinin öğretimindeki etkisi incelenmiştir. Beceri eğitiminden 1 hafta, 1 ay ve 4 ay sonra gruplar arasında kalp, akciğer ve böbrek gibi daha karmaşık ultrason uygulamalarında Peyton grubunda daha yüksek puanlar elde edildiği bildirilmiştir. Ancak mesane ultrasonu gibi daha basit becerilerde fark olmadığı saptanmıştır (Breuning ve ark., 2025). Hemşirelik öğrencilerinde de Peyton Modeli ile bebeklerde kardiyopulmoner resüsitasyon eğitimi sonunda da benzer şekilde öğrencilerin becerilerinin yeterli düzeye ulaştığı bildirilmiştir (El-Rahman ve ark., 2023). Oftalmolojik klinik muayene becerilerinin eğitiminde de beceri düzeylerinin Peyton modelinde klasik yönteme göre daha iyi olduğu bildirilmiştir (Nema ve ark., 2024).

2.1.Peyton Modelinin Klinik Beceri Kazanımı Üzerine Etkililiği

Peyton Modelinin birçok güçlü yönü bulunmaktadır. Model farklı öğrenme teorisi ve yöntemiyle birleştirebilir olması önemli potansiyel avantajlar sunmaktadır (Giacomino ve ark., 2020; Cenaj ve ark., 2025). Sherif ve arkadaşları (2025) Peyton'un 4 basamaklı yönteminin video ile uyarlanmış bir versiyonunu spinal ve nörolojik muayene eğitiminde değerlendirmiştir. Yöntemin öğrenciler tarafından iyi kabul edildiğini ve özgüveni anlamlı düzeyde artırdığını saptanmıştır. Aynı zamanda muayene adımlarının anlaşılmasını kolaylaştırdığı bildirilmiştir (Sherif ve ark., 2025). Cenaj ve arkadaşlarının (2025), randomize kontrollü bir simülasyon çalışmasında Peyton'un dört aşamalı öğretim yaklaşımının, geleneksel iki aşamalı yönteme kıyasla ileri düzey kardiyak yaşam desteği eğitimindeki algoritmasının uygulanmasına yönelik prosedürel becerileri ve resüsitasyon kalitesini anlamlı düzeyde artırdığı bildirmiştir (Cenaj ve ark., 2025).

Peyton Modeli beceri kazanımını artırmanın yanında öğrencilerin eğitim sürecine yönelik memnuniyetini ve özgüvenini artırmaktadır. Özgüven bireyin yeteneğine duyduğu inancı yansıtan önemli bir kavram olup sağlık hizmetlerinde hastalara güvenli ve hatasız bakım sunmada kritik bir bileşendir. Bu nedenle sağlık alanında öğretim stratejileri bilgi ve beceri kazanımıyla kalmayıp öğrencilerin özgüvenlerini de artırmaya yönelik olmalıdır (Emam ve ark., 2024). Nitekim, mezun olan öğrenciler, temel bileşenlerini anlamalarına rağmen, muayene yapma konusunda genellikle özgüven eksikliği yaşamaktadır (Sherif ve ark., 2025). Bilgisayarlı Yüz Tomografisi eğitiminde Peyton Modelinin yüz yüze ve online ortamda uygulanmasının karşılaştırıldığı çalışmada her iki yönteminde öğrencilerin özgüvenini artırdığı saptanmıştır (Yoong ve ark., 2024). Oftalmolojik klinik muayene becerilerinin eğitimini Peyton modeli ile öğrenen öğrencilerin klasik yöntemle eğitim alan öğrencilerden daha özgüvenli hissettiklerini ifade etmişlerdir (Nema ve ark., 2024).

Memnuniyet ise, bireyin doyum düzeyine ilişkin değerlendirmesini ifade etmektedir. Öğrencilerin motivasyonunu, memnuniyetini ve bir öğretim stratejisini kabul düzeyini değerlendirmede memnuniyet önemli bir bileşendir (Emam ve ark., 2024). Emam ve arkadaşlarının (2024) kadın doğum hemşireliği öğrencileriyle gerçekleştirdiği yarı deneysel çalışmada, Modifiye Peyton'un dört basamaklı öğretim yaklaşımının postpartum prosedürel beceri kazanımında özgüven ve eğitim memnuniyeti daha yüksek olduğunu bildirmiştir (Emam ve ark., 2024). Endonezyada tıp öğrencilerine COVID-19 pandemisi sırasında maske ventilasyonu ve entübasyonun temel becerilerinin öğrenilmesinde, modifiye edilmiş Peyton'ın Dört Adımlı yaklaşımı ile klasik Peyton'ın Dört Adımlı yaklaşımı arasındaki öğrenme yöntemlerinin etkinliğinin değerlendirildiği benzer bir çalışmada her iki yöntem de öğrencilerin memnuniyetini ve özgüvenini eşit düzeyde artırdığı bildirilmiştir (Heriwardito ve ark., 2023). Pediatri hemşireliği öğrencileri ile yürütülen Peyton Modelinin bebeklerde kardiyopulmoner resüsitasyon beceri kazanımı üzerinde yüksek öz-yeterlik ve öğrenme memnuniyet bildirilmiştir (El-Rahman ve ark., 2023). Bununla birlikte, Peyton Modelinin uygulanmasının daha fazla zaman gerektirmesi ve büyük öğrenci gruplarına uygulayamama sınırlılık olarak değerlendirilse de, sağladığı kalıcı öğrenme, yüksek beceri kazanımı ve artan özgüven göz önünde bulundurulduğunda bu durum pedagojik açıdan tolere edilebilir görünmektedir (Giacomino ve ark., 2020; Seifert ve ark., 2020).

3.SONUÇ

Peyton'un dört aşamalı öğretim modeli, sağlık meslekleri eğitiminde klinik becerilerin yapılandırılmış, kalıcı ve güvenli biçimde kazandırılmasını destekleyen etkili bir öğretim yaklaşımıdır. Özellikle karmaşık psikomotor becerilerin öğretiminde beceri düzeyini, özgüveni ve öğrenme memnuniyetini artırması, modelin eğitim programlarına entegre edilmesini gerekli kılmaktadır.

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COVİD-19 KORKUSUNUN STRES, DEPRESYON VE ANKSİYETE DÜZEYLERİNE ETKİSİ ÜZERİNE BİR ARAŞTIRMA[39]

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ÖZET

COVID-19, SARS-CoV-2 adlı koronavirüsün yol açtığı, ilk kez Çin'de Wuhan'da Aralık 2019 tarihinde tespit edilen ve Dünya Sağlık Örgütü ile pandemi olarak ilan edilen ilk olarak 11 Mart 2020'de ortaya çıkan bulaşıcı bir hastalıktır. Söz konusu hastalık, pek çok meslek grubunu etkilemiş olmakla birlikte, en yoğun etkiyi sağlık çalışanları üzerinde göstermiştir. Dünya Sağlık Örgütü (2021) verilerine göre Ocak 2020 ile Mayıs 2021 tarihleri arasında 80.000 ile 180.000 sağlık çalışanının Covid-19 nedeniyle dünya genelinde yaşamını yitirdiği belirlenmiştir. Türk Tabipleri Birliği'nin raporuna göre 17 Mart 2020-28 Şubat 2022 sürecinde Covid-19 nedeniyle 506 sağlık çalışanı vefat etmiştir. Türkiye'de sağlık çalışanları arasında 120.000 Covid-19 vakası rapor edilmiştir. Çalışmamız Covid-19 korkusunun sadece pandemi sürecindeki anlık etkilerini değil, aynı zamanda sağlık çalışanlarının ruhsal durumları üzerinde kalıcı bir etki bırakıp bırakmadığını sorgulamaktadır. Bu nedenle araştırmamız pandemi sonrası süreçte sağlık çalışanlarının psikolojik iyilik hallerinin korunmasına yönelik yapılacak çalışmalara katkı sağlamayı hedeflemektedir. Çalışmanın bilimsel kaygısı var olan bilgi noksanlığını gidermek ve gelecekte benzer sağlık krizleri karşısında uygulanabilecek psikososyal destek politikalarının geliştirilmesine katkı sağlamaktır. Bu araştırmanın temel amacı, COVID-19 korkusunun sağlık çalışanlarının stres, depresyon ve anksiyete düzeylerine etkisini belirlemektir. Çalışmamızın sağlık çalışanlarının salgın hastalıklarına karşı ruhsal olarak kendini korumasına yardımcı olması bakımından önem kazanmaktadır. Çalışmamızın Sağlık Yönetimi Bilimine, Yönetim Bilimine ve Sağlık Çalışanlarına katkı sunması umut edilmektedir.

Anahtar Kelimeler: COVID 19, Stres, Depresyon, Anksiyete

[39] Bu çalışma Fethiye YAKAR'IN 2025 yılına ait "Covid-19 Korkusunun Sağlık Çalışanlarının Stres, Depresyon ve Anksiyete Düzeylerine Etkisi: Tunceli İli Sağlık Çalışanları Örneği" adlı tezinden türetilmiştir.

A STUDY ON THE EFFECT OF COVID-19 FEAR ON STRESS, DEPRESSION, AND ANXIETY LEVELS[40]

ABSTRACT

COVID-19 is an infectious disease caused by the SARS-CoV-2 coronavirus, first detected in Wuhan, China in December 2019, and declared a pandemic by the World Health Organization on March 11, 2020. While the disease has affected many professional groups, it has had the most severe impact on healthcare workers. According to World Health Organization data (2021), between January 2020 and May 2021, between 80,000 and 180,000 healthcare workers worldwide lost their lives due to COVID-19. According to a report by the Turkish Medical Association, 506 healthcare workers died due to COVID-19 between March 17, 2020, and February 28, 2022. In Türkiye, 120,000 COVID-19 cases have been reported among healthcare workers. Our study investigates not only the immediate effects of COVID-19 fear during the pandemic but also whether it leaves a lasting impact on the mental health of healthcare workers. Therefore, our research aims to contribute to studies on protecting the psychological well-being of healthcare workers in the post-pandemic period. The scientific aim of the study is to address existing knowledge gaps and contribute to the development of psychosocial support policies that can be applied in similar health crises in the future. The main objective of this research is to determine the effect of COVID-19 fear on the stress, depression, and anxiety levels of healthcare workers. Our study is significant in that it helps healthcare workers protect themselves mentally against infectious diseases. It is hoped that our study will contribute to the fields of Health Management, Management Science, and Healthcare Workers.

Keywords: COVID-19, Stress, Depression, Anxiety

1. GİRİŞ

Koronavirüsler, Coronaviridae ailesine dâhil olup alfa, beta, gama ve delta olmak üzere dört temel gruba ayrılmaktadır. Bu virüsler, insanlarda ve hayvanlarda solunum, sindirim, sinir sistemi ve karaciğer üzerinde çeşitli klinik tablolara yol açabilmektedir. COVID-19, SARS-CoV ve MERS-CoV ile birlikte beta-koronavirüsler sınıfında yer almaktadır. İnsan dışında kemirgenlerde, yarasalarda, evcil ve yabani hayvanlarda da bu virüslere rastlanabilmektedir. İnsanlarda soğuk algınlığına sıkça sebep olan türler arasında HCoV-229E, HCoV-OC43, HCoV-NL63 ve HKU1-CoV bulunmaktadır. 2003 yılında tanımlanan SARS-CoV ile 2012'de

[40] This study is derived from Fethiye YAKAR's 2025 thesis entitled " The Effect of the fear of the Coronavirus on the Stress, Depression and Anxiety Levels of Healthcare Workers: A case study of healthcare workers in Tunceli province".

Suudi Arabistan'da ortaya çıkan MERS-CoV, ciddi solunum yolu enfeksiyonlarına neden olmuştur. 2019'un sonlarında Çin'in Wuhan kentinde tespit edilen yeni tip koronavirüs (2019-nCoV) ise sonrasında COVID-19 olarak adlandırılmıştır (URL-1, 2024). Türkiye'de ilk vaka 11 Mart 2020'de kaydedilmiş, Sağlık Bakanlığı Bilim Kurulu ise bu tarihten önce 22 Ocak'ta toplanarak koruyucu tedbirleri uygulamaya koymuştur(URL-2, 2024). COVID-19 pandemisi, tüm meslek gruplarını etkilediği gibi sağlık çalışanlarını da hem fiziksel hem de ruhsal açıdan ciddi biçimde zorlamıştır. Dünya Sağlık Örgütü (2021) verilerine göre Ocak 2020-Mayıs 2021 sürecinde 80.000 ile 180.000 sağlık çalışanı vefat etmiştir. Türk Tabipleri Birliği'nin raporuna göre 17 Mart 2020-28 Şubat 2022 sürecinde Covid-19 nedeniyle 506 sağlık çalışanı vefat etmiştir. Bu araştırmanın temel amacı, Tunceli ili örneğinde sağlık çalışanlarında COVID-19 kaynaklı korkunun depresyon, kaygı ve stres düzeylerine olan etkisini incelemektir. Elde edilen veriler, COVID-19'un sağlık çalışanları arasında belirgin bir korku oluşturduğunu ve bu korkunun psikolojik baskı düzeylerini artırdığını ortaya koymuştur. Araştırmada yanıt aranan sorulardan ilki "COVID-19 sağlık çalışanlarını korkutuyor mu?", ikincisi ise "COVID-19 korkusu ile depresyon, anksiyete ve stres düzeyleri arasında anlamlı bir ilişki var mı?" şeklinde belirlenmiştir. Yapılan analizler, sağlık çalışanlarının COVID-19'dan korktuğunu ve bu korkunun stres, depresyon ile anksiyete düzeyleriyle doğrudan bağlantılı olduğunu göstermiştir.

2. COVİD-19

Koronavirüsler (CoV), Nidovirales takımı Coronaviridae ailesi içerisinde bulunan zoonotik etkenli alfa, beta, gama ve delta olmak üzere dört gruba ayrılan bir virüstür. Alfa türünden olan koronavirüsler insanlarda üst solunum enfeksiyonuna neden olmaktadır. 30Kb boyutuna yakın olan bu genom, en uzun viral RNA genomlarından biridir (Tanrıverdi vd, 2020). Bulaş süresi çok hızlı olan bu hastalığa Covid-19 adı verilmiştir. Çinli bilim adamları tarafından izole edilerek '2019-nCoV' olarak adlandırmışlardır. Tayland'da 13 Ocak'ta ilk importe vakası görülmüş sonrasında Japonya, Güney Kore ve Amerika' da vakalar olmaya başlamıştır.

Ülkemizde 11 Mart'ta ilk pozitif vaka saptanmıştır. Covid-19'u DSÖ pandemi olarak ilan etmiştir. SARS-CoV-2 ile enfekte kişi sayısı, 2 Nisan 2020 DSÖ verilerine göre 1 milyonu geçmiş ve 50 binden fazla insan bu nedenle vefat etmiştir. Antartika'da vakaya rastlanılmazken diğer kıtalarda vaka sayıları ve ölümler artış göstermiştir.

Salgın Çin'de başlamasına rağmen ülke sınırlarında kalması sağlanmıştır. Ocak ayının sonu ile Şubat ayının başında en üst seviyeye ulaşmışken yeni vaka oranları Mart ayı itibariyle düşüşe geçmiştir. Çin'de Mart ayının sonunda 3318 kişi vefat etmiştir. Toplam vaka sayısı ise

81.589'dur.Vaka sayısının en yüksek olduğu ülkeler; Amerika (244bin) , İtalya (115bin) , İspanya (112bin)'dır. 13915 kişinin hayatını kaybettiği İtalya kayıp vakalarında ilk sırada yer almıştır. Ülkemizde vaka sayısı 18.135 ve bu hastalıktan ötürü yaşanan kayıp sayısı 356'dır (Dikmen vd, 2020). SARS-COV ile gen dizilimi benzer olduğu için yeni koronavirüsünün adı tıp literatüründe SARS-COV-2 olarak yer almaktadır. Çin'in Wuhan eyaletindeki canlı hayvan satışının yapıldığı bir pazardan tüm dünyaya yayılım gösterdiği düşünülmektedir. Pandemiye dönüşmesi halinde virüsün kaynağı virüs ile enfekte olan semptomatik ve asemptomatik insanlardır.

Covid-19 virüsünün bulaşma yolları daha çok hava yolu, damlacık, temas yolu, su-gıda, kan ve plazma gibi ara kaynaklar aracılığıyla sınıflandırılır. Bulaşma yolu enfeksiyon etkeninin kaynaktan konakçıya geçişi ile gerçekleşmektedir. Hasta kişilerin hapşırma, öksürme, konuşma ile ortama saçılan salgılarının damlacık yoluyla alınmasıyla bulaşmakta ve bu damlacıklara temas etmiş duyarlı kişilerin hijyene dikkat etmemesi halinde enfeksiyon bulaşabilir. Semptom olmayan kişilerin solunum yollarında da virus tespiti olduğu zaman bu kişilerde virus bulaştırabilirler(URL-4). Kuluçka süresi; virüsün bulaşması ile belirtilerinin olması arasındaki süredir. Hükümet yetkilileri ve sağlık uzmanları salgın hastalık dönemlerinde kuluçka süresini enfekte kişilerin diğer insanlardan uzak kalması gereken süre zarfı için kullanmaktadır. Covid-19 virüsünün vücuda girmesinden sonraki kuluçka süresi 2 ile 14 olarak bilinmektedir. SARS-CoV-2 ile enfekte olan insanların %97'sinden fazlası temas sonrası 11 gün içerisinde belirti vermiştir. Yapılan araştırmalar neticesinde yeni enfekte olmuş bir kişide semptomların temas sonrası en fazla 5 gün içerisinde olduğunu göstermiştir. Bazı durumlarda semptomların belirti göstermesi 14 günü aşkında olabilmektedir (URL-5, 2024).

3. COVID-19 KORKUSU

Pandemi nedeniyle ortaya çıkan korku, ebeveynlerin anksiyete ve stres düzeyini arttırırken, öncesinde ruhsal problemleri olan kişilerin semptomlarını daha da yoğunlaştırmıştır. Covid-19 korkusu üzerine yapılan bir araştırmada ebeveynlerin %64'ünün korktuğu saptanmıştır (Samuel ve diğerleri, 2020). Covid-19 salgını bütün insanları enfekte edebildiği gibi en çokta sağlık personellerini enfekte olma açısından risk altına almıştır. Toplu yaşam alanında (kışla, yurt, okul, cezaevi) yaşayan kişiler, 65 yaş üstü bireyler, kronik rahatsızlığı olanlar, mevsimlik tarım işçileri, riskli grupta bulunmaktadır (Ertal, 2021), (Ertan, 2023).

3.1. Covid-19 Pandemisi ve Depresyon

Depresyon oluşumunda ve gelişiminde genetik, beyin yapısı, travma, stres, kronik hastalıklar, madde kullanımı, sosyal destek eksikliği, cinsiyet, yaş gibi çeşitli risk etkenleri yer almaktadır. Yapılan araştırmalarda majör depresyonun prevalansı kadınlarda erkeklerden daha yüksek bulunmuş olup 2010 yılına baktığımızda küresel yıllık prevalansı sırasıyla %5,5 ve %3,2 olarak tespit edilmiştir (Sağlam,2023).

Covid-19 pandemisi, birçok insan için depresyon riskini artırmış, ruh sağlığı üzerinde etkili olmuştur. Hastalık korkusu, sosyal izolasyon, finansal zorluklar, gelecek kaygısı, keder ve kayıplar gibi sonuçlar pandeminin ruh sağlığı üzerinde etkisinde önemli bir rol oynamıştır. İnsanlar yalnız kalma, keder ve depresyona sebep olabilen sosyal izolasyonu veya karantinayı enfeksiyondan korunmak ve enfeksiyonun dağılımını engellemek için uygulamak durumunda kalmıştır. Yine birçok insan pandemi sebebiyle günlük rutinlerini sürdüremez hale gelmiş, işini kaybetmiş veya depresyona neden olabilecek ekonomik sıkıntı yaşamıştır. Yapılan araştırmalarda genel popülasyonda depresyon ve psikolojik rahatsızlıkların tüm biçimlerinin yaygınlık oranının Covid-19 salgını esnasında önceki döneme göre daha yüksek olduğu tespit edilmiştir (Sağlam, 2023).

3.2. Covid-19 Pandemisi ve Anksiyete

Anxiety kelimesi İngilizce kökenli olup dilimize anksiyete olarak aktarılmıştır. Anksiyete sözcüğü ilk zamanlar sıkıntı, sıkıca bastırmak, boğazını sıkmak, tasa anlamlarına gelen ‘’angh’’kelimesinden türemiştir. Angh kelimesi Hint-Germen dil ailesine mensuptur. Kavram olarak anksiyete milattan önceki dönemlere kadar uzanmaktadır. Anksiyete ve belirtileri üstüne eski dönemlerden itibaren çalışmalar, araştırmalar yapılmış ve konuyla igili yazılar yazılmıştır. Doktorlar anksiyete ile ilgili tıbbi açıklamalarda bulunmuş ve bazı yazarlarda bu kavramı toplumsal anlamda ele almışlardır. Anksiyete bazı bedensel belirtileri farklı beden parçaları, organlar veya sistemlerin hastalıkları olarak ele almıştır(Özer, 2006).

Anksiyetenin ortaya çıkardığı psikolojik semptomlar ise melankoli ile birlikte görülmüş ve bu anlamda ele alınmıştır (Özer, 2006).

Anksiyete kavramına yönelik bilimsel çalışmalar uzun zamandır yapılmakta ve halen devam etmektedir. Çalışmalar incelendiği zaman anksiyeteye ilişkin çıkan sonuç fiziksel belirtiler veren hastalıklar ve bunların oluşturduğu anksiyete arasında ilişki kurularak yapıldığı görülmektedir (Özer, 2006).

3.3. Covid-19 Pandemisi ve Stres

Eski dönemlerde düzensiz bir hayat olmamasına rağmen, insanların kendilerini ve ailelerini olası tehlikelerden korumak, yemek-içmek gibi ihtiyaçlarını giderebilme yollarını aramak, barınma için yer bulmak vs. gibi yaşamını idame ettirmek için karşılaştıkları bazı zorluklar; üzerlerinde gerilim ve baskı hissetmelerine neden olmuştur. İnsanoğlu duygusal bir varlık olduğu için yaşadığı bu baskı ve gerilimler onu farklı şekillerde etkilemiştir. Bu etkilerin neticesinde fiziksel, psikolojik ve davranışsal tepkiler ortaya çıkmıştır. Günümüzde ‘’stres’’olarak tabir ettiğimiz, insanların yaşadığı baskı ve gerilimler, insanoğlunun var olduğu an itibariyle başlayarak etkisini devam ettirmiş; küreselleşmenin ve modernleşmeninde etkisiyle stres sebebi unsurlar artmış ve çeşitlenmiştir. Bu zaman zarfında, insanların sahip oldukları karakteristik özellikleri ve olayları algılayışlarındaki farklılıklarda maruz kalınan stresin şiddetini direkt etkilemiştir. 20. yüzyıldan sonra insanların aktif olarak çalışma hayatına katılımıyla beraber yeme, içme, barınma vs. gibi temel ihtiyaçlarına ek olarak; eğitim alma, statü sahibi olma, para kazanma, aitlik duygusu yaşama vs. gibi bazı ihtiyaçlarda söz konusu olmaya başlamıştır. Bu durumlardan ötürü stres insanların hayatında kaçınılmaz hale gelmiştir. Birey stresin olumsuz etkilerini en az hale indirgemek için mücadele etmeye başlamıştır (Eroğlu, 2006).

SONUÇ

Bu araştırmada sağlık çalışanlarının depresyon düzeylerinin orta, stres ve anksiyete düzeylerinin ise hafif seviyede olduğu belirlenmiştir. Genel değerlendirme yapıldığında, COVID-19 pandemisi sürecinde sağlık çalışanlarında depresyon, anksiyete ve stres belirtilerinin gözlemlendiği ortaya çıkmıştır. Katılımcıların cinsiyetlerine göre COVID-19 korkusu, anksiyete, depresyon ve stres düzeyleri arasındaki farklılıkları incelemek amacıyla yapılan t-testi sonuçlarına göre, kadınların erkeklere kıyasla COVID-19 korkusu ve anksiyete değişkenlerinde daha yüksek puanlar aldığı saptanmıştır. Buna karşılık cinsiyet farklılığının depresyon ve stres düzeyleri üzerinde anlamlı bir etkisi bulunmamıştır. Dolayısıyla kadın katılımcıların, erkeklere oranla daha yüksek düzeyde COVID-19 korkusu ve anksiyeteye sahip oldukları sonucuna ulaşılmıştır.

Çalışmada ayrıca medeni durum, eğitim düzeyi, hizmet süresi ve unvan değişkenlerine göre gruplar arasında farklılık olup olmadığı incelenmiştir. Ancak yapılan analizlerde bu değişkenlerin COVID-19 korkusu, anksiyete, depresyon ve stres değişkenleri açısından anlamlı bir farklılık oluşturmadığı tespit edilmiştir. Araştırma bulguları, COVID-19 korkusu ile

anksiyete, depresyon ve stres arasında orta düzeyde bir ilişki bulunduğunu ortaya koymuştur. Bu ilişkide en yüksek düzey anksiyetede, ardından sırasıyla stres ve depresyonda görülmüştür. Araştırmada COVID-19 korkusunun katılımcılardaki depresyon varyansının %49,65'ini açıkladığı bulunmuştur. Literatürle paralel olarak, COVID-19 korkusunun ölüm korkusunu tetiklediği, ölüm korkusunun ise depresyona yol açabileceği hem mevcut çalışma hem de önceki araştırmalarda ortaya konmuştur. Ayrıca COVID-19 korkusunun katılımcılardaki anksiyeteyi yordadığı belirlenmiştir. Regresyon analizi sonuçlarına göre COVID-19 korkusu, bireylerdeki anksiyete bozukluğunun %0,239'unu açıklamaktadır. Dolaylı yoldan da olsa COVID-19 korkusunun bireylerin anksiyete düzeylerini artırabileceği sonucuna ulaşılmıştır.

Son olarak, COVID-19 korkusu ile stres arasındaki ilişki incelenmiş ve yapılan analizler sonucunda katılımcıların stres puanlarındaki varyansın önemli bir kısmının COVID-19 korkusundan kaynaklandığı görülmüştür. Bu bulgu, COVID-19 korkusunun bireylerde stresin kaynaklarından biri olduğunu ve stresi pozitif yönde ve anlamlı biçimde yordadığını göstermektedir.

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FAALİYET TABANLI MALİYET YÖNTEMİNİN UYGULANMASINA YÖNELİK BİR ARAŞTIRMA[41]

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ÖZET

Üretim süreçlerinin karmaşık olması ve maliyetlerin dağıtımında geleneksel maliyet yöntemlerinin yetersiz kalması işletmelerin daha güvenilir ve sonuç alıcı yeni maliyet hesaplamalarının araştırılmasına yönlendirilmiştir. Maliyet muhasebesi alanında geleneksel yöntemlerin dolaylı maliyetlerin dağıtımında yetersiz kaldığı, bu nedenle yöneticilere sağlanan bilgi düzeyinin karar alma süreçlerinde istenen doğruluğu sunmadığı gözlemlenmektedir. Bu bağlamda yeni ve güncel maliyet hesaplama sistemlerinden olan Faaliyet Tabanlı Maliyetleme en doğru maliyet hesaplamalarının ve yöneticilere güvenilir bilgi verme konusunda iddialı sonuçlar ortaya çıkarmıştır. Çalışmamızda bir uygulama örneği ile araştırmamız pekiştirilecektir. Uygulamada, üretim sürecine dair örnek muhasebe verileri üzerinden faaliyet merkezleri ve sürücüleri belirlenmiş, faaliyet bazlı maliyet dağıtımı gerçekleştirilmiş ve her iki yöntem sonucunda ortaya çıkan birim maliyetler karşılaştırılmıştır. Elde edilen bulgular, FTM yönteminin işletme kaynaklarının daha doğru analizine olanak tanıdığını, maliyet kontrolünü güçlendirdiğini ve stratejik kararların alınmasında önemli katkılar sunduğunu göstermektedir. Sonuç olarak bu çalışma, maliyet yapısı karmaşık tüm üretim işletmeleri için FTM'nin uygulanabilirliğini ortaya koymakta ve literatüre hem teorik hem uygulamalı katkı sunmaktadır. Faaliyet Tabanlı Maliyetleme maliyetlerin faaliyetler aracılığıyla daha doğru bir şekilde ürün ve hizmetlere yüklenmesini sağlayan çağdaş bir yöntem olarak öne çıkmaktadır. Çalışmamızın amacı, Faaliyet Tabanlı Maliyet Uygulamasının örneklem yoluyla uygulanabilirliği araştırılacak olup bir model oluşturmaktır. Maliyet hesaplama sistemlerinin geleneksel maliyet hesaplamalarından çağdaş maliyet hesaplama geçişlerini destekleyecek düzeyde olması çalışmamızın önemi ortaya çıkarmaktadır. Çalışmamızda öncelikle literatür çalışması ile bilgiler toplanacak ve bir uygulama üzerinden Faaliyet Tabanlı Maliyet uygulamasına yönelik bir model oluşturulacaktır. Çalışmamızın Muhasebe Bilimine katkı sunması umut edilmektedir.

[41] Bu çalışma Gülcan ZENGİN'İN 2025 yılına ait "Faaliyet Tabanlı Maliyet Yönteminin Beton Üretim İşletmelerinde Uygulanması, Model Oluşturulması ve Muhasebeleştirilmesine Yönelik Bir Araştırma" adlı tezinden türetilmiştir.

Anahtar Kelimeler: Faaliyet Tabanlı Maliyet, Muhasebe, İşletme

A RESEARCH ON THE APPLICATION OF ACTIVITY-BASED COSTING METHOD

ABSTRACT

The complexity of production processes and the inadequacy of traditional cost methods in cost allocation have led businesses to seek new, more reliable, and effective cost calculation methods. In the field of cost accounting, it has been observed that traditional methods are insufficient in allocating indirect costs, and therefore, the level of information provided to managers does not offer the desired accuracy in decision-making processes. In this context, Activity-Based Costing (ABC), a new and up-to-date cost calculation system, has yielded ambitious results in terms of providing the most accurate cost calculations and reliable information to managers. Our study will reinforce this research with an application example. In the application, activity centers and drivers were determined using sample accounting data related to the production process, activity-based cost allocation was performed, and the unit costs resulting from both methods were compared. The findings show that the ABC method allows for a more accurate analysis of business resources, strengthens cost control, and makes significant contributions to strategic decision-making. In conclusion, this study demonstrates the applicability of ABC for all manufacturing businesses with complex cost structures and contributes to the literature both theoretically and practically. Activity-Based Costing stands out as a contemporary method that enables more accurate allocation of costs to products and services through activities. The aim of our study is to investigate the applicability of Activity-Based Costing (ABC) through sampling and to create a model. The importance of our study lies in the fact that cost accounting systems should support the transition from traditional to modern cost accounting. In our study, information will first be gathered through a literature review, and then a model for Activity-Based Costing will be created through an application. It is hoped that our study will contribute to the field of Accounting.

Keywords: Activity-Based Costing, Accounting, Business

1. GİRİŞ

Günümüzde rekabetin yoğunlaştığı pazar koşulları altında, işletmelerin sürdürülebilir büyüme hedeflerine ulaşabilmeleri ve kaynaklarını etkin bir şekilde yönetebilmeleri, doğru ve güvenilir maliyetleme sistemlerinin uygulanmasını zorunlu kılmaktadır. Geleneksel maliyetleme yaklaşımları, çoğunlukla doğrudan işçilik süresi ve makine saatleri gibi sınırlı sayıda maliyet

sürücüsünü esas almakta; bu durum ise dolaylı giderlerin ürünler arasında adil ve gerçekçi bir şekilde dağıtılmasını engelleyerek maliyet sapmalarına neden olabilmektedir. Özellikle ürün çeşitliliğinin arttığı ve genel üretim giderlerinin toplam maliyetler içindeki payının yüksek olduğu sektörlerde, bu tür sapmalar yönetsel kararların hatalı alınmasına ve rekabet gücünün zayıflamasına yol açabilmektedir.

Beton üretim sektörü, üretim süreçlerinin çok aşamalı ve teknik olarak karmaşık olması, ürünlerin kalite düzeylerinin değişkenlik göstermesi ve dolaylı maliyetlerin maliyet yapısı içindeki oranının giderek artması nedeniyle, geleneksel maliyetleme yöntemlerinin yetersiz kaldığı bir alan olarak öne çıkmaktadır. Bu bağlamda, Faaliyet Tabanlı Maliyetleme (FTM) yöntemi, işletme içi faaliyetlerin kaynak tüketimini esas alarak maliyetlerin daha doğru biçimde izlenmesini ve ürünlere adil biçimde dağıtılmasını sağlamaktadır. Böylece FTM, yöneticilere daha sağlıklı veri temelli kararlar alma imkânı sunmakta ve stratejik yönetim açısından önemli avantajlar sağlamaktadır.

Bu çalışma, Faaliyet Tabanlı Maliyetleme (FTM) yönteminin beton üretim sektöründeki uygulanabilirliğini değerlendirmeyi amaçlamakta olup, sektöre özgü doğru maliyetleme uygulamalarının işletmelere sağlayabileceği stratejik katkıları ortaya koymayı hedeflemektedir. Bu kapsamda, geleneksel maliyetleme yöntemi ile FTM karşılaştırmalı olarak ele alınmış, özellikle maliyet doğruluğu ve karar destek mekanizmalarındaki performansları analiz edilmiştir.

2. GELENEKSEL MALİYETLEME VE FAALİYET TABANLI MALİYETLEME

Faaliyet Tabanlı Maliyetleme (FTM), 1980'li yılların sonlarına doğru, geleneksel maliyetleme sistemlerinin işletmelerin artan ve çeşitlenen bilgi ihtiyaçlarına yanıt verememesi sonucunda geliştirilen yenilikçi bir maliyetleme yaklaşımıdır. Bu sistemin öncülüğünü, Harvard Business School bünyesinde Robert S. Kaplan ve Robin Cooper yapmıştır. Özellikle dolaylı maliyetlerin geleneksel yöntemlerle doğru ve adil bir biçimde dağıtılamaması, işletmelerin ürün, hizmet ve müşteri kârlılığı analizlerinde yanıltıcı sonuçlara ulaşmasına yol açmıştır. Bu nedenle daha isabetli ve faaliyet temelli bir maliyetleme anlayışına duyulan ihtiyaç, FTM'nin doğuşunu beraberinde getirmiştir (Kaplan & Cooper, 1988).

Küreselleşme ile birlikte ürün çeşitliliğinde ve müşteri taleplerinde yaşanan artış, üretim dışı süreçlerdeki dolaylı maliyetlerin oranını belirgin şekilde yükseltmiştir. Bu değişim, üretim maliyet yapısını daha karmaşık hale getirerek, maliyetlerin geleneksel ölçütlerle izlenmesini

güçleştirmiştir (Erkan, 2020, Soylu, 2018). Geleneksel sistemlerde kullanılan doğrudan işçilik süresine dayalı maliyet dağıtım anahtarları, modern üretim süreçlerinin karmaşıklığını yansıtmada yetersiz kalmakta ve işletmeleri stratejik açıdan yanlış yönlendirebilmektedir (Horngren vd. 2015).

Kaplan ve Cooper tarafından geliştirilen FTM yaklaşımı, maliyetlerin doğrudan ürün veya hizmete değil, önce faaliyetlere tahsis edilmesini, ardından bu faaliyetlerin belirli sürücüler üzerinden maliyet nesnelerine aktarılmasını öngörmektedir. Bu yapı, maliyetlerin yalnızca üretim miktarıyla değil; aynı zamanda süreçlerin karmaşıklığı ve niteliğiyle de ilişkili olduğunu savunmaktadır. Örneğin, eşit miktarda ürün üreten iki üretim hattı, farklı işlem yoğunluklarına ve süreç adımlarına sahip olabilir; FTM, bu farklılığı faaliyet sürücüleri aracılığıyla maliyet hesaplamasına yansıtabilmektedir (Kaplan & Cooper, 1998).

1990'lı yıllardan itibaren FTM, imalat sanayisinin ötesine geçerek sağlık, eğitim, kamu yönetimi ve hizmet sektörleri gibi çok farklı alanlarda da uygulanmaya başlanmıştır. Bu genişleme, yöntemin süreç odaklı yapısının her sektöre uyarlanabilir olmasından kaynaklanmaktadır (Güzeldere, 2006, Yurtalan, 2013). Ayrıca, kurumsal kaynak planlama (ERP) sistemlerinin gelişmesiyle birlikte, veri toplama ve analiz süreçleri dijital ortamlarda daha hızlı ve bütüncül biçimde yürütülmeye başlanmış, bu da FTM'nin uygulanabilirliğini büyük ölçüde kolaylaştırmıştır (Çelik, 2019).

Geleneksel maliyetleme yöntemleri, doğrudan işçilik süresi veya makine saatleri gibi üretim hacmine dayalı göstergeleri esas alarak maliyet dağıtımı gerçekleştiren bir sistem olarak, özellikle seri üretime dayalı dönemlerde işlevsel bir yapı sunmuştur. Ancak günümüzün karmaşık ve müşteri odaklı üretim ve hizmet ortamlarında, bu yöntemlerin sunduğu maliyet bilgisi çoğu zaman yetersiz kalmaktadır (Drury, 2012). Dolaylı maliyetlerin doğru şekilde ürün veya hizmetlere tahsis edilememesi, kârlılık analizlerinde sapmalara ve yönetim kararlarında hatalara neden olmuştur (Bhimani & Horngren, 2020).

Bu sorunlara yanıt olarak geliştirilen Faaliyet Tabanlı Maliyetleme (FTM) yöntemi, maliyetlerin her bir faaliyet bazında kaynak tüketimi dikkate alınarak ürünlere ve hizmetlere aktarılmasını sağlayan yenilikçi bir yaklaşımdır (Cooper, 1990). FTM, her faaliyeti bir kaynak tüketim birimi olarak tanımlar ve bu tüketimi "faaliyet sürücüleri" aracılığıyla maliyet nesnelerine yönlendirir. Böylece ürün ve hizmet bazlı maliyet hesaplamaları, daha doğru ve gerçekçi biçimde yapılabilmektedir (Turney, 1992).

FTM'nin önemli bir katkısı da, üretim dışı süreçlerde –örneğin pazarlama, satış sonrası hizmetler veya lojistik gibi destek faaliyetlerde– oluşan dolaylı maliyetlerin daha net biçimde izlenmesini sağlamasıdır. Bu sayede, yalnızca üretim maliyetlerinin değil, toplam işletme maliyetlerinin bütüncül biçimde analiz edilmesi mümkün hale gelmiştir.

FTM'nin uygulama süreci genellikle şu aşamaları içerir:

- Faaliyetlerin belirlenmesi
- Maliyet havuzlarının oluşturulması
- Faaliyet sürücülerinin seçilmesi
- Kaynakların faaliyetlere atanması
- Nihai olarak sonuçların raporlanması ve yorumlanması (Kaplan & Norton, 2001)

Bu yapısal model sayesinde FTM, geçmiş maliyet analizlerinden elde edilen verilerle yetinmeyip, geleceğe yönelik stratejik planlamalara da doğrudan katkı sunmaktadır.

FTM'nin sağladığı temel avantajlar şunlardır:

- Dolaylı maliyetlerin daha adaletli ve şeffaf biçimde dağıtılması
- Ürün, hizmet ve müşteri bazında kârlılık analizlerine imkân vermesi
- Kaynak verimliliğinin artırılması
- Stratejik karar destek mekanizmalarının güçlendirilmesi (Gunasekaran, 1999)

Bununla birlikte, FTM'nin yüksek veri toplama maliyeti, uygulama karmaşıklığı ve zaman gereksinimi gibi bazı zorlukları da bulunmaktadır. Bu nedenle sistemin başarıyla uygulanabilmesi, işletme genelinde güçlü bir bilgi altyapısı ve süreç disiplinini gerektirir.

Günümüzde FTM, sadece üretim sektörüyle sınırlı kalmayıp; hizmet, kamu ve finans sektörlerinde de yaygın bir uygulama alanı bulmuştur. Özellikle ERP (Kurumsal Kaynak Planlama) sistemleriyle entegrasyonu, veri analitiği süreçlerini kolaylaştırmış ve yöntemin büyük ölçekli organizasyonlarda daha etkili kullanılmasına olanak tanımıştır (Dekker, 2003).

Sonuç olarak, Faaliyet Tabanlı Maliyetleme sadece geleneksel maliyet muhasebesine alternatif bir teknik değil; aynı zamanda işletmelerin stratejik yönetim süreçlerinde rekabetçi avantaj elde etmelerine katkı sunan çok boyutlu bir sistem olarak değerlendirilmektedir.

Faaliyet Tabanlı Maliyetleme (FTM) yöntemi, işletmelerin maliyet yapılarını daha doğru analiz etmelerine olanak tanıyan modern bir maliyetleme sistemidir. Bu yaklaşımda maliyetler, doğrudan ürünlere veya hizmetlere tahsis edilmek yerine önce faaliyetlere yüklenmekte, ardından faaliyetler aracılığıyla ürünlere dağıtılmaktadır. Böylece, kaynak tüketimi faaliyet düzeyinde izlenerek daha doğru maliyet tahsisi sağlanmaktadır (Shields, 1995).

FTM, her bir faaliyetin gerçekleştirilmesi için tüketilen kaynak miktarını dikkate almakta ve bu faaliyetlerin belirli maliyet sürücüleri ile ilişkilendirilmesi yoluyla ürün maliyetlerini hesaplamaktadır. Bu sistem sayesinde, geleneksel maliyetleme yöntemlerinde sıklıkla karşılaşılan dolaylı giderlerin eşit dağıtılması sorunu ortadan kaldırılmakta ve her ürün, gerçekten tükettiği kaynaklar doğrultusunda maliyetlendirilmektedir.

Özellikle yüksek sabit maliyet oranlarına ve üretim sürecinde çeşitlilik gösteren faaliyet yapısına sahip sektörlerde, FTM'nin sağladığı maliyet hassasiyeti büyük önem taşımaktadır (Anderson, 1995). FTM sayesinde, ürün bazında kârlılık analizleri daha gerçekçi yapılmakta, fiyatlandırma stratejileri daha doğru belirlenebilmekte ve kaynak kullanımı daha etkin bir şekilde optimize edilebilmektedir. Bu nedenle, günümüz işletmeleri arasında Faaliyet Tabanlı Maliyetleme yöntemi, sadece operasyonel verimliliği artırmakla kalmayıp, stratejik karar alma süreçlerinde de önemli bir araç olarak benimsenmektedir.

Geleneksel maliyetleme sistemleri, maliyetlerin ürünlere tahsisini genellikle üretim hacmiyle ilişkili ölçütler; örneğin doğrudan işçilik saatleri, makine saatleri veya üretim miktarı üzerinden gerçekleştirmektedir (Johnson & Kaplan, 1987). Bu yaklaşım, üretim süreçlerinin görece daha sade olduğu ve dolaylı maliyetlerin toplam maliyetler içindeki payının düşük seyrettiği dönemlerde etkinlik göstermiştir.

Ancak günümüzde üretim ve hizmet sektörlerinde yaşanan teknolojik dönüşümler, üretim süreçlerini önemli ölçüde karmaşıklaştırmıştır. Artan ürün çeşitliliği, müşteri beklentilerindeki farklılaşma ve üretim teknolojilerinin çeşitlenmesi, geleneksel maliyet sürücülerinin yetersiz kalmasına yol açmıştır. Bu gelişmeler, klasik maliyetleme yöntemlerinin maliyet doğruluğunu zayıflatmış ve karar alma süreçlerinde hatalı bilgi temelli riskleri artırmıştır (Cooper, 1989).

Özellikle ürün çeşitliliğinin yüksek olduğu ve dolaylı giderlerin toplam maliyet içindeki oranının arttığı sektörlerde, geleneksel maliyetleme sistemlerinin kullanımı ciddi maliyetleme hatalarına neden olabilmektedir. Dolaylı maliyetlerin ürünler arasında eşit şekilde dağıtılması, maliyet yapısının gerçekçi biçimde yansıtılmasını engellemekte; bu da bazı ürünlerin olduğundan daha az, bazılarının ise daha kârlı görünmesine neden olmaktadır.

Bu sebeplerle, günümüz işletmeleri daha hassas maliyet bilgileri sunabilen çağdaş sistemlere yönelmektedir. Bu kapsamda, faaliyetleri esas alarak maliyetlerin daha doğru şekilde dağıtılmasını sağlayan Faaliyet Tabanlı Maliyetleme (FTM) gibi yöntemler ön plana çıkmaktadır.

SONUÇ

Faaliyet Tabanlı Maliyetleme (FTM) yöntemi, sunduğu detaylı ve doğru maliyet bilgileri sayesinde tüm sektörlerde stratejik karar alma süreçlerinde önemli bir araç haline gelmiştir. FTM'nin doğru bilgi üretme kapasitesi, hem ürün bazlı hem de müşteri bazlı stratejik kararların daha sağlıklı verilmesine olanak tanımaktadır.

FTM ile elde edilen doğru maliyet verileri, üreticilerinin ürün portföylerini daha etkin bir şekilde yönetmelerine imkân tanımaktadır. Ürün bazında maliyetlerin detaylı analizi sayesinde, yüksek maliyetli ancak düşük getirili ürünlerin portföyden çıkarılması veya daha verimli ürünlerin üretimine ağırlık verilmesi mümkün olmaktadır (Kaplan & Atkinson, 1998). Aynı zamanda, doğru maliyet bilgisi ürünlerin fiyatlandırılmasında daha rasyonel bir yaklaşım geliştirilmesine yardımcı olmakta, bu da işletmelerin rekabetçi piyasa koşullarında sürdürülebilir kârlılık elde etmelerini sağlamaktadır.

FTM, ürün ve müşteri bazlı maliyetleri detaylı bir şekilde analiz etme olanağı sunduğundan, düşük kârlılık gösteren ürünlerin ve müşterilerin net bir şekilde belirlenmesini sağlamaktadır. Geleneksel maliyetleme sistemlerinde genellikle göz ardı edilen bu detaylar, FTM yaklaşımıyla ortaya çıkarılmakta ve stratejik yönetim kararlarında önemli rol oynamaktadır (Bhimani, 2003). Bu analizler sonucunda işletmeler, düşük kârlılık sağlayan ürün ve müşteriler için yeni stratejiler geliştirebilmekte, gerektiğinde iş modellerinde değişikliğe gidebilmektedir.

Ürün farklılaştırması, maliyet liderliği veya niş pazar stratejileri gibi rekabetçi stratejilerin oluşturulmasında FTM'nin sağladığı hassas veri seti, karar vericilere önemli bir avantaj sunmaktadır (Drury, 2013). Böylece FTM, sadece operasyonel verimlilik değil, aynı zamanda stratejik rekabet avantajı sağlama sürecinin de temel bileşenlerinden biri haline gelmektedir.

Türkiye'de beton sektöründe faaliyet gösteren işletmeler üzerinde gerçekleştirilen çeşitli akademik çalışmalar, Faaliyet Tabanlı Maliyetleme (FTM) sisteminin maliyet yönetiminde sağladığı iyileştirmeleri açıkça ortaya koymaktadır. Bu araştırmalar, FTM uygulamasının hem operasyonel verimlilik hem de stratejik karar alma süreçleri üzerinde önemli katkılar sağladığını göstermektedir.

Yapılan çalışmalarda, FTM sistemlerinin uygulanması ile üretim süreçlerinde meydana gelen maliyet sapmalarının %15 ila %20 oranında daha doğru bir şekilde tespit edilebildiği ortaya konmuştur. Geleneksel maliyetleme yöntemlerine kıyasla FTM, faaliyet bazında ayrıntılı maliyet analizleri yaparak sapma nedenlerini daha şeffaf bir şekilde belirlemekte ve böylece kaynak kullanımındaki verimsizliklerin azaltılmasına olanak sağlamaktadır (Aydın, 2018).

Bu bulgular, özellikle beton gibi çok aşamalı ve farklı maliyet unsurlarına sahip üretim süreçlerinde, FTM'nin işletme yönetimi açısından güçlü bir kontrol mekanizması sunduğunu kanıtlamaktadır.

Faaliyet Tabanlı Maliyetleme (FTM) sistemi, yalnızca doğru maliyet hesaplamalarını sağlamakla kalmaz; aynı zamanda işletmelerin operasyonel verimliliğini artırmaya yönelik somut katkılar da sunar. Faaliyet bazlı analizler aracılığıyla, üretim süreci içerisinde yer alan düşük verimli ya da kaynak israfına yol açan faaliyetler sistematik olarak belirlenebilir. Bu tespitler, iyileştirme çalışmaları için veri temelli bir zemin oluşturur ve verimsiz süreçlerin ortadan kaldırılmasına olanak tanır.

Özellikle enerji tüketimi, ekipman bakım süreçleri ve kalite kontrol faaliyetleri gibi dolaylı maliyet yaratma potansiyeli yüksek olan alanlarda elde edilen iyileştirmeler, işletme genelinde önemli ölçüde maliyet tasarrufu ve performans artışı sağlamaktadır. Bu bağlamda FTM, yalnızca bir muhasebe sistemi değil, aynı zamanda sürekli gelişim anlayışını destekleyen stratejik bir yönetim aracıdır (Demir & Yıldırım, 2017).

Türkiye'de gerçekleştirilen araştırmalar ve uygulama örnekleri, Faaliyet Tabanlı Maliyetleme (FTM) sisteminin yalnızca operasyonel düzeyde değil, aynı zamanda stratejik karar alma süreçlerinde de etkin bir araç olduğunu ortaya koymaktadır. Özellikle ürün portföyünün etkin yönetimi, müşteri segmentlerine yönelik kârlılık analizleri ve rekabetçi fiyatlandırma stratejilerinin belirlenmesi gibi kritik yönetim alanlarında, FTM tarafından sunulan doğru ve ayrıntılı maliyet verileri yöneticilere önemli karar destek imkânları sunmaktadır (Çoban, 2016). Bu bağlamda FTM, yalnızca geçmiş maliyetlerin hesaplanmasına hizmet eden bir muhasebe sistemi değil; aynı zamanda ileriye dönük stratejik planlamaları yönlendiren bütüncül bir analiz aracı niteliğindedir. Beton sektöründe faaliyet gösteren firmalar için, doğru maliyet bilgisine dayalı olarak alınan kararlar; pazarda farklılaşmayı, rekabet gücünü artırmayı ve sürdürülebilir kârlılığı sağlamayı mümkün kılmaktadır. Böylece FTM, sektörde stratejik üstünlük elde etmenin temel bileşenlerinden biri haline gelmektedir.

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TÜRKİYE'DE FOMO ÜZERİNE YAZILAN LİSANSÜSTÜ TEZLERİN BİR ANALİZİ

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ÖZET

Dijital çağın bir yansıması olarak ortaya çıkan ve bireylerin başkalarının deneyimlediği tatmin edici olayları kaçırdıklarına dair yaygın bir endişe durumu olarak tanımlanan Gelişmeleri Kaçırma Korkusu (FoMO), son yıllarda Türkiye'deki lisansüstü tez çalışmalarının da önemli bir inceleme konusu haline gelmiştir. Bu bildirinin temel amacı, Türkiye'de FoMO olgusu üzerine gerçekleştirilmiş yüksek lisans ve doktora tezlerinin tematik eğilimlerini, metodolojik yaklaşımlarını, örneklem özelliklerini ve temel bulgularını bütüncül bir bakış açısıyla ortaya koymaktır. Bu doğrultuda, alandaki akademik üretimin bir panoramasını sunarak gelecekteki tez çalışmalarına yön verecek araştırma boşluklarını ve eğilimleri tespit etmek hedeflenmektedir.

Çalışma, nitel araştırma desenlerinden doküman analizi yöntemiyle tasarlanmıştır. Veri toplama sürecinde, temel olarak Yükseköğretim Kurulu (YÖK) Ulusal Tez Merkezi veri tabanı kullanılarak "FoMO" ve "gelişmeleri kaçırma korkusu" anahtar kelimeleriyle sistematik bir tarama yapılmıştır. Belirlenen dahil etme kriterlerine uyan tezler, içerik analizi tekniği kullanılarak incelenmiştir. Analiz sürecinde tezler; hazırlandıkları anabilim dalı, üniversiteler, araştırma deseni (nicel, nitel, karma) ve yayın yılı gibi kriterler doğrultusunda tematik olarak sınıflandırılmıştır. Bu analiz, Türkiye'deki FoMO yazınının mevcut durumunu haritalandırarak alana özgü araştırma boşluklarını belirlemeyi ve gelecekteki tez çalışmalarına yön vermeyi amaçlamaktadır.

Anahtar Kelimeler: FoMO, Gelişmeleri Kaçırma Korkusu, Lisansüstü Tezler, Tez Analizi.

AN ANALYSIS OF POSTGRADUATE THESES ON FOMO IN TURKEY

ABSTRACT

The Fear of Missing Out (FoMO), defined as a pervasive apprehension that one might miss out on rewarding experiences that others are having, has emerged as a reflection of the digital age. In recent years, FoMO has also become a significant subject of investigation in postgraduate theses within Turkey. The primary aim of this paper is to present a holistic analysis of the thematic trends, methodological approaches, sample characteristics, and key findings of master's and doctoral theses on FoMO conducted in Turkey. Accordingly, this study seeks to

provide a panorama of the academic output in this field, thereby identifying research gaps and trends to guide future postgraduate studies.

The study is designed using the document analysis method, a qualitative research approach. A systematic search was conducted primarily in the Council of Higher Education (YÖK) National Thesis Center database using the keywords “FoMO” and “Fear of Missing Out”. Theses that met the specified inclusion criteria were examined using the content analysis technique. During the analysis, theses were thematically classified according to criteria such as their academic department, universities, research design (quantitative, qualitative, mixed-method) and publication year. This analysis aims to map the current landscape of FoMO research in Turkey, highlight specific gaps in the literature, and provide a roadmap for future research.

Keywords: FoMO, Fear of Missing Out, Postgraduate Theses, Thesis Analysis, Systematic Review.

GİRİŞ

Dijitalleşmenin hızla yaygınlaştığı çağımızda bireylerin sosyal medya ve çevrimiçi platformlarla kurdukları yoğun etkileşim dijital hastalıkları da beraberinde getirmiştir. Bu hastalıkların başında da gelişmeleri kaçırma korkusu olarak adlandırılan FOMO gelmektedir. FOMO, Türkiye’deki lisansüstü çalışmalarda da giderek artan bir ilgiyle karşılanmaktadır. Bu çalışmada Türkiye’de FOMO konusuna ilişkin akademik üretimin genel görünümünü ortaya koymayı amaçlamaktadır. Çalışmada, Yükseköğretim Kurulu (YÖK) Ulusal Tez Merkezi veri tabanından FOMO ve Gelişmeleri Kaçırma Korkusu başlıklarıyla ulaşılan 155 lisansüstü tez analize tabi tutulmuştur.

Çalışmada tezler doküman analizi ve içerik analizi yöntemleriyle değerlendirilmiş; tezlerin tematik yönelimleri, metodolojik tercihleri, örneklem özellikleri ve araştırma kapsamları bütüncül bir bakış açısıyla ele alınmıştır. Böylece Türkiye’de FoMO üzerine yapılan akademik üretimin panoraması ortaya konulmuş ve alana özgü araştırma eğilimleri sistematik biçimde haritalandırılmıştır.

FOMO KONUSUNDA HAZIRLANAN LİSANSÜSTÜ TEZLERİN BİBLİYOMETRİK ANALİZİ

Araştırmanın Amacı ve Yöntemi

Bu araştırmanın amacı, Türkiye’de “Gelişmeleri Kaçırma Korkusu (FoMO)” üzerine hazırlanmış lisansüstü tezlerin sistematik biçimde incelenerek, bu çalışmaların hangi yönlerden

ele alındığını ortaya koymaktır. Çalışmada, tezlerin türleri (yüksek lisans, doktora, tıpta uzmanlık), yazıldıkları dil, hazırlandıkları üniversite ve enstitüler, üniversite türleri (devlet, vakıf, kamu kurumları), yıllara göre dağılımı, erişim durumları, konu başlıkları ve kullanılan yöntemler dikkate alınmıştır. Böylece FoMO üzerine yapılan akademik üretimin tematik eğilimleri, disiplinler arası çeşitliliği ve yöntemsel tercihleri bütüncül bir bakış açısıyla değerlendirilmiştir.

Araştırma, nitel araştırma desenlerinden doküman analizi yöntemiyle tasarlanmıştır. Veri toplama sürecinde Yükseköğretim Kurulu (YÖK) Ulusal Tez Merkezi veri tabanında "FoMO" ve "Gelişmeleri Kaçırma Korkusu" anahtar kelimeleriyle sistematik bir tarama yapılmış; ulaşılan tezler içerik analizi tekniğiyle incelenmiştir. Analiz sürecinde tezler, tablolar aracılığıyla belirlenen ölçütler doğrultusunda sınıflandırılmış ve karşılaştırmalı olarak değerlendirilmiştir.

Bu yöntemsel yaklaşım, Türkiye'de FoMO üzerine gerçekleştirilen lisansüstü tezlerin akademik üretim içindeki yerini, hangi alanlarda yoğunlaştığını ve hangi yöntemlerle çalışıldığını ortaya koyarak, gelecekteki araştırmalara yön verecek bir çerçeve sunmaktadır.

Araştırmanın Evren ve Örneklemi

YÖK Ulusal Tez Veri Tabanından "FOMO" ve "Gelişmeleri Kaçırma Korkusu" anahtar kelimeleri ile tarama yapılarak bu kapsamdaki tez dokümanlarının incelenmesi yolu ile ulaşılmıştır. 2025 yılı Aralık ayı itibari ile 155 adet tez çalışma kapsamında incelenmiş olup, tamamına erişim sağlanmıştır. Araştırmanın evrenini Türkiye'de FOMO üzerine yapılan lisansüstü tezler oluştururken örneklemini de tezlerin tamamı oluşturmaktadır.

Bulgular ve Değerlendirme

FOMO anahtar kelimesi ile toplam 73 adet tez hazırlandığı görülmektedir. Ancak 29 tez başlığında hem FOMO hem de Gelişmeleri Kaçırma Korkusu yer almaktadır. Bunların 6'sı doktora 1'i tıpta uzmanlık geriye kalan 22'si ise yüksek lisans tezidir. Gelişmeleri Kaçırma Korkusu anahtar kelimesi ile hazırlanan 111 adet tez olduğu görülmektedir. Ancak bunların 29'u FOMO anahtar kelimesi ile de karşımıza çıkmaktadır. Geriye 82 tez kalmaktadır. Bunların 11 adeti doktora tezi, 2 adedi tıpta uzmanlık tezi ve geriye kalan 69'u ise yüksek lisans tezidir. Her iki anahtar kelime ile taratıldığında toplam 155 adet tez hazırlandığı görülmektedir.

	Özellikler	Sayı	Yüzde
Tezlerin Türü	Yüksek Lisans	126	%81,3
	Doktora	26	%16,8
	Tıpta Uzmanlık	3	%1,9

Veriler, FoMO üzerine hazırlanan lisansüstü tezlerin büyük çoğunluğunu yüksek lisans çalışmalarının (%81,3) oluşturduğunu göstermektedir. Doktora tezleri (%16,8) daha sınırlı bir paya sahiptir, tıpta uzmanlık tezleri ise oldukça düşük bir oranda (%1,9) temsil edilmektedir. Bu dağılım, FoMO'nun Türkiye'de henüz doktora düzeyinde derinlemesine araştırmalara konu olmaktan ziyade, daha çok yüksek lisans düzeyinde incelendiğini ortaya koymaktadır. Ancak bunun altında yatan temel sebep, konunun yeni olması ve doktora düzeyinde tez yazım sürecinin yüksek lisansa göre daha uzun olması da yatabilir.

	Özellikler	Sayı	Yüzde
Tezlerin Dili	Türkçe	146	%94,2
	İngilizce	9	%5,8

Tezlerin neredeyse tamamı Türkçe (%94,2) hazırlanmış, yalnızca küçük bir kısmı İngilizce (%5,8) olarak yazılmıştır. Bu durum, FoMO araştırmalarının ulusal akademik çevrede yoğunlaştığını, uluslararası akademik iletişime yönelik üretimin ise sınırlı kaldığını göstermektedir. Ayrıca Türkiye'de yabancı dilde tez yazımının zorunlu olduğu program sayısının görece az olmasının da bunda önemli bir etkisinin olduğunu belirtmek gerekmektedir.

	Üniversite Adı	Hazırlanan Tez Sayısı	Yüzde
Tezlerin Hazırlandığı Üniversiteler	İstanbul Medipol Üniversitesi	4	%2,6
	İstanbul Ticaret Üniversitesi	1	%0,6
	Sağlık Bakanlığı	1	%0,6
	Karabük Üniversitesi	2	%1,3
	İstanbul Gedik Üniversitesi	1	%0,6
	Mardin Artuklu Üniversitesi	1	%0,6
	Pamukkale Üniversitesi	1	%0,6
	Kocaeli Üniversitesi	2	%1,3
	Işık Üniversitesi	1	%0,6
	Amasya Üniversitesi	1	%0,6
	Tekirdağ Namık Kemal Üniversitesi	1	%0,6
	Selçuk Üniversitesi	6	%3,9
	Çağ Üniversitesi	3	%1,9
	Zonguldak Bülent Ecevit Üniversitesi İstanbul Aydın Üniversitesi	1 3	%0,6 %1,9
	Kahramanmaraş Sütçü İmam Üniversitesi	1	%0,6
	Çanakkale Onsekiz Mart Üniversitesi Atatürk Üniversitesi	1 4	%0,6 %4,5
	Ankara Hacıbayram Veli Üniversitesi	4	%1,3
	Üsküdar Üniversitesi	7	%0,6
	Özyeğin Üniversitesi	2	%0,6
	Yeditepe Üniversitesi	1	%2,6
	Aydın Adnan Menderes Üniversitesi	1	%1,3
	Necmettin Erbakan Üniversitesi	4	%1,3
	İstanbul Esenyurt Üniversitesi	2	%1,9
	İstanbul Gelişim Üniversitesi	2	%1,3

	Karamanoğlu Mehmetbey Üniversitesi	3	%1,3
	Fırat Üniversitesi	2	%4,5
	Dokuz Eylül Üniversitesi	2	%4,5
	Bayburt Üniversitesi	1	%0,6
	Ege Üniversitesi	3	%2,6
	Erzincan Binali Yıldırım Üniversitesi	2	%0,6
	Marmara Üniversitesi	7	%2,6
	İstanbul Okan Üniversitesi	1	%0,6
	Nevşehir Hacı Bektaş Veli Üniversitesi	4	%0,6
	Manisa Celal Bayar Üniversitesi	1	%0,6
	Beykoz Üniversitesi	1	%0,6
	Kütahya Dumlupınar Üniversitesi	1	%0,6
	Çukurova Üniversitesi	1	%0,6
	Sakarya Üniversitesi	1	%1,9
	Doğuş Üniversitesi	1	%1,3
	Düzce Üniversitesi	1	%0,6
	Yozgat Bozok Üniversitesi	1	%0,6
	Bandırma Onyedi Eylül Üniversitesi	1	%1,3
	Bolu Abant İzzet Baysal Üniversitesi	1	%1,3
	Sivas Cumhuriyet Üniversitesi	3	%1,3
	Hasan Kalyoncu Üniversitesi	2	%1,3
	Aksaray Üniversitesi	1	%1,9
	İnönü Üniversitesi	1	%0,6
	Fatih Sultan Mehmet Vakıf Üniversitesi	2	%0,6
	Kırıkkale Üniversitesi	2	%1,3
	Kastamonu Üniversitesi	1	%1,3
	Eskişehir Osmangazi Üniversitesi	2	%1,3
	Sakarya Uygulamalı Bilimler Üniversitesi	2	%1,3
	Gazi Üniversitesi	2	%1,9
	İstanbul Bilgi Üniversitesi	2	%0,6
	Bahçeşehir Üniversitesi	3	%0,6
	Osmaniye Korkut Ata Üniversitesi	1	%1,3
	Ondokuz Mayıs Üniversitesi	1	%1,3
	Trabzon Üniversitesi	1	%1,3
	Haliç Üniversitesi	1	%1,9
	Atılım Üniversitesi	2	%0,6
	Süleyman Demirel Üniversitesi	1	%0,6
	Boğaziçi Üniversitesi	1	%0,6
	Anadolu Üniversitesi	2	%0,6
	Başkent Üniversitesi	3	%0,6
	Yıldız Teknik Üniversitesi	1	%0,6
	TED Üniversitesi	1	%0,6
	İstanbul Üniversitesi	2	%1,9
	Van Yüzüncü Yıl Üniversitesi	1	%0,6
	Koç Üniversitesi	1	%0,6
	Bilecik Şeyh Edebali Üniversitesi	1	%0,6
	KTO Karatay Üniversitesi	2	%0,6
	Eskişehir Teknik Üniversitesi	1	%0,6
	Altınbaş Üniversitesi	1	%0,6
	Gaziantep Üniversitesi	1	%0,6
	Sakarya Üniversitesi	1	%0,6
	İstanbul Sabahattin Zaim Üniversitesi	1	%0,6
	Kayseri Üniversitesi	1	%0,6
	Hacettepe Üniversitesi	1	%0,6
	Bursa Uludağ Üniversitesi	1	%0,6
	İstanbul Üniversitesi	3	%0,6
	Bartın Üniversitesi	1	%0,6

	Erciyes Üniversitesi	1	%0,6
	İzmir Katip Çelebi Üniversitesi	1	%0,6

FoMO üzerine yapılan tezlerin hem devlet hem de vakıf üniversitelerinde üretildiği görülmektedir. Devlet üniversiteleri %66,5 ile baskın konumdadır. Vakıf üniversitelerinin payı %32,9'dur. Bu dağılım, FoMO araştırmalarının Türkiye'de geniş bir kurumsal çeşitlilik içinde yürütüldüğünü, ancak devlet üniversitelerinin akademik üretimde daha belirleyici olduğunu göstermektedir. Ancak şunu da belirtmek gerekir ki, üniversite çeşitliliği oldukça fazladır. Bu Üniversiteler arasında Üsküdar, Marmara ve Selçuk Üniversiteleri hazırlanan tez sayısı açısından öne çıkan üniversiteler olarak karşımıza çıkmaktadırlar.

	Enstitü Adı	**Hazırlanan Tez Sayısı**	**Yüzde**
Tezlerin Hazırlandığı Enstitüler	Sosyal Bilimler Enstitüsü	82	%52,9
	Fen Bilimleri Enstitüsü	3	%1,9
	Sağlık Bilimleri Enstitüsü	8	%5,2
	Eğitim Bilimleri Enstitüsü	15	%9,7
	Lisansüstü Eğitim Enstitüsü	41	%26,5
	Kış Sporları ve Spor Bilimleri Enstitüsü	1	%0,6
	Karabük Eğitim ve Araştırma Hastanesi	1	%0,6
	Atatürk Üniversitesi Tıp Fakültesi	1	%0,6
	Sakarya Üniversitesi Tıp Fakültesi	1	%0,6
	Turizm Araştırmaları Enstitüsü	1	%0,6
	İşletme Enstitüsü	1	%0,6

Tezlerin yarısından fazlası Sosyal Bilimler Enstitüsü (%52,9) bünyesinde hazırlanmıştır. Lisansüstü Eğitim Enstitüsü (%26,5) ve Eğitim Bilimleri Enstitüsü (%9,7) de önemli paya sahiptir. Sağlık Bilimleri (%5,2) ve Fen Bilimleri (%1,9) enstitülerinde ise daha sınırlı sayıda çalışma yapılmıştır. Bu bulgu, FoMO'nun ağırlıklı olarak sosyal bilimler perspektifinden ele alındığını, sağlık ve fen bilimleri alanlarında ise daha sınırlı biçimde incelendiğini göstermektedir. Ancak Turizm Enstitüsü, İşletme Enstitüsü gibi sayıca çok olmayan birimlerde de konuya ilgininin olduğu aşikardır.

	Hazırlanan Tez Sayısı	**Sayı**	**Yüzde**
Tezlerin Hazırlandığı Üniversite Türlerine Göre Dağılımı	Vakıf Üniversitesi	51	%32,9
	Devlet Üniversitesi	103	%66,5
	Sağlık Bakanlığı	1	%0,6

Tezlerin yaklaşık 1/3'ünün vakıf üniversitelerinde hazırlandığı, yalnızca 1 tıpta uzmanlık tezi nedeniyle Sağlık Bakanlığında hazırlandığı görülmektedir. FOMO ile ilgili yazılan 103 tez ile hazırlanan toplam tezlerin 2/3'ünün devlet üniversiteleri bünyesinde hazırlandığı görülmektedir.

	Yıl	**Sayı**	**Yüzde**
Tezlerin Hazırlandığı Yıllara Göre Dağılımı	2017	2	%1,3
	2018	9	%5,8
	2019	8	%5,2

	2020	4	%2,6
	2021	18	%11,6
	2022	25	%16,1
	2023	28	%18,1
	2024	31	%20,0
	2025	30	%19,4

FoMO üzerine hazırlanan tezlerin yıllara göre artış eğilimi gösterdiği dikkat çekmektedir. 2017'de yalnızca %1,3 oranında tez hazırlanmışken, 2024'te bu oran %20'ye ulaşmıştır. 2025 yılında ise %19,4 ile yüksek düzeyde üretim devam etmiştir. Bu artış, FoMO'nun Türkiye'de son yıllarda hızla yükselen bir araştırma konusu haline geldiğini ortaya koymaktadır. Dijitalleşmeye olan ilgi arttıkça FOMO'ya olan ilginin de artabileceği düşünülmektedir.

	Erişim Durumu	**Yüzde**
Tezlere Erişim Oranı	Erişime Açık	%100

FOMO ile ilgili tezlerin yakın dönemde yazılmasından ötürü tezlerin tamamına erişimin mümkün olduğu görülmektedir.

	Konular	**Adet**	**Yüzde**
Tezlerin Temel Konu Başlık Dağılımı	Aile Hekimliği	1	%0,6
	Bankacılık	1	%0,6
	Bilgisayar Mühendisliği Bilimleri	1	%0,6
	Bilim ve Teknoloji	2	%1,3
	Dil ve Konuşma Terapisi	1	%0,6
	Eğitim ve Öğretim	15	%9,7
	Ekonomi	2	%1,3
	Gazetecilik	1	%0,6
	Güzel Sanatlar	1	%0,6
	Halk Sağlığı	1	%0,6
	Halkla İlişkiler	7	%4,5
	Hemşirelik	2	%1,3
	İletişim Bilimleri	6	%3,9
	İstatistik	2	%1,3
	İşletme	37	%23,9
	Psikiyatri	2	%1,3
	Psikoloji	40	%25,8
	Radyo Televizyon	1	%0,6
	Reklamcılık	3	%1,9
	Sağlık Eğitimi	1	%0,6
	Sağlık Yönetimi	1	%0,6
	Sosyal Hizmet	1	%0,6
	Sosyoloji	1	%0,6
	Spor	6	%3,9
	Turizm	7	%4,5
	Yönetim Bilişim Sistemleri	2	%1,3
	Yöntem	**Adet**	**Yüzde**
Tezlerde Uygulanan Yöntemler	Anket Uygulaması	155	%100

Tezlerin en yoğun şekilde psikoloji (%25,8) ve işletme (%23,9) alanlarında üretildiği görülmektedir. Eğitim (%9,7), halk sağlığı (%4,5), spor (%4,5) ve sosyoloji (%3,9) gibi alanlar da dikkate değer katkılar sunmaktadır. Diğer disiplinlerde ise daha sınırlı sayıda çalışma

yapılmıştır. Bu dağılım, FoMO'nun bireysel psikolojik etkilerinin yanı sıra örgütsel davranış, eğitim süreçleri ve toplumsal sağlık bağlamında da incelendiğini göstermektedir.

SONUÇ

FoMO üzerine yapılan lisansüstü çalışmaların incelenmesi sonucunda, bu dijital olgunun son yıllarda akademik ilgi odağı haline geldiği ve özellikle 2024-2025 yıllarında zirve noktasına ulaştığı görülmektedir. Toplam 155 tezin değerlendirildiği bu süreçte, akademik üretimin büyük bir bölümünün yüksek lisans düzeyinde (%81,3) ve Türkçe (%94,2) olarak gerçekleştirildiği saptanmıştır. Araştırmaların kurumsal olarak devlet üniversitelerinde (%66,5) ve enstitü bazında Sosyal Bilimler Enstitüleri (%52,9) çatısı altında yoğunlaştığı, tematik olarak ise en çok psikoloji (%25,8) ve işletme (%23,9) disiplinlerinde ele alındığı sonucuna ulaşılmıştır.

Mevcut akademik tablodaki en dikkat çekici bulgu, incelenen tüm tezlerin (%100) veri toplama yöntemi olarak sadece anket uygulamasını tercih etmiş olmasıdır. Bu metodolojik tekdüzeliği aşmak adına, gelecekteki araştırmalarda FoMO'nun altında yatan derin motivasyonları anlamaya yönelik nitel veya karma desenli çalışmaların yürütülmesi büyük önem arz etmektedir. Ayrıca, literatürdeki çalışmaların çoğunluğunun yüksek lisans düzeyinde kalması nedeniyle, konunun daha kapsamlı ve teorik derinliği olan doktora tezleri ile desteklenmesi önerilmektedir.

Akademik üretimin uluslararası görünürlüğünü artırmak ve küresel literatürle etkileşime girmek amacıyla İngilizce dilinde hazırlanan tezlerin sayısı artırılmalı; sağlık, teknoloji ve sanat gibi daha az çalışılan disiplinlerle disiplinlerarası köprüler kurulmalıdır. Uzunlamasına araştırmalarla FoMO'nun zaman içindeki değişimini gözlemlemek ve farklı yaş grupları, meslekler ya da kültürel bağlamlarda karşılaştırmalı analizler yapmak da alana özgü yeni açılımlar sağlayacaktır.

POLİTİKA KURULLARI ÜZERİNE YAZILAN LİSANSÜSTÜ TEZLERİN ANALİZİ

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ÖZET

2018'de Cumhurbaşkanlığı Hükümet Sistemi'nin kabulü, Türk kamu yönetimine önemli yapısal değişiklikler getirmiştir. Bu yenilikler arasında, politika geliştirme süreçlerinde Cumhurbaşkanına stratejik danışmanlık yapmak üzere tasarlanan Politika Kurulları öne çıkmaktadır. Bu bildiri, bu yeni idari yapı üzerine yazılan lisansüstü tezleri sistematik olarak analiz etmeyi amaçlamaktadır. Çalışma, bu yeni gelişen literatürdeki tematik odakları, metodolojik tercihleri ve temel bulguları haritalandırmayı hedeflemektedir. Böylece, mevcut araştırma eğilimleri belirlenerek gelecek çalışmalar için yeterince araştırılmamış alanlar vurgulanacaktır.

Araştırma, nitel doküman analizi yöntemini kullanmaktadır. Veri setini, Yükseköğretim Kurulu Ulusal Tez Merkezi veri tabanından "Politika Kurulları" anahtar kelimesiyle elde edilen yüksek lisans ve doktora tezleri oluşturmaktadır. Toplanan tezler, önceden tanımlanmış kategorilere göre içerik analizi yoluyla incelenecektir. Bu kategoriler tezin anabilim dalını, araştırma desenini ve ele alınan özel sorunları içermektedir. Bu analizin, Politika Kurullarının akademik alandaki yansımalarına dair bütüncül bir bakış açısı sunması ve alandaki yeni araştırmacılara bir yol haritası sağlaması beklenmektedir.

Anahtar Kelimeler: Kamu Politikası, Cumhurbaşkanlığı Hükümet Sistemi, Politika Kurulları, Tez Analizi, Literatür Taraması.

AN ANALYSIS OF POSTGRADUATE THESES ON POLICY BOARDS

ABSTRACT

The adoption of the Presidential Government System in 2018 introduced significant structural changes to Turkish public administration. Prominent among these innovations are the Policy Boards, designed to provide strategic advice to the President in policymaking processes. This paper aims to systematically analyze the postgraduate theses written on this new administrative structure. The study seeks to map the thematic focuses, methodological choices, and key findings within this emerging literature. Thus, by identifying current research trends, it will highlight under-researched areas for future studies.

The research employs a qualitative document analysis method. The dataset consists of master's and doctoral theses obtained from the Council of Higher Education National Thesis Center database using the keyword "Policy Boards". The collected theses will be examined through content analysis according to predefined categories. These categories include the academic department, research design, and the specific issues addressed. This analysis is expected to offer a comprehensive overview of the academic discourse on the Policy Boards and provide a roadmap for new researchers in the field.

Keywords: Public Policy, Presidential Government System, Policy Boards, Thesis Analysis, Literature Review.

GİRİŞ

Cumhurbaşkanlığı Hükümet Sistemi'nin kabulüyle birlikte Türk kamu yönetiminde ortaya çıkan en önemli kurumsal yeniliklerden biri, politika geliştirme süreçlerinde Cumhurbaşkanına doğrudan danışmanlık yapmak üzere oluşturulan Politika Kurullarıdır. Bu kurullar, karar alma mekanizmalarının işleyişine stratejik bir boyut kazandırmış ve kamu politikalarının şekillenmesinde yeni bir kurumsal çerçeve ortaya koymuştur.

Politika Kurulları üzerine yapılan lisansüstü tezlerin incelenmesi, bu yeni idari yapının akademik literatürde nasıl karşılık bulduğunu anlamak açısından önemlidir. Tezlerin büyük çoğunluğunun yüksek lisans düzeyinde olması, konunun akademik üretim açısından henüz erken bir evrede bulunduğunu göstermektedir. Bununla birlikte doktora düzeyinde hazırlanan çalışmaların artış eğilimi, ilerleyen dönemde daha derinlemesine kuramsal ve metodolojik katkıların ortaya çıkacağına işaret etmektedir.

Araştırmaların farklı üniversitelere ve enstitülere dağılması, Politika Kurulları konusunun yalnızca belirli merkezlerde değil, ülke genelinde farklı akademik gelenekler ve bakış açılarıyla ele alındığını göstermektedir. Bu çeşitlilik, konunun kamu yönetimi ve siyaset bilimi ekseninde yoğunlaşmasına rağmen farklı akademik çevrelerde ilgi uyandırdığını ortaya koymaktadır. Yöntemsel açıdan ise literatür taraması ve içerik analizinin baskınlığı, araştırmaların betimleyici düzeyde kaldığını ve ilerleyen süreçte daha fazla saha araştırmasına ihtiyaç duyulduğunu göstermektedir.

Bu çerçevede, Politika Kurulları üzerine yapılan lisansüstü tezlerin sistematik analizi, yalnızca mevcut akademik üretimi haritalandırmakla kalmamakta; aynı zamanda kamu yönetimi araştırmalarında yeni yönelimlerin ve boşlukların belirlenmesine katkı sağlamaktadır. Böylece,

hem literatüre bütüncül bir bakış açısı kazandırılmakta hem de gelecekteki çalışmalar için yol gösterici bir kuramsal zemin oluşturulmaktadır.

POLİTİKA KURULLARI KONUSUNDA HAZIRLANAN LİSANSÜSTÜ TEZLERİN BİBLİYOMETRİK ANALİZİ

Araştırmanın Amacı ve Yöntemi

Bu çalışma, 2018 yılında Cumhurbaşkanlığı Hükümet Sistemi ile Türk kamu yönetimine dahil olan Politika Kurulları üzerine yazılan lisansüstü tezleri sistematik olarak analiz etmeyi amaçlamaktadır. Araştırma aracılığıyla, bu yeni idari yapıya dair literatürdeki tematik odaklar, metodolojik tercihler ve temel bulgular haritalandırılarak gelecekteki çalışmalar için bir yol haritası sunulması hedeflenmektedir.

Araştırmada nitel doküman analizi yöntemi kullanılmıştır. Veri seti, YÖK Ulusal Tez Merkezi veri tabanından "Politika Kurulları" ve "Politika Kurulu" anahtar kelimeleriyle taranan ve tam erişim sağlanan 10 adet tezden (4 doktora, 6 yüksek lisans) oluşturulmuştur. Bu tezler; anabilim dalı, araştırma deseni ve ele alınan özel sorunlar gibi önceden tanımlanmış kategorilere göre içerik analizi yoluyla incelenmiştir

Araştırmanın Evren ve Örneklemi

YÖK Ulusal Tez Veri Tabanından politika kurulu ve politika kurulları anahtar kelimeleri ile tarama yapılarak bu kapsamdaki tez dokümanlarının incelenmesi yolu ile ulaşılmıştır. 2025 yılı Aralık ayı itibari ile 10 adet tez çalışma kapsamında incelenmiş olup, 10 adet tez dokümanının tamamına tam erişim sağlanmıştır. Araştırmanın evrenini Türkiye'de politika kurulları üzerine yapılan lisansüstü tezler oluşturmaktadır. Örneklemini ise ulaşılabilen 10 adet tez oluşturmaktadır.

Bulgular ve Değerlendirme

Cumhurbaşkanlığı Politika Kurulları ile ilgilİ YÖK Ulusal Tez Veri Merkezinde 10 adet tez olduğu görülmektedir. Bunların 4 adedi doktora tezi iken, geriye kalan 6'sı ise yüksek lisans tezidir.

	Özellikler	Sayı	Yüzde
Tezlerin Türü	Yüksek Lisans Doktora	6 4	%60 %40

Tezlerin %60'ının yüksek lisans düzeyinde olması, konunun akademik üretim açısından henüz erken bir aşamada olduğunu göstermektedir. Literatürde yeni ortaya çıkan idari yapılar genellikle önce yüksek lisans tezlerinde incelenir, doktora düzeyinde ise daha derinlemesine

kuramsal ve metodolojik katkılar yapılır. Bu dağılım, konunun akademik alanda giderek önem kazandığını ve doktora düzeyinde araştırmaların artış eğiliminde olduğunu işaret etmektedir.

	Özellikler	Sayı	Yüzde
Tezlerin Dili	Türkçe	10	%100

İncelenen tüm tezlerin Türkçe olması, konunun daha çok ulusal bağlamda tartışıldığını ve uluslararası literatüre yansımasının henüz sınırlı olduğunu ortaya koymaktadır. Literatürde kamu yönetimi reformlarının uluslararası karşılaştırmalı çalışmalara konu olduğu bilinse de, Türkiye'deki Politika Kurulları üzerine yapılan araştırmaların daha çok yerel akademik çevrelerde tartışıldığını söylemek mümkündür.

	Üniversite Adı	Hazırlanan Tez Sayısı	Yüzde
Tezlerin Hazırlandığı Üniversiteler	Ankara Hacıbayram Veli Üniversitesi	2	%20
	Niğde Ömer Halisdemir Üniversitesi	1	%10
	Süleyman Demirel Üniversitesi	1	%10
	İnönü Üniversitesi	1	%10
	İstanbul Medeniyet Üniversitesi	1	%10
	Zonguldak Bülent Ecevit Üniversitesi	1	%10
	Bartın Üniversitesi	1	%10
	Trakya Üniversitesi	1	%10
	Maltepe Üniversitesi	1	%10

Tezlerin farklı üniversitelere dağılmış olması, Politika Kurulları konusunun yalnızca belirli merkezlerde değil, Türkiye'nin farklı bölgelerinde akademik ilgi uyandırdığını göstermektedir. Ankara Hacı Bayram Veli Üniversitesi'nin %20 oranla diğer üniversitelerden biraz daha fazla tez üretmiş olması dikkat çekicidir; ancak genel dağılım incelendiğinde çalışmaların çok geniş bir üniversite yelpazesine yayıldığı görülmektedir. Bu durum, Politika Kurulları üzerine araştırmaların tek bir akademik merkezde yoğunlaşmadığını, aksine ülke çapında farklı akademik gelenekler ve bakış açılarıyla ele alındığını ortaya koymaktadır. Literatürde kamu politikası araştırmalarının genellikle başkent merkezli üniversitelerde yoğunlaştığına dair bulgular olsa da, bu tablo Türkiye'de Politika Kurulları konusunun daha yaygın ve çeşitlenmiş bir akademik ilgiye konu olduğunu göstermektedir.

	Enstitü Adı	Hazırlanan Tez Sayısı	Yüzde
Tezlerin Hazırlandığı Enstitüler	Sosyal Bilimler Enstitüsü	4	%40
	Lisansüstü Eğitim Enstitüsü	6	%60

Tezlerin çoğunluğunun Lisansüstü Eğitim Enstitüsü bünyesinde hazırlanması, üniversitelerdeki yeni enstitü yapılanmalarının araştırma üretiminde aktif rol oynadığını göstermektedir. Literatürde enstitülerin kurumsal yapısının araştırma çeşitliliğini etkilediği vurgulanır; bu dağılım da yeni enstitülerin kamu yönetimi alanında üretken olduğunu ortaya koymaktadır.

	Anabilim Dalı Adı	Hazırlanan Tez Sayısı	Yüzde
Tezlerin Hazırlandığı Anabilim Dalları	Kamu Hukuku	1	%10
	Kamu Yönetimi	2	%20
	Siyaset Bilimi ve Kamu Yönetimi	5	%50
	Kamu Yönetimi ve Siyaset Bilimi	1	%10
	Siyaset Bilimi ve Uluslararası İlişkiler	1	%10

Tezlerin yarısının (%50) "Siyaset Bilimi ve Kamu Yönetimi" anabilim dalında hazırlanması, Politika Kurulları konusunun daha çok kamu yönetimi perspektifinden ele alındığını göstermektedir. Hatta kamu yönetimi ile kamu yönetimi ve siyaset bilimi anabilim dallarının da yalnızca isim farklılaşması olduğu dikkate alındığında tezlerin %80'nin kamu yönetimi disiplini tarafından hazırlandığını göstermektedir. Literatürde kamu politikası araştırmalarının disiplinlerarası bir nitelik taşıdığı bilinse de, bu bulgu Türkiye'de konunun daha çok siyaset bilimi ve kamu yönetimi ekseninde işlendiğini ortaya koymaktadır.

	Üniversite Türü	Sayı	Yüzde
Tezlerin Hazırlandığı Üniversite Türlerine Göre Dağılımı	Vakıf Üniversitesi	1	%10
	Devlet Üniversitesi	9	%90

Çalışmaların %90'ının devlet üniversitelerinde ve %80'inin Siyaset Bilimi ve Kamu Yönetimi disiplini ekseninde hazırlanmış olması dikkat çekicidir. Tezlerin %90'ının devlet üniversitelerinde hazırlanması, Politika Kurulları üzerine araştırmaların daha çok kamu üniversitelerinde yürütüldüğünü göstermektedir. Literatürde kamu yönetimi araştırmalarının genellikle devlet üniversitelerinde yoğunlaştığı bilinir; bu bulgu da bu eğilimi doğrulamaktadır.

	Yıl	Sayı	Yüzde
Tezlerin Hazırlandığı Yıllara Göre Dağılımı	2019	1	%10
	2020	1	%10
	2021	1	%10
	2022	2	%20
	2023	2	%20
	2024	1	%10
	2025	2	%20

Tezlerin yıllara göre dağılımı, 2022'den itibaren belirgin bir artış olduğunu göstermektedir. Bu artış, Politika Kurullarının uygulamadaki etkilerinin daha görünür hale gelmesiyle ilişkilendirilebilir. 2018 yılında kurulan Politika Kurullarına ilişkin araştırma yapılabilmesi için

belli bir zamana ihtiyaç vardır. Literatürde kamu yönetimi reformlarının akademik çalışmalara yansımasının genellikle birkaç yıl gecikmeli olduğu belirtilir; bu bulgu da bu kuramsal çerçeveyi doğrulamaktadır.

	Erişim Durumu	Sayı	Yüzde
Tezlere Erişim Oranı	Erişime Açık Erişime Kapalı	10 0	%100

Tüm tezlerin erişime açık olması, araştırmacılar için önemli bir avantajdır. Literatürde açık erişim politikalarının akademik üretimi ve bilgi paylaşımını artırdığı vurgulanır. Bu durum, Politika Kurulları üzerine yapılacak yeni araştırmalar için güçlü bir veri tabanı oluşturacaktır.

	Konular	Adet	Yüzde
Tezlerin Temel Konu Başlık Dağılımı	Kamu Yönetimi	10	%100
	Yöntem	**Adet**	**Yüzde**
Tezlerde Uygulanan Yöntemler	Literatür Taraması Söylem ve İçerik Analizi	9 1	%90 %10

Tezlerin %90'ında literatür taraması yönteminin tercih edilmesi, Politika Kurulları üzerine yapılan araştırmaların henüz kuramsal ve betimleyici düzeyde olduğunu göstermektedir. Literatürde yeni idari kurumların araştırılmasında başlangıçta literatür taraması ve içerik analizi gibi yöntemlerin öne çıktığı, daha sonra ampirik yöntemlerin çeşitlendiği görülür. Bu bulgu, Politika Kurulları araştırmalarının henüz erken aşamada olduğunu ve ilerleyen dönemde daha fazla saha araştırmasına ihtiyaç duyulduğunu ortaya koymaktadır.

SONUÇ

Politika Kurulları üzerine yapılan lisansüstü tezlerin analizi, bu kurumun akademik literatürde henüz erken bir evrede olduğunu göstermektedir. Tezlerin %60'ının yüksek lisans düzeyinde olması, araştırmaların daha çok keşif ve betimleme aşamasında yoğunlaştığını ortaya koymaktadır. Doktora düzeyindeki %40'lık pay ise konunun giderek derinleştiğini ve kuramsal katkıların artış eğiliminde olduğunu göstermektedir. Çalışmaların tamamının Türkçe olması, araştırmaların ulusal bağlamda şekillendiğini; yöntemsel açıdan ise %90 oranında literatür taramasına dayalı olması, ampirik çeşitliliğin henüz sınırlı kaldığını ortaya koymaktadır.

Tezlerin farklı üniversite ve enstitülerde hazırlanması, konunun geniş bir akademik ilgiye sahip olduğunu; anabilim dallarının ise ağırlıklı olarak siyaset bilimi ve kamu yönetimi ekseninde yoğunlaştığını göstermektedir. Yıllara göre artan tez sayısı, Politika Kurullarının uygulamadaki etkilerinin görünür hale gelmesiyle birlikte akademik üretimin ivme kazandığını işaret etmektedir.

AB ÜLKELERİ HİZMETLER SEKTÖRÜ FİRMALARINDA SÜRDÜRÜLEBİLİRLİĞİN SERMAYE YAPISINA ETKİSİ

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ÖZET

Son yıllarda ülkeler arası ihtilaflar, ekonomik durgunluk, şirket skandalları, küresel ısınma, çevre kirliliği ve iklim krizleri gibi sorunlar sürdürülebilirliğe olan ilginin tüm dünyada artmasına neden olmuştur. Ayrıca işletmeler sürdürülebilirlik alanındaki faaliyetlerini raporlamaya başlamıştır. İşletmelerin çevresel, sosyal ve kurumsal yönetim (ESG) alanındaki faaliyet ve yatırımları ESG skorları ile ölçülmeye başlanmıştır. ESG skorları firmaların tüm paydaşları tarafından firmaların çevresel, sosyal ve kurumsal yönetişim kalitesinin bir ölçütü olarak kullanılmaya başlanmıştır. Bu gelişmeler ile birlikte ESG skorunun firmaların performansı, firma değeri, yatırımcı davranışına etkisi gibi konular araştırılmaya başlanmıştır. Finans literatüründe güncel araştırma konularından biri de sürdürülebilirliğin sermaye yapısına etkisidir ve bu alanda az sayıda çalışma bulunmaktadır. Bu çalışmanın amacı firmaların ESG skorlarının sermaye yapısı üzerindeki etkisi araştırmaktır. 2015-2024 dönemini kapsayan çalışmada, Avrupa Birliği ülkelerinde hizmet sektöründe faaliyet gösteren 43 işletmenin verisi analiz edilmiştir. ESG skorunun sermaye yapısına etkisini araştırmada Güçlendirilmiş Panel Düzeltilmiş Standart Hatalar (PCSE) yöntemi kullanılmıştır. Elde edilen sonuçlar, ESG skorları ile sermaye yapısı arasında pozitif yönlü bir ilişki olduğunu göstermektedir. Karlılığı temsilen kullanılan faiz, vergi ve amortisman öncesi karın toplam aktiflere oranı ile ESG skoru arasında negatif yönlü bir ilişki bulunmuştur. Firma büyüklüğünü temsilen kullanılan aktif büyüklüğünün, ESG skoru üzerinde istatistiksel olarak anlamlı bir etkisi çıkmamıştır.

Anahtar Kelimeler: ESG, Sürdürülebilirlik, Kaldıraç Oranı, Sermaye Yapısı, Karlılık

THE IMPACT OF SUSTAINABILITY ON THE CAPITAL STRUCTURE OF SERVICES SECTOR COMPANIES IN EU COUNTRIES

ABSTRACT

In recent years, issues such as international conflicts, economic stagnation, corporate scandals, global warming, environmental pollution, and climate crises have led to a worldwide increase in interest in sustainability. In addition, businesses have begun reporting on their sustainability activities. Businesses' activities and investments in environmental, social, and corporate

governance (ESG) are now measured using ESG scores. ESG scores have started to be used by all stakeholders as a measure of the quality of companies' environmental, social, and corporate governance. With these developments, topics such as the impact of ESG scores on company performance, company value, and investor behavior have begun to be researched. One of the current research topics in financial literature is the impact of sustainability on capital structure, and there are few studies in this area. The purpose of this study is to investigate the effect of companies' ESG scores on their capital structure. The study, covering the period 2015-2024, analyzed data from 43 companies operating in the service sector in European Union countries. The Panel Corrected Standard Errors (PCSE) method was used to investigate the effect of ESG scores on capital structure. The results indicate a positive relationship between ESG scores and capital structure. A negative relationship was found between the ratio of earnings before interest, taxes, and depreciation to total assets, used as a proxy for profitability, and the ESG score. The size of assets, used as a proxy for firm size, did not have a statistically significant effect on the ESG score.

Keywords: ESG, Sustainability, Leverage Ratio, Capital Structure, Profitability

1. GİRİŞ

Sermaye yapısı, genel olarak işletmelerin varlıklarının finansmanında kullandıkları fonların, hangi oranda öz kaynak ve hangi oranda borçlardan oluştuğunu gösteren bir kavramdır. İşletmeler borcun vergi kalkanı avantajından ve finansal kaldıraç etkisinden faydalanmak için borçla finansmana öncelik verebilirler. Ancak sermaye yapısı içerisinde borçlanmanın payı yükseldikçe işletmenin finansal riski de artacağından, borcun sermaye yapısı içindeki oranına dikkat edilmesi gerekmektedir. Bu oran, işletmenin faaliyet gösterdiği bölge, işletmenin faaliyet gösterdiği sektör, rakip işletmelere göre vb. değişiklik gösterebilir (Ceylan & Korkmaz, 2021). İşletmeler, sermaye yapılarını oluştururken, her bir kaynak kaleminin ayrı ayrı maliyetleri hesaplanarak, ağırlıklı ortalama sermaye maliyetine ulaşırlar. Ağırlıklı ortalama sermaye maliyetinin minimum olduğu nokta firmalar için optimal sermaye yapısı olarak kabul edilir. Optimal sermaye yapısının belirlenmesi ve korunması, teorik olarak zor olduğu gibi pratikte de zordur. Optimal sermaye yapısı belirlenirken, finans yöneticisinin dikkate alması gereken birçok değişken söz konusudur. Bunlar içerisinde ülkenin faiz politikaları, yatırımcıların kararları, ülkedeki finans kuruluşlarının işletmeye bakış açıları vb. örnekler sayılabilir (Okka, 2015).

İşletmelerin sermaye yapılarını etkileyen faktörler, makroekonomik faktörler, firmaya özgü faktörler ve finansal piyasalara bağlı faktörler olarak üç ana başlık altında incelenebilir (Aydın, Başar, & Coşkun, 2021). Tüm bu faktörleri açacak olursak işletmeye özgü faktörler, firmanın riski düzeyi, büyüklüğü, karlılık, işletmenin varlık yapısı vb. şeklinde sıralanabilir. Finansal piyasalara özgü faktörler, sermaye piyasasının gelişmişlik düzeyi, finansal aracıların gelişmişlik düzeyleri, yasal sistemin etkinliği ve kreditör ve hissedar haklarıdır. Makroekonomik faktörlerde ise, işletmenin faaliyet gösterdiği ülkenin büyüme oranı, enflasyon oranı, faiz oranı ve vergi oranı olarak ifade edilebilir (Kakilli Acaravcı 2004).

Sürdürülebilirlik ve sürdürülebilir kalkınma kavramları dünyada çevresel bozulmanın gittikçe artması ile birlikte son yılların en çok tartışılan konuları arasında yer almaktadır. Sürdürülebilirlik, enerji, ekonomi ve çevre üçgeninin tam merkezinde bulunduğu için hükümetler ve hükümetlerarası örgütlerin yanı sıra, sosyal bilimcilerden fen ve doğa bilimcilerine, politikacılardan yerel ve uluslararası çevre örgütlerine kadar çok geniş bir kesim tarafından tartışılmaktadır. Sürdürülebilirliğe ilişkin kaygılar Malthus ve Jevons gibi 18. ve 19. yüzyıl iktisatçılarına kadar gitse de "sürdürülebilir kalkınma" kavramının doğması 20. yüzyılda çevreye ilişkin kaygıların ortaya çıkışına rastlamaktadır. Sürdürülebilirlik kavramının genel kabul görmesi ve geniş bir kullanım alanı bulması Dünya Çevre ve Kalkınma Komisyonu'nun (1987) "Ortak Geleceğimiz" başlıklı raporuyla gerçekleşmiştir. Bu raporda sürdürülebilir kalkınma "bugünün gereksinimlerini, gelecek kuşakların da kendi gereksinimlerini karşılayabilme olanağından ödün vermeksizin karşılayan kalkınma" şeklinde tanımlanmıştır (Yeni, 2014: 183-184).

Sürdürülebilirlik kavramı, bir durumun veya herhangi bir şeyin devam etmesini sağlamak anlamına gelmektedir (Yavuz, 2010). Genel olarak ise insan faaliyetleri sonucunda tükenme noktasına doğru yol almakta olan, dünya kaynaklarının verimli kullanılmasıyla, insan ve işletmelerin, varlıklarını devam ettirmesi olarak ifade edilebilir (Turner, 2008). Günümüzde bu kavram, ekonomik kavramlarla beraber ele alınmakta ve sürdürülebilir kalkınma ile eş anlamlı olarak ifade edilebilmektedir (Yavuz, 2010).

Son yıllarda ülkeler arası ihtilaflar, ekonomik durgunluk, şirket skandalları, küresel ısınma, çevre kirliliği ve iklim krizleri gibi sorunlar ve işletmelerin paydaşlarından gelen talepler, sürdürülebilirlik ile ilgili çeşitli raporlamaların yapılmasına yol açmıştır. Finans alanında özellikle çevre, sosyal sorumluluk ve kurumsal yönetim noktasında sürdürülebilirlik ile ilgili konulara olan ilgi artmış, bu konularda yürütülen faaliyet ve yatırımların raporlaması ihtiyacını

ortaya çıkarmış ve bu ihtiyaca yanıt olarak da işletmelerin çevresel, sosyal ve kurumsal yönetim (ESG) ile ilgili faaliyetlerini değerlendirmek için kullanılan ESG skorları ortaya çıkmıştır. İşletmelerin paydaşlarının finansal kararları üzerinde daha fazla belirleyici olmaya başlayan bu skorlar, finans literatüründe de ölçümü zor olan faaliyetleri değerlendirmede somut bir gösterge olarak yoğun olarak kullanılmaya başlanmıştır (Çetenak, Ersoy ve Işık, 2022: 76). Sürdürülebilirlik raporları ve ESG skorları hissedarlar ve yatırımcılar tarafından kurumsal şeffaflığın, sosyal ve çevresel performansın ve yönetim kalitesinin bir göstergesi olarak kabul edilmektedir (Özsözgün Çalışkan, 2012: 41).

Sürdürülebilirliğin, işletmelerin performanslarına olan etkisinin incelenmesi ve analizlerinin standart hale getirebilmek için, günümüzde ortak bir ölçü olarak ESG verileri kullanılmaktadır. ESG, işletmelerin, çevresel, sosyal ve yönetişim açısından sürdürülebilirliklerinin, 630 farklı metrik kullanarak hesaplandığı veriler olarak ifade edilebilir. Bu metriklerin sonucunda ortaya çıkan skorlar, üç ana kategori ayrı ayrı görülebileceği gibi, bu üç kategoriden de ortalama bir ESG skoru elde edilmektedir (Refinitiv, 2022).

ESG skoru, işletmelerin çevresel, sosyal ve kurumsal yönetim alanlarındaki yatırım ve faaliyetleri ile ilgili performansını ortaya koyan bir ölçüttür. ESG skoru, çevresel, sosyal ve kurumsal yönetim olmak üzere üç temel alt unsurdan oluşmaktadır. İşletmeler için bu üç alt unsura (çevresel faaliyetlere ilişkin (Environmental Pillar Score), sosyal faaliyetlere ilişkin (Social Pillar Score) ve kurumsal yönetim faaliyetlerine ilişkin (Governance Pillar Score) ayrı ayrı skorlar hesaplanmakta hem de bu üç alt unsurların bileşimiyle kombine ESG skoru esaplanmaktadır (Çetenak, Ersoy ve Işık, 2022: 76).

Finans literatüründeki en güncel konulardan birisi sürdürülebilirliğin firmalar üzerindeki etkisidir. Finans literatürü incelendiğinde sürdürülebilirliğin ve bu kapsamda ESG skorunun işletmeler üzerindeki etkisinin farklı açılardan ve farklı ülke grupları ve sektörlerde araştırıldığı görülmektedir. Sürdürülebilirliğin ve ESG skorlarının işletmelerin finansal performansı, firma değeri, yatırımcı davranışı, yeşil tahviller, risk yönetimi vb. üzerindeki etkisini inceleyen çok sayıda çalışma bulunmaktadır. Sürdürülebilirlik ile ilgili güncel araştırma konularından biri de sürdürülebilirliği işletmelerin sermaye yapısı üzerindeki etkisidir ve bu konuda literatürde sınırlı sayıda araştırma vardır. Bu nedenle bu çalışmada işletmelerde sürdürülebilirliğin bir ölçütü olarak kullanılan ESG skorunun sermaye yapısı üzerindeki etkisi araştırılarak literatüre katkı sağlamak amaçlanmıştır. Çalışma 2015-2024 dönemini kapsamaktadır ve Avrupa Birliği ülkelerinde hizmet sektöründe faaliyet gösteren, on yıllık verisine ulaşılabilen 43 işletmenin

verisi kullanılmıştır. Çalışmada araştırma yöntemi olarak panel regresyon analizi yöntemi kullanılmıştır.

2. LİTERATÜR TARAMASI

Kalyoncu & Çetin (2024) çalışmalarında ESG performansının sermaye yapısı üzerindeki etkisini incelemişlerdir. Bu sebeple BRICS-T ülkelerinde finansal sektör haricinde iş yapan şirketlerin 2014-2021 yılları arası verileri incelenmiş ve toplam 6230 firma-yıl gözlemi üzerinden panel veri analizi yapılmıştır. Çalışma sonucunda çevresel performans skoru, sosyal performans puanı ve ESG puanının zamanla borç oranını olumsuz yönde ve istatistiksel olarak etkilediği görülmüştür. Fakat, yönetişim performans puanının zamanla borç oranı üzerindeki etkisi istatistiksel olarak anlamsız bulunmuştur.

Chang, Rhee & Yoon (2024) çalışmalarında borçluların sermaye yapısının ESG'yi entegre etme motivasyonlarını nasıl etkilediği analiz edilmiştir. Borçlular, dış yatırımcılara yapılması beklenen ödemeleri azaltmak için sosyal açıdan değerli ancak finansal açıdan düşük performans gösteren projeleri tercih etmişlerdir. Yatırımcıların elindeki menkul kıymetlerin getirileri projenin karlılığına karşı oldukça duyarlı olduğunun ve bu finansal kazançların daha da artacağından bahsetmiştir. Ancak, yatırımcılar arasındaki rekabet sözleşme duyarlılığını içsel olarak azaltarak ESG hedeflerini zayıflatacağını da belirtmiştir. Finansal motivasyona sahip borçluların, borçlanmayı tercih edeceklerini; bu, yeşil finansmanda borçlanmanın artan eğiliminin olası bir açıklaması olacağını öne sürmüştür. Asimetrik bilgi altında, ESG odaklı borçlular, bazı yatırımcılar doğrudan yeşil finansman için parasal kayıpları göze alabilecek sonuç odaklı olmayan yatırımcılar olduğu için, hisse senedi ihraç ederek türlerini güvenilir bir şekilde gösterebileceklerinden bahsedilmiştir.

Yang & Deng (2025) çalışmalarında, ESG derecelendirme uyuşmazlığının kurumsal sermaye yapısı ayarlama hızına etkisini araştırmaktadır. Çalışma içindeki bulgular, ESG derecelendirme uyuşmazlığındaki bir standart sapma artışının, ortalama sermaye yapısı ayarlama hızında %7,8'lik bir azalmaya yol açtığını ortaya koymuştur. Bu engelleyici etki, özellikle hedef sermaye yapısından aşağı yönlü sapmalar gösteren şirketlerde daha fazla belirgin olduğu söylenmiştir. Analiz, finansman kısıtlamaları, finansal kaynak tahsis verimliliği ve yatırımcı güveninin, ayarlama hızını azaltan ana mekanizmalardan olduğunu belirlemiştir. Ayrıca, daha yüksek ESG performansı, ESG derecelendirme uyuşmazlığının ayarlama hızı üzerindeki azaltıcı etkisini azaltmaya yardımcı olacaktır. Farklı derecelendirme kuruluşu kaynaklarına göre, ortalama yerel ESG uyuşmazlığının da ayarlama hızına daha büyük bir engel teşkil ettiğini

bulmuşlardır. Son olarak, kurumsal bilgi açıklama kalitesinin artması, bu olumsuz etkiyi etkili bir şekilde azaltmaktadır.

Hsu vd. (2023) 2003 ile 2020 yılları arasında 28 ülkedeki küresel halka açık şirketlerde kısmi ayarlama yaklaşımını kullanarak, yüksek çevresel, sosyal ve yönetişim (ESG) performansının kaldıraç oranlarının ayarlama hızının artmasına yol açıp açmadığını incelemiştir. Özellikle ESG performansı ve faiz oranı politikalarının ortak etkilerinin şirketlerin kaldıraç oranlarının ayarlama hızını nasıl etkilediğiyle ilgilenmiş ve ESG performansı daha iyi olan şirketlerin kaldıraç oranlarını ayarlama maliyetlerinin daha düşük ve borç yönetiminin daha hızlı olduğunu, bu da kurumsal kaldıraç oranlarında daha hızlı ayarlamaları kolaylaştırdığını gösteren kanıtlar bulmuştur. Ayrıca, ESG performansının kaldıraç oranlarını ayarlama hızı üzerindeki olumlu etkisi, yüksek ve potansiyel olarak daha değişken faiz oranı politikalarına sahip ülkelerde daha az belirgindir. Bu araştırmanın ayrıca, güçlü kurumsal kalite, sıkılaştırma politikası ve iyi tahakkuk kalitesinin bilgi asimetrisini azalttığını ve kaldıraç oranlarını ayarlama hızını artırdığını göstermektedir. Farklı olarak ESG performansı, kurumsal çerçevelerin zayıf olduğu ülkelerdeki şirketler için daha yavaş kurumsal kaldıraç ayarlamalarıyla ilişkili olduğundan bahsetmiştir. Sıkılaştırma politikaları uygulayan ülkelerde ESG puanlarının en üst %10'unda yer alan şirketler için ESG performansı ile kurumsal kaldıraç ayarlama hızı arasında pozitif bir bağlantı bulduğu söylenmiştir.

Zhao & Zhang (2024) çalışmalarında ESG skorlarının kurumsal finansman üzerindeki etkisini anlamak ve özellikle Çin'de faaliyet gösteren işletmelerde ESG ve sermaye yapısı üzerine kanıtlar üzerine araştırma yapmışlardır. Bu araştırma, Çinli şirketlerde ESG performansı ile sermaye yapısı arasındaki bağlantıyı, bilhassa borç ve öz sermaye finansmanına odaklanarak araştırmaktadır. 2010-2022 yılları arasındaki panel verilerini ve sistem GMM modelini kullanan çalışma, şirket özel unsurlarını kontrol etmektedir. Sonuçlar, çevresel ve yönetişim skorlarının borç finansmanıyla negatif, öz sermaye finansmanıyla ise pozitif bir ilişki içinde olduğunu göstermektedir. Sosyal skorların borç finansmanı üzerinde anlamlı bir etkisi olmadığını, ancak öz sermaye finansmanı üzerinde pozitif bir etkisi olduğu görüldüğünden bahsedilmiştir. Tüm ESG göstergeleri borç/öz sermaye oranıyla pozitif bir ilişki içindedir ve sürdürülebilirliğin sermaye yapısı tercihlerinde rolünü vurgulamaktadır. Bu bulgular, politika yapıcıları sürdürülebilir uygulamaları teşvik etmede ve kurumsal liderlerin finansman stratejilerini sürdürülebilirlik hedefleriyle uyumlu hale getirmede, uzun vadeli büyümeyi ve paydaş değerini desteklemede yol gösterici niteliktedir.

Kurt & Sakınç (2025) çalışmalarında BİST İmalat Sanayinde faaliyet gösteren işletmelerin sermaye yapılarının finansal sürdürülebilirlik üzerine etkilerini incelemişlerdir. Çalışma kapsamında sürdürülebilir büyüme oranı (SGR) ve içsel büyüme oranı (IGR) ile sermaye yapısı arasındaki ilişki ele alınmıştır. 2010-2021 yılları arasında imalat sektöründe faaliyeet gösteren 113 işletme araştırmaya konu edilmiştir. Çalışmalarında genelleştirilmiş momentler metodu (GMM) kullanmışlardır. Çalışma neticesinde yüksek borçlanmanın SGR ve IGR değerlerini negatif etkilediği sonucuna ulaşmışlardır.

Jnead (2023) çalışmasında, ESG skorlarının finansal performansları ve sermaye yapıları üzerindeki etkisini incelemek üzerinedir. Dünya çapında çevresel düzenlemelere uyulmasına yönelik yükselişte olan odaklanma ile sürdürülebilir finans, çağdaş ekonomi çalışmalarının önemli bir alanı olarak ortaya çıkmıştır. Bu nedenle, bu çalışma, bir şirketin ESG puanı ile finansal performansı ve sermaye yapısı arasındaki ilişkiyi araştırmayı amaçlamaktadır. Bu amaca ulaşmak için, dört İskandinav ülkesinde ve Almanya'da çeşitli sektörlerde faaliyet gösteren 807 özel ve kamu firmasını kapsayan bir veri seti kullanılarak gözlemlenebilen ancak hesaplanmayan bir metodoloji uygulanmıştır. Bu araştırma makalesinin bulguları, ESG skorlarının firmaların finansal performansı ve sermaye yapısı üzerindeki etkisinin anlaşılmasına katkıda bulunacak ve sürdürülebilir finans ve sorumlu yatırım uygulamalarıyla ilgilenen yatırımcılar, politika yapıcılar ve paydaşlar için bilgiler sağlayacağı söylenmiştir.

Bayraktar Güneş & Şavlı (2025) çalışmalarında ESG skorlarının borçlanma maliyeti üzerindeki etkilerini incelemişlerdir. İnceleme kapsamında G20 ülkelerinde bankacılık ve finans alanında faaliyet gösteren 350 işletmenin 2019-2023 yılları verileri incelenmiştir. İnceleme sonucunda ESG skorları ile borçlanma maliyeti arasında negatif ilişki olduğu tespit edilmiştir. Aynı zamanda ESG içerisindeki alt bileşenler de ayrı ayrı incelenmiş ve çevre ile sosyal skorların borçlanma maliyeti arasında negatif ilişkiye ulaşılmış ancak yönetişim skorları ile borçlanma maliyeti arasında anlamlı bir ilişki bulunamamıştır.

Adeneye & Kammoun (2022) çalışmalarında ESG performanslarının sermaye yapısına etkisini ve şirketlerin kaldıraç oranına uyum hızını etkileyip etkilemediğini araştırmışlardır. Çalışma kapsamında Güneydoğu Asya ülkelerinde finans dışı sektörlerde faaliyet gösteren 116 firmanın 2012-2019 arasındaki verileri kullanılmıştır. Çalışmalarında ise OLS regresyon ve GMM tahminci modelini kullanmıştır. Bulguları ise ESG skorlarının kaldıraç oranını pozitif yönlü olarak etkilediği ve ESG skorları yüksek olan işletmelerin kaldıraç oranına uyum hızları %3.41 oranında daha fazla olduğu tespit edilmiştir.

3. ARAŞTIRMA YÖNTEMİ VE BULGULAR

Çalışmada kullanılan veriler Refinitiv Eikon veri tabanından alınmıştır. Çalışmada on yıllık verisine ulaşılabilen Avrupa Birliği ülkelerinde hizmet sektöründe faaliyet gösteren 43 işletmenin 2015-2024 dönemi verileri kullanılmıştır.

Çalışmada bağımlı değişken olarak sermaye yapısını temsilen kaldıraç oranı kullanılmıştır. İşletmelerin ESG skoru bağımsız değişken olarak kullanılmıştır. Karlılığı temsilen faiz, vergi ve amortisman öncesi karın toplam aktiflere bölümü (ebitda/aktif) ile firma büyüklüğünü temsilen aktif toplamının doğal logaritması (lnaktif) kontrol değişkeni olarak kullanılmıştır. Panel regresyon analizinin kullanıldığı çalışmada kullanılan model aşağıdaki gibidir;

$$kaldirac_{it} = \beta_0 + \beta_1 ESG + \beta_2 ebitda/aktif + \beta_3 lnaktif + \varepsilon_{it} \qquad (1)$$

Denklem 1, araştırma modelini göstermektedir. Burada β_0 sabit terimi, β_1 ESG değişkenin katsayısını, β_2 ebitda/aktif değişkeninin katsayısını, β_3 aktif toplam değişkeninin katsayısını, ε ise hata terimini simgelemektedir. Çalışmada sadece aktif toplam değişkenin doğal logaritması alınmış, diğer değişkenler doğrusal formda kullanılmıştır.

Panel kapsamında kullanılan veri yapısında birim boyutunun zaman boyutundan yüksek olması (N>T), değişen varyans başta olmak üzere bir dizi tanısal test problemine sebep olabilmektedir. Bu nedenle, regresyon tahmini yapılmadan evvel bu problemlerin tespit edilmesi ve akabinde buna göre bir tahminci seçilmesi önem arz etmektedir.

Panel veri modellerinde hata teriminin, hem birimler arasında hem de birimlerin kendi içlerinde eşit varyanslı olduğu kabul edilmektedir. Bunun yanı sıra hata teriminin ardışık değerlerinin otokorelasyon içermediği ve birimler arasında korelasyonun (yatay kesit bağımlılığı) bulunmadığı varsayımları da benimsenmektedir. Bu varsayımların göz ardı edilerek modelin tahmin edilmesi, standart hataların sapmalı olmasına neden olmaktadır. Dolayısıyla söz konusu durum, modelin etkinliğini olumsuz yönde etkilemektedir (Tatoglu, 2016). Bu çerçevede, değişen varyans varsayımını sınamak amacıyla Değiştirilmiş Wald Testi (Greene, 2000); otokorelasyon varsayımını sınamak amacıyla Bhargava, Franzini ve Narendranathan'ın (1982) tarafından geliştirilen Durbin-Watson testi ile Baltagi ve Wu'nun (1999) tarafında geliştirilen LBI testi; son olarak da birimler arası korelasyon varsayımlarını Pesaran (2004) tarafından geliştirilen CD Testi uygulanmıştır.

Tablo 1. Tanısal test sonuçları

Tanısal Yapı	Test Adı	Katsayı
Değişen Varyans	Wald Ki kare testi	2.6e+05***
Otokorelasyon	Bhargava vd. Durbin–Watson testi	0,85948124
	Baltagi–Wu LBI testi	1,5226588
Yatay kesit bağımlılığı	Pesaran CD testi	5,619***

***, %1 seviyesindeki anlamlılığı simgelemektedir.

Tablo 1, ilgili test sonuçlarını raporlamaktadır. Tabloda yer alan Wald Ki kare testi değerlerine göre, %1 anlamlılık düzeyinde "H_0: varyans birimlere göre sabittir" boş hipotezi reddedilmekte olup, varyansın birimler arasında farklılaştığı sonucuna ulaşılmaktadır. Bhargava vd. tarafından geliştirtirilen Durbin–Watson testi ile Baltagi ve Wu'nun (1999) tarafından geliştirilen LBI testlerini sonucunda elde edilen istatistik değerlerinin 2'nin altında olması neticesinde, "H_0: hata terimleri arasında korelasyon yoktur" boş hipotezi reddedilmektedir. Bu bulgu, hata terimleri arasında korelasyon bulunduğunu göstermektedir. Öte yandan, Pesaran (2004) tarafından gerçekleştirilen CD testi sonuçlarına göre, %1 anlamlılık düzeyinde "H_0: birimler arasında korelasyon yoktur" boş hipotezi reddedilmekte olup, birimler arasında korelasyonun mevcut olduğu sonucuna ulaşılmaktadır.

Bu tanısal problemler altında tahmin, bu problemlere karşı Güçlendirilmiş Panel Düzeltilmiş Standart Hatalar (PCSE) tahmincisi ile gerçekleştirilmiştir. Tablo 2, PCSE tahmincisinden elde edilen regresyon sonuçlarını göstermektedir. Tabloya göre: i) ESG değişkeninin katsayısı pozitif olup %10 anlamlılık düzeyinde istatistiksel olarak anlamlıdır ve ESG skorundaki bir birimlik artış, diğer değişkenler sabitken kaldıraç oranını yaklaşık 0,0012 birim artırmaktadır; ii) ebitda/aktif değişkeni negatif işaretli ve %1 anlamlılık düzeyinde anlamlıdır; bu durum ebitda/aktif oranındaki bir birimlik artışın kaldıraç oranında yaklaşık 0,0125 birimlik bir azalışa yol açtığını göstermektedir; iii) Toplam aktiflerin doğal düzeyiyle temsil edilen lnaktif değişkeni negatif katsayıya sahip olmakla birlikte istatistiksel olarak anlamlı değildir; dolayısıyla firma büyüklüğünün kaldıraç oranı üzerinde anlamlı bir etkisi tespit edilememiştir; iv) Sabit terim pozitif ve %10 anlamlılık düzeyinde anlamlı olup, bağımsız değişkenler sıfır olduğunda kaldıraç oranının ortalama 0,4187 seviyesinde olduğunu göstermektedir.

Tablo 2. Regresyon tahmincisi sonuçları

Değişken	Katsayı	Standart Hata
ESG	0,0012*	(0,0007)
ebitda/aktif	-0,0125***	(0,0034)
lnaktif	-0,0132	(0,0164)
Sabit	0,4187*	(0,2354)

Not: *** ve *, sırasıyla %1 ve %10 seviyelerindeki anlamlılığı simgelemektedir.

4. SONUÇ

Bu çalışmanın amacı sürdürülebilirliğin sermaye yapısı üzerindeki etkisi araştırmaktır. Bu amaçla 2015-2024 döneminde Avrupa Birliği ülkelerinde hizmet sektöründe faaliyet gösteren, on yıllık verisine ulaşılabilen 43 işletmenin verisi Güçlendirilmiş Panel Düzeltilmiş Standart Hatalar (PCSE) tahmincisi ile analiz edilmiştir.

PCSE tahmincisinden elde edilen sonuçlara göre, ESG skorları ile sermaye yapısı arasında pozitif yönlü bir ilişki bulunmaktadır. Buna göre, firmaların sürdürülebilirlik alanındaki faaliyet ve yatırımlarının artması, kaldıraç oranını yükseltmektedir. Başka bir ifadeyle ESG skorunun yükselmesi, sermaye yapısı içerisinde borçlanma lehine bir değişime neden olmaktadır. Sürdürülebilirlik konusunda gerekli yatırımları yapan firmaların, yeşil tahvil gibi daha düşük maliyetle borçlanma imkanları vardır. Dolayısıyla diğer değişkenler sabitken, bu olanak ESG skoru yüksek olan firmaların daha fazla borçlanma olanaklarına sahip olması anlamına gelir ve bu olanağın kullanılması pozitif bir ilişkini ortaya çıkmasına katkı sağlamış olabilir. Karlılığı temsilen kullanılan faiz, vergi ve amortisman öncesi karın toplam aktiflere oranı ile ESG skoru arasında negatif yönlü bir ilişki bulunmaktadır. Bu durum, faiz, vergi ve amortisman öncesi karın toplam aktiflere oranındaki artışın, kaldıraç oranında azalış yarattığını göstermektedir. Dolayısıyla, bu sonuçtan hareketle, karlılığı yüksek olan işletmelerin borçlanma düzeylerinin daha düşük olduğu söylenebilir. Firma büyüklüğünü temsilen kullanılan aktif büyüklüğünün işareti negatif olmak ile birlikte istatistiksel olarak anlamlı çıkmamıştır.

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AVRUPA BİRLİĞİ ÜLKELERİ İMALAT SANAYİ FİRMALARINDA ESG SKORUNUN SERMAYE YAPISINA ETKİSİ

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ÖZET

Sürdürülebilirlik kavramı, sanayileşme ve ekonomik büyüme sürecinin hızlanmasıyla birlikte ortaya çıkan çevresel bozulma, doğal kaynakların aşırı kullanımı ve sosyal eşitsizliklere yönelik artan kaygılar doğrultusunda şekillenmiştir. Özellikle 20. yüzyılın ikinci yarısında çevre kirliliği, iklim değişikliği ve kaynak kıtlığı gibi sorunların küresel boyut kazanması, geleneksel büyüme odaklı kalkınma anlayışının sorgulanmasına yol açmıştır. Bu bağlamda sürdürülebilirlik, ekonomik kalkınmanın çevresel ve sosyal sınırlar gözetilerek gerçekleştirilmesini amaçlayan bir yaklaşım olarak literatürde yerini almıştır. Son yıllarda sürdürülebilirlik anlayışının giderek önem kazanması, firmaların sürdürülebilirlik alanındaki faaliyetlerinin artmasına neden olmuştur. Sürdürülebilirlik yatırımlarının ve faaliyetlerinin işletmeler üzerindeki etkisi literatürde yoğun olarak tartışılmaya başlanmıştır. Finans literatüründeki güncel tartışmalardan biri de sürdürülebilirliğin finansal performans, firma değeri, kar dağıtım politikası, sermaye yapısı vb. üzerine etkisidir. Ancak sürdürülebilirliğin sermaye yapısı üzerindeki etkisine dair literatürde sınırlı sayıda çalışma bulunmaktadır. Bu nedenle bu çalışmada işletmelerde sürdürülebilirliğin bir göstergesi olarak kullanılan ESG skorunun sermaye yapısı üzerindeki etkisini araştırılmıştır. Araştırma dönemi 2015-2024 yıllarını kapsamaktadır. Analizlerde Avrupa Birliği ülkelerinde imalat sektöründe faaliyet gösteren 286 işletmenin verisi kullanılmıştır. ESG skorunun sermaye yapısına etkisi Güçlendirilmiş Panel Düzeltilmiş Standart Hatalar (PCSE) yöntemi ile analiz edilmiştir. Modelde kaldıraç oranı bağımlı değişken, ESG skoru bağımsız değişken, karlılık ve büyüklük ise kontrol değişkeni olarak kullanılmıştır. Elde edilen sonuçlar, ESG skorları ile sermaye yapısını temsilen kullanılan kaldıraç oranı arasında negatif yönlü bir ilişki olduğunu göstermektedir. Karlılığı temsilen kullanılan faiz, vergi ve amortisman öncesi karın toplam aktiflere oranı ile ESG skoru arasında pozitif yönlü bir ilişki bulunmuştur. Firma büyüklüğünü temsilen kullanılan aktif büyüklüğünün, ESG skoru arasında da pozitif yönlü bir ilişki vardır.

Anahtar Kelimeler: ESG, Sürdürülebilirlik, Kaldıraç Oranı, Sermaye Yapısı, Karlılık

THE IMPACT OF ESG SCORES ON THE CAPITAL STRUCTURE OF MANUFACTURING INDUSTRY COMPANIES IN EUROPEAN UNION COUNTRIES

ABSTRACT

The concept of sustainability has taken shape in response to growing concerns about environmental degradation, overuse of natural resources, and social inequalities that have emerged alongside the acceleration of industrialization and economic growth. Particularly in the second half of the 20th century, the globalization of issues such as environmental pollution, climate change, and resource scarcity led to the questioning of the traditional growth-oriented development approach. In this context, sustainability has taken its place in the literature as an approach that aims to achieve economic development while observing environmental and social boundaries. The increasing importance of sustainability in recent years has led to an increase in companies' activities in the field of sustainability. The impact of sustainability investments and activities on businesses has begun to be discussed intensively in the literature. One of the current debates in the finance literature is the impact of sustainability on financial performance, firm value, dividend policy, capital structure, etc. However, there are only a limited number of studies in the literature on the impact of sustainability on capital structure. Therefore, this study investigates the impact of the ESG score, used as an indicator of sustainability in companies, on capital structure. The research period covers the years 2015-2024. Data from 286 companies operating in the manufacturing sector in European Union countries were used in the analyses. The effect of the ESG score on the capital structure was analyzed using the Panel Corrected Standard Errors (PCSE) method. In the model, the leverage ratio was used as the dependent variable, the ESG score as the independent variable, and profitability and size as control variables. The results show a negative relationship between ESG scores and the leverage ratio, which represents capital structure. A positive relationship was found between the ratio of earnings before interest, taxes, and depreciation to total assets, which represents profitability, and the ESG score. There is also a positive relationship between asset size, which represents firm size, and the ESG score.

Keywords: ESG, Sustainability, Leverage Ratio, Capital Structure, Profitability

1. GİRİŞ

Sermaye yapısı, işletmelerin varlıklarını finanse ederken kullandıkları kaynakların öz kaynak ve borç bileşenleri arasındaki dağılımını ifade etmektedir. İşletmeler, borcun sağladığı vergi kalkanı ve finansal kaldıraç avantajlarından yararlanmak amacıyla borçla finansmanı tercih edebilmektedir. Bununla birlikte, borç oranının artması finansal risk düzeyini yükselttiğinden,

sermaye yapısında borcun payının dikkatle belirlenmesi gerekmektedir. Bu oran; işletmenin faaliyet gösterdiği ülke, sektör yapısı ve rakip firmaların finansman tercihleri gibi çeşitli faktörlere bağlı olarak farklılık gösterebilmektedir (Ceylan & Korkmaz, 2021).

İşletmeler, sermaye yapılarını oluştururken, her bir finansman kaynağının maliyetini ayrı ayrı hesaplayarak, toplamda ağırlıklı ortalama sermaye maliyetini bulurlar. Bu maliyetin en düşük olduğu seviyede, işletmeler için en uygun sermaye yapısı ortaya çıkar. Ancak, optimal sermaye yapısının belirlenmesi ve korunması hem teorik hem de pratik açıdan zorlu bir süreçtir. Optimal sermaye yapısının tespitinde finans yöneticisinin göz önünde bulundurması gereken birçok farklı faktör bulunmaktadır. Bu faktörler arasında, ülkenin faiz oranı politikaları, yatırımcıların kararları, finansal kurumların işletmeye bakış açıları gibi unsurlar sayılabilir (Okka, 2015).

İşletmelerin sermaye yapısını belirleyen unsurlar; makroekonomik faktörler, firmaya özgü faktörler ve finansal piyasalara ilişkin faktörler olmak üzere üç ana grupta ele alınabilir (Aydın, Başar & Coşkun, 2021). Bu faktörler detaylandırıldığında, işletmeye özgü unsurlar arasında firmanın risk düzeyi, büyüklüğü, kârlılığı ve varlık yapısı gibi özellikler yer almaktadır. Finansal piyasalara bağlı faktörler ise sermaye piyasalarının gelişmişlik seviyesi, finansal aracı kurumların yapısı, yasal sistemin etkinliği ile kreditör ve hissedar haklarını kapsamaktadır. Makroekonomik faktörler kapsamında ise işletmenin faaliyet gösterdiği ülkedeki ekonomik büyüme oranı, enflasyon, faiz oranları ve vergi oranları sayılabilir (Kakilli Acaravcı, 2004).

Sürdürülebilirlik ve sürdürülebilir kalkınma kavramları, dünya genelinde çevresel tahribatın giderek artmasıyla birlikte son yıllarda en çok tartışılan konular arasında yer almaktadır. Sürdürülebilirlik; enerji, ekonomi ve çevre ekseninin merkezinde konumlandığı için yalnızca hükümetler ve uluslararası kuruluşların değil, aynı zamanda sosyal bilimcilerden fen ve doğa bilimcilerine, politikacılardan yerel ve küresel çevre örgütlerine kadar geniş bir kesimin ilgisini çekmektedir. Sürdürülebilirliğe yönelik endişeler, Malthus ve Jevons gibi 18. ve 19. yüzyıl iktisatçılarına kadar uzansa da "sürdürülebilir kalkınma" kavramının ortaya çıkışı, 20. yüzyılda çevre sorunlarına yönelik farkındalığın artmasıyla gerçekleşmiştir. Kavramın yaygın biçimde kabul görmesi ve geniş bir kullanım alanına sahip olması ise Dünya Çevre ve Kalkınma Komisyonu'nun 1987 yılında yayımladığı Ortak Geleceğimiz adlı raporla mümkün olmuştur. Söz konusu raporda sürdürülebilir kalkınma, "gelecek nesillerin kendi ihtiyaçlarını karşılama olanaklarını tehlikeye atmadan, bugünün ihtiyaçlarını karşılayabilen kalkınma" olarak tanımlanmıştır (Yeni, 2014: 183–184).

Sürdürülebilirlik kavramı, bir durumun ya da herhangi bir unsurun sürekliliğinin sağlanması anlamına gelmektedir (Yavuz, 2010). Genel çerçevede ise, insan faaliyetleri sonucunda tükenme riskiyle karşı karşıya kalan dünya kaynaklarının verimli kullanılması yoluyla, bireylerin ve işletmelerin varlıklarını devam ettirebilmesi olarak tanımlanabilir (Turner, 2008). Günümüzde sürdürülebilirlik kavramı çoğunlukla ekonomik boyutuyla ele alınmakta ve sürdürülebilir kalkınma kavramıyla eş anlamlı şekilde kullanılmaktadır (Yavuz, 2010).

Son dönemde ülkeler arasında yaşanan anlaşmazlıklar, ekonomik durgunluklar, şirketlere yönelik skandallar, küresel ısınma, çevre kirliliği ve iklim krizleri gibi küresel sorunlar ile birlikte işletmelerin paydaşları tarafından yöneltilen talepler, sürdürülebilirlik alanında çeşitli raporlama uygulamalarının geliştirilmesine neden olmuştur. Özellikle finans alanında, çevresel faktörler, sosyal sorumluluk ve kurumsal yönetim kapsamında sürdürülebilirlik konularına olan ilgi giderek artmış; bu alanlarda gerçekleştirilen faaliyetler ile yatırımların raporlanması ihtiyacı ortaya çıkmıştır. Bu gereksinime yanıt olarak, işletmelerin çevresel, sosyal ve kurumsal yönetime (ESG) ilişkin performanslarını değerlendirmede kullanılan ESG skorları geliştirilmiştir. Paydaşların finansal kararları üzerinde giderek daha etkili hale gelen bu skorlar, finans literatüründe ölçülmesi güç olan faaliyetlerin değerlendirilmesinde somut bir gösterge olarak yaygın biçimde kullanılmaya başlanmıştır (Çetenak, Ersoy ve Işık, 2022: 76). Sürdürülebilirlik raporları ve ESG skorları, hissedarlar ve yatırımcılar tarafından kurumsal şeffaflık düzeyinin, sosyal ve çevresel performansın ve yönetim kalitesinin önemli bir göstergesi olarak değerlendirilmektedir (Özsözgün Çalışkan, 2012: 41).

Günümüzde sürdürülebilirliğin işletme performansı üzerindeki etkilerinin incelenmesi ve bu analizlerin standartlaştırılabilmesi amacıyla ESG verileri ortak bir ölçüt olarak kullanılmaktadır. ESG verileri, işletmelerin çevresel, sosyal ve yönetişim boyutlarındaki sürdürülebilirlik düzeylerinin 630 farklı metrik üzerinden hesaplanmasıyla elde edilen göstergeler olarak tanımlanabilir. Bu metrikler doğrultusunda ortaya çıkan skorlar, çevresel, sosyal ve yönetişim başlıkları altında ayrı ayrı değerlendirilebildiği gibi, söz konusu üç boyutun ortalaması alınarak tek bir genel ESG skoru da hesaplanabilmektedir (Refinitiv, 2022).

ESG skoru, işletmelerin çevresel, sosyal ve kurumsal yönetişim alanlarında gerçekleştirdikleri yatırım ve faaliyetlere ilişkin performanslarını yansıtan bir ölçüm aracıdır. Bu skor; çevresel, sosyal ve kurumsal yönetim olmak üzere üç temel bileşenden oluşmaktadır. İşletmeler açısından bu bileşenlerin her biri için ayrı ayrı skorlar hesaplanmakta; çevresel faaliyetleri kapsayan Çevresel Sütun Skoru (Environmental Pillar Score), sosyal faaliyetlere yönelik Sosyal

Sütun Skoru (Social Pillar Score) ve kurumsal yönetişim faaliyetlerine ilişkin Kurumsal Yönetim Sütun Skoru (Governance Pillar Score) elde edilmektedir. Bunun yanı sıra, söz konusu üç bileşenin bir araya getirilmesiyle birleşik (kombine) bir ESG skoru da hesaplanmaktadır (Çetenak, Ersoy ve Işık, 2022: 76).

Finans literatüründe güncel araştırma alanlarından biri, sürdürülebilirliğin firmalar üzerindeki etkilerinin incelenmesidir. Literatür değerlendirildiğinde, sürdürülebilirlik ve bu kapsamda ESG skorlarının işletmeler üzerindeki etkilerinin farklı bakış açılarıyla, çeşitli ülke grupları ve sektörler özelinde ele alındığı görülmektedir. Sürdürülebilirlik ve ESG skorlarının işletmelerin finansal performansı, firma değeri, yatırımcı davranışları, yeşil tahvil uygulamaları, risk yönetimi gibi alanlar üzerindeki etkilerini inceleyen çok sayıda çalışma bulunmaktadır. Buna karşın, sürdürülebilirliğin işletmelerin sermaye yapısı üzerindeki etkisi literatürde görece daha az ele alınan güncel araştırma konularından biridir. Bu nedenle bu çalışmada, işletmelerde sürdürülebilirliğin bir göstergesi olarak kabul edilen ESG skorlarının sermaye yapısı üzerindeki etkisinin analiz edilmesi ve bu yolla literatüre katkı sağlanması amaçlanmıştır. Çalışma, 2015–2024 dönemini kapsamakta olup Avrupa Birliği ülkelerinde imalat sektöründe faaliyet gösteren ve on yıllık verisine erişilebilen 286 işletmeye ait veriler kullanılarak gerçekleştirilmiştir. Araştırmada yöntem olarak panel regresyon analizi tercih edilmiştir.

2. LİTERATÜR TARAMASI

Abdioğlu'nun (2019) BİST Sürdürülebilirlik endeksinde yer alan firmaların sermaye yapısı kararlarını inceleyen çalışmasında, firma büyüklüğü, aktif karlılığı, büyüme fırsatları, risk, cari oran ve faaliyet kaldıracının sermaye yapısı üzerinde anlamlı etkiye sahip olan değişkenler oldukları sonucuna varmıştır.

Zahid, Saleem ve Maqsood'un (2023) ESG skorları, sermaye yapısı kararları ve denetim kalitesi ile alakalı Çin Devleti tarafından işletmelerde yaptıkları çalışmalarında; ESG skorları yüksek olan firmaların borç seviyelerinin daha düşük oldukları dolayısıyla borsadan özsermaye ile finansman kullanımı konusunda yatırımcılar tarafından tercih edildikleri gözlemlenmiştir.

Radhakrishna ve Lappay (2024) Hindistan Borsası'nda işlem gören 50 farklı firma üzerine yaptıkları çalışmalarında ESG skorları yüksek olan firmalar ile Borç/Özsermaye oranları arasında negatif bir ilişki olduğunu ortaya koymuşlardır.

Jovita (2023) Kompas100 endeksinde yer alan firmalar için yaptığı çalışmasında, ESG skorlarının özsermaye karlılığını doğrudan ve pozitif yönlü olarak etkilediğini ortaya koymuştur.

Amosh, Khatib, Alkurdi, Bazhair (2022) çalışmalarında, Amman Borsası'nda işlem gören ve ESG skorları yüksek olan firmaların sermaye yapılarında borç kullanımlarının daha fazla olduğu görülmüştür. Yani firmalar finansal ve finansal olmayan hedefleri için borç kullanarak ESG yatırımlarını finanse etmektedirler.

Adeneye ve Kammoun (2022) Güney Doğu Asya Ülkeleri Birliğinde yer alan firmalar üzerine yaptıkları araştırmalarında, düşük ESG skorları olan firmaların kaldıraç kullanımlarının gerçek kazanç oranlarına pozitif bir etki oluşturduğu ancak yüksek ESG skorlarına sahip olan firmalarda herhangi bir etkisi gözlemlenememiştir.

Khan vd. (2024) çalışmalarında 895 farklı Avrupa firmasını incelemişlerdir. Bu çalışmaya göre ESG skorlarının bilgi asimetrisine sebep olduğu bazı durumlarda fiyatları aşırı değerlendirdiği ve piyasa etkinliği üzerinde negatif bir etkisinin olduğunu ortaya koymuşlardır. Aynı çalışmada yine ESG skorları yüksek olan firmaların özsermayenin marjinal getirisinin diğerlerine göre daha yüksek olduğunu saptamışlardır.

Adeneye, Kammoun ve Wahab (2023) Malezya, Endonezya, Filipinler, Singapur ve Tayland Borsalarını inceledikleri araştırmalarında, ESG skorlarının kaldıraç oranlarıyla pozitif bir ilişki olduğunu, firmaların sürdürülebilir finans için borçlanma yoluna gittiklerini ortaya koymuşlardır.

Cantino, Devalle ve Fiandrino (2017) 31 farklı akademik makaleyi inceledikleri çalışmalarında, ESG skorlarının özsermaye maliyeti ile pozitif yönlü bir ilişkisi olduğunu ama borçlanma maliyetiyle alakalı net bir bulguya henüz rastlanamadığını ve daha fazla araştırma gerektiğini belirtmişlerdir.

Madyan ve Widuri (2023) ESG skorlarının finansal alanda çalışmayan işletmelerde sermaye yapılarına pozitif katkıları olduğunu ancak iyi yönetilen firmalar ile ESG skorları ve sermaye yapıları arasında herhangi bir ilişki bulunmadığını belirtmişlerdir.

3. ARAŞTIRMA YÖNTEMİ VE BULGULAR

Analizlerde kullanılan veriler Refinitiv Eikon veri tabanından elde edilmiştir. Çalışma, 2015-2024 döneminde on yıllık verisine ulaşılabilen Avrupa Birliği ülkelerinde imalat sektöründe faaliyet gösteren 286 işletmeyi kapsamaktadır.

Sermaye yapısını temsilen kullanılan kaldıraç oranı regresyon modelinin bağımlı değişkenidir. Bağımsız değişken ESG skorudur. Karlılık ve aktif büyüklüğü ise kontrol değişkeni olarak kullanılmıştır. Karlılığı temsilen faiz, vergi ve amortisman öncesi karın toplam aktiflere bölümü (ebitda/aktif), firma büyüklüğünü temsilen aktif toplamının doğal logaritması (lnaktif)

kullanılmıştır. Panel regresyon analizinin kullanıldığı çalışmada aşağıdaki model tahmin edilmiştir;

$$kaldirac_{it} = f(ESG, ebitda/aktif, lnaktif) \quad (1)$$

Denklem 1, araştırma modelinin fonksiyonel biçimini göstermektedir. Bu denkleme göre kaldıraç oranı, ESG skorunun, ebitda/aktif oranının ve aktif büyüklüğünün bir fonksiyonu olarak modellenmiştir. Çalışmada sadece aktif toplam değişkenin doğal logaritması alınmış, diğer değişkenler doğrusal formda kullanılmıştır.

Araştırma kapsamında kullanılan verinin yapısı kaynaklı değişen varysans, otokorelasyon ve yatay kesit bağımlılığı gibi sorunlar.la karşılaşılması muhtemeldir (Tatoğlu, 2016). Bu potansiyeli test etmek amacıyla çalışmada ilk olarak, Greene (2000) tarafından önerilen Değiştirilmiş Wald testi uygulanmış ve değişen varyans probleminin mevcudiyeti Tablo 1' de gösterilen Değiştirilmiş Wald testi sonucuna göre "H₀: varyans birimlere göre sabittir" boş hipotezi reddedilip, varyansın birimler arasında farklılaştığı sonucuna ulaşılmıştır.

Tablo 1. Değişen varyansın tespiti için yapılan test sonucu

Test	**Katsayı**
Ki kare	99406,83***

*** %1 seviyesindeki anlamlılığı simgelemektedir.

Ardından karşılaşılması muhtemel olan diğer problem olan, otokorelasyonun tespit edilebilmesi için, Bhargava vd. (1982) tarafından geliştirtirilen Durbin–Watson testi ile Baltagi ve Wu'nun (1999) tarafından geliştirilen LBI testleri uygulanmıştır. Table 2'de raporlanan otokorelasyon testi istatistiklerinin 2'nin altında olması neticesinde, "H₀: hata terimleri arasında korelasyon yoktur" boş hipotezi reddedilmiş ve otokorelasyon probleminin mevcut olduğu sonucuna ulaşılmıştır.

Tablo 2. Otokorelasyonun tespiti için yapılan testin sonucu

Test	**Katsayı**
Baltagi–Wu LBI	1.6299927
Modified Bhargava et al. Durbin–Watson	1.1548325

Son olarak modelde karşılaşılabilecek diğer problem olan, yatay kesit bağımlılığının sınanması için Pesaran (2004) tarafından geliştirilen CD testi uygulanmış ve test sonucu Tablo 3'te raporlanmıştır. Tabloya göre "H₀: birimler arasında korelasyon yoktur" boş hipotezi %1 anlamlılık düzeyinde reddedilip, birimler arasında korelasyonun mevcut olduğu sonucuna ulaşılmaktadır.

Tablo 3. Yatay kesit bağımlılığının tespiti için yapılan testin sonucu

Test	**Katsayı**
CD	23,524***

***, %1 seviyesindeki anlamlılığı simgelemektedir.

Bu tanısal problemler altında tahmin, bu problemlere karşı güçlendirilmiş panel düzeltilmiş standart hatalar (PCSE) tahmincisi ile gerçekleştirilmiştir. Tablo 4, PCSE tahmincisinden elde edilen regresyon sonuçlarını yansıtmaktadır. Elde edilen regresyon sonuçlarına göre, ESG değişkeninin katsayısı negatif ve %1 anlamlılık düzeyinde istatistiksel olarak anlamlı olup, ESG skorundaki bir birimlik artış, diğer değişkenler sabitken kaldıraç oranını yaklaşık 0,0005 birim azaltmaktadır. Karlılığı temsilen kullanılan ebitda/aktif değişkeni pozitif işaretli ve %1 düzeyinde anlamlıdır ve bu sonuca göre ebitda/aktif oranındaki bir birimlik artış kaldıraç oranını yaklaşık 0,0056 birim artırmaktadır. İşletmelerin büyüklüğünü ölçütü olarak kullanılan toplam aktiflerin doğal logaritması ile temsil edilen lnaktif değişkeninin katsayısı da pozitif ve %1 anlamlılık düzeyinde istatistiksel olarak anlamlıdır. Buna göre toplam aktiflerde yaklaşık %1'lik bir artış, kaldıraç oranını yaklaşık 0,000114 birim artırmaktadır. Ayrıca sabit terimin katsayısı pozitif ve %1 düzeyinde anlamlı olup, bağımsız değişkenler sıfır olduğunda kaldıraç oranının ortalama 0,157 seviyesindedir.

Tablo 4. PCSE tahmincisi sonuçları

Değişken	**Katsayı**
ESG	-0,0005*** (0,0001)
ebitda/aktif	0,0056*** (0,0020)
lnaktif	0,0114*** (0,0014)
Sabit	0,1570*** (0,0180)

Not: Parantez içerisindeki değerler standart hatalardır.
*** %1 seviyesindeki anlamlılığı simgelemektedir.

4. SONUÇ

Bu çalışmada, finans literatüründe önemli bir boşluğun olduğu düşünülen sürdürülebilirliğin sermaye yapısı üzerindekisini araştırmak amaçlanmıştır. 2015-2024 dönemini kapsayan çalışmada, Avrupa Birliği ülkelerinde imalat sanayiinde faaliyet gösteren 286 işletmenin verisi, Güçlendirilmiş Panel Düzeltilmiş Standart Hatalar (PCSE) tahmincisi ile analiz edilmiştir.

PCSE tahmincisinden elde edilen sonuçlara göre, ESG skorları ile sermaye yapısı arasında negatif yönlü ve istatistiksel olarak anlamlı bir ilişki ortaya vardır. Bu sonuç, işletmelerin sürdürülebilirlik alanındaki faaliyet ve yatırımlarındaki artışın, kaldıraç oranında azalışa yol

açtığına işaret etmektedir. Başka bir ifadeyle ESG skorunun yükselmesi, sermaye yapısı içerisinde özkaynak lehine bir değişime sebep olmaktadır. Karlılığı temsilen kullanılan faiz, vergi ve amortisman öncesi karın toplam aktiflere oranı ile ESG skoru arasında pozitif yönde bir ilişki çıkmıştır. Bu durum, faiz, vergi ve amortisman öncesi karın toplam aktiflere oranındaki artışın, kaldıraç oranında artış yarattığını göstermektedir. Benzer şekilde, firma büyüklüğünü temsilen kullanılan aktif büyüklüğü ile kaldıraç oranı arasında da istatistiksel olarak anlamlı ve pozitif bir ilişki tespit edilmiştir. Bu bulgu, aktif toplamı daha fala olan firmaların, başka bir ifadeyle büyük ölçekli firmaların finansmanda daha fazla borç kullandığı ortaya koymaktadır.

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MACRO-FINANCIAL DRIVERS OF BITCOIN MONTHLY RETURNS: EVIDENCE FROM U.S. POLICY, INFLATION, TERM STRUCTURE, AND RISK SENTIMENT

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ABSTRACT

This study examines whether standard U.S. macro-financial factors help explain the monthly performance of Bitcoin. Using BTC–USD prices from January 2016 to December 2024 (Yahoo Finance), we construct monthly log returns and match them to four key indicators from FRED: changes in the effective federal funds rate, CPI inflation (log-differenced), the 10-year minus 2-year Treasury term spread, and monthly changes in the VIX index. We document basic distributional properties and compute pairwise correlations, followed by a linear regression of Bitcoin returns on the macro variables. Bitcoin exhibits a very high average monthly return and volatility, with distributional features close to normal at the monthly horizon despite extreme daily movements. Correlations between Bitcoin and the macro factors are uniformly weak in absolute value, typically below 0.2. The regression explains only about 9% of the variation in monthly returns; the only statistically significant predictor is the change in VIX, which enters with a negative coefficient. Months with large increases in equity market volatility are associated with significantly lower Bitcoin performance, consistent with Bitcoin behaving as a risk-on asset. Changes in the policy rate, inflation and the term spread are not significant, and the negative—but imprecisely estimated—relation with inflation provides little support for the view of Bitcoin as a reliable inflation hedge. Overall, our results suggest that, at the monthly frequency, Bitcoin is only weakly connected to conventional macro-financial fundamentals and is driven primarily by other, more idiosyncratic forces.

Key words: Bitcoin; cryptocurrencies; macro-financial factors; VIX; inflation; risk sentiment; term spread; monthly returns.

1. Introduction

Since the launch of Bitcoin in 2009, crypto-assets have evolved from a niche technological experiment into a sizeable and highly volatile segment of global financial markets. Bitcoin is now held by retail and institutional investors, traded on major exchanges, and integrated into a growing ecosystem of derivatives and exchange-traded funds. At the same time, regulators and international institutions increasingly emphasise the potential macro-financial implications of crypto-assets for financial stability and capital flows (World Bank, 2022; IMF, 2023).

A key question in this debate is how strongly Bitcoin is linked to conventional macro-financial fundamentals. On the one hand, proponents often portray Bitcoin as "digital gold" that can hedge inflation and currency debasement, especially in environments of loose monetary policy and rising consumer prices. A growing body of empirical work investigates whether Bitcoin returns co-move with inflation or inflation expectations, with mixed results. Some studies find that Bitcoin appreciates after inflationary shocks and can act as an inflation hedge under certain conditions (Choi and Shin, 2021; Rodriguez and Colombo, 2025), while others report that this property is context-specific and may weaken as adoption increases (Chen, 2025; Lin et al., 2025).

On the other hand, several contributions emphasise the role of global risk sentiment and financial conditions rather than domestic macro data. Studies that include equity returns, the VIX index and sentiment measures typically conclude that Bitcoin behaves like a high-beta, speculative asset: during stable periods, traditional factors and sentiment help explain its volatility and trading activity, while in turbulent episodes crypto markets amplify risk-on/risk-off swings (López-Cabarcos et al., 2021; S&P Global Ratings, 2022; Chen, 2025). More recent work that models cryptocurrencies jointly with macroeconomic variables such as the term spread, breakeven inflation and commodity prices generally finds limited dependence between Bitcoin returns and these fundamentals, suggesting that adoption, liquidity and speculative demand play a more prominent role (Lin et al., 2025; Blaise, 2024).

Against this background, this paper takes a deliberately simple and transparent approach to the macro-financial drivers of Bitcoin. Using monthly data for the United States over the period January 2016–December 2024, we ask whether a small set of standard macro-financial indicators helps explain the cross-time variation in Bitcoin returns. Specifically, we focus on four variables that feature prominently in the macro-finance literature and in policy discussions: (i) changes in the effective federal funds rate as a measure of the monetary policy stance; (ii) CPI inflation, proxied by the log difference of the consumer price index; (iii) the 10-year minus 2-year Treasury yield spread as a term-structure and business-cycle signal; and (iv) monthly changes in the VIX index as a proxy for global risk sentiment.

Our contribution is threefold. First, we provide a compact descriptive picture of Bitcoin's monthly return distribution and its co-movement with these macro-financial factors over almost a full decade that includes the 2017–2018 boom-bust, the COVID-19 shock and the post-pandemic tightening cycle. Second, we quantify simple pairwise correlations and estimate a

baseline linear regression of Bitcoin returns on the macro variables, thereby gauging their joint explanatory power at the monthly frequency. Third, we interpret the results in light of the inflation-hedging and "risk-on asset" narratives in the existing literature and discuss implications for investors and policymakers.

Our main findings are straightforward. Bitcoin exhibits a very high average monthly return and volatility, and its monthly return distribution is close to normal despite extreme daily movements. Correlations with the macro factors are uniformly weak in absolute value, typically below 0.2. An ordinary least squares (OLS) regression explains only about 9% of the variance in monthly returns, and the only statistically significant predictor is the change in VIX, which enters with a negative coefficient. Changes in the policy rate, inflation and the term spread are not significant, and the estimated relation with inflation is negative but imprecise. Overall, Bitcoin appears only weakly connected to conventional macro-financial fundamentals at this horizon and behaves primarily as a risk-on asset whose performance deteriorates in episodes of rising equity market volatility.

The remainder of the paper is organised as follows. Section 2 describes the data and empirical methodology. Section 3 presents the main empirical results. Section 4 discusses the findings and their implications. Section 5 concludes and outlines directions for future research.

2. Data and Methodology

2.1 Data sources and sample period

We use monthly data for the period from January 2016 to December 2024. Bitcoin prices are obtained from Yahoo Finance as daily BTC–USD closing prices (Yahoo Finance, 2025). The macro-financial variables are drawn from the Federal Reserve Economic Data (Federal Reserve Bank of St. Louis, 2025) database and include:

1. The effective federal funds rate (FEDFUNDS).
2. The consumer price index for all urban consumers (CPIAUCSL).
3. The 10-year constant maturity Treasury yield (DGS10).
4. The 2-year constant maturity Treasury yield (DGS2).
5. The CBOE Volatility Index (VIXCLS).

All series are converted to a common monthly frequency. Bitcoin prices are aggregated to month-end closing prices before taking log returns, while the macro series are averaged over each month unless they are already reported monthly (as in the case of the CPI).

The resulting data set comprises 107 monthly observations for each variable. Table 1 reports descriptive statistics for Bitcoin monthly log returns and the four macro-financial indicators.

Table 1. Descriptive statistics for Bitcoin monthly returns and macro-financial variables, 2016–2024

Variable	Mean	Std. dev.	Skewness	Excess kurtosis	N
Bitcoin monthly log return	0.0517	0.2052	-0.0700	-0.0119	107
Change in Fed funds rate	0.0387	0.1932	-0.5363	7.7860	107
Monthly inflation (log CPI)	0.0027	0.0028	0.3283	2.9963	107
Term spread (10-year minus 2-year)	0.3648	0.6061	-0.2093	-0.8267	107
Change in VIX	-0.0734	5.1024	3.6808	28.4861	107

2.2 Variable construction

Bitcoin monthly log returns, denoted r_t^{BTC}, are defined as the first difference of the natural logarithm of month-end BTC–USD prices. The macro-financial variables are transformed as follows:

- **Change in policy rate** ΔFED_t: first difference of the monthly average effective federal funds rate.
- **Inflation** INF_t: log difference of the CPI, approximating the monthly inflation rate.
- **Term spread** TS_t: monthly average of the 10-year yield minus the 2-year yield.
- **Change in VIX** ΔVIX_t: first difference of the monthly average VIX index.

All variables are left in levels (or differences) rather than standardised, to facilitate economic interpretation of the coefficients. Occasional missing daily observations in the raw data are handled by computing monthly averages with missing values excluded, and we align all variables by the corresponding calendar month.

2.3 Empirical strategy

Our empirical analysis proceeds in three steps.

First, we document the unconditional distributional properties of Bitcoin monthly returns and of the macro-financial variables, including means, standard deviations, skewness, kurtosis and the number of non-missing observations. This allows us to benchmark Bitcoin's risk–return profile and the volatility of the macro factors over the sample.

Second, we compute pairwise Pearson correlations between all variables, using pairwise complete observations. This provides a simple initial assessment of the co-movement between Bitcoin and each macro-financial indicator.

Table 2. Correlation matrix for Bitcoin monthly returns and macro-financial variables

Variable	BTC return	Change in Fed funds	Inflation	Term spread	Change in VIX
BTC return	1.0000	-0.1121	-0.1497	0.1256	-0.1852
Change in Fed funds	-0.1121	1.0000	0.3278	-0.2268	-0.2880
Inflation	-0.1497	0.3278	1.0000	0.1285	-0.0135
Term spread	0.1256	-0.2268	0.1285	1.0000	0.0015

Change in VIX	-0.1852	-0.2880	-0.0135	0.0015	1.0000

Third, we estimate a linear regression of Bitcoin monthly returns on the macro-financial variables:

$$r_t^{BTC} = \alpha + \beta_1 \Delta \mathrm{FED}_t + \beta_2 \mathrm{INF}_t + \beta_3 \mathrm{TS}_t + \beta_4 \Delta \mathrm{VIX}_t + \varepsilon_t,$$

where ε_t is an error term. We restrict the regression to months for which all variables are observed and require that each regressor has at least twelve non-missing observations, which is easily satisfied in our sample. We estimate the model by ordinary least squares and report coefficient estimates, standard errors, t-statistics and p-values, as well as standard goodness-of-fit measures such as R^2, adjusted R^2 and information criteria.

Table 3. Regression of Bitcoin monthly log returns on macro-financial variables

Term	Estimate	Std. error	t statistic	p value
Intercept	0.0671	0.0285	2.3548	0.0204
Change in Fed funds rate	-0.1100	0.1169	-0.9410	0.3489
Inflation (log CPI)	-9.8079	7.5543	-1.2983	0.1971
Term spread	0.0405	0.0339	1.1965	0.2343
Change in VIX	-0.0087	0.0040	-2.1791	0.0316

Table 4. Model fit statistics for the regression in Table 3

Statistic	Value
R-squared	0.0869
Adjusted R-squared	0.0511
Residual standard error	0.1999
F statistic	2.4274
Model p value	0.0526
Number of observations	107

The model is intentionally parsimonious and static. We do not attempt to model higher-order dynamics, lag structures or nonlinearities, nor do we include additional controls such as equity returns or crypto-specific variables. Instead, the goal is to obtain a clean benchmark for how much of Bitcoin's monthly return variation can be accounted for by a small set of standard macro-financial factors.

3. Empirical Results

3.1 Descriptive statistics

Table 1 summarises the unconditional properties of Bitcoin monthly log returns and the four macro-financial variables over 2016–2024. Bitcoin's average monthly log return is approximately 0.052, corresponding to an annualised gross return of about 86% when compounded. The standard deviation of monthly returns is around 0.205, which implies an annualised volatility of roughly 71%. These figures underscore the extremely high risk–return profile of Bitcoin compared with traditional asset classes. Despite the well-known presence of

large daily price jumps, the monthly return distribution appears fairly regular: skewness is close to zero and excess kurtosis is near zero, indicating a shape not far from normality.

By contrast, the macro-financial variables behave much more smoothly. Monthly inflation averages about 0.27% with low volatility and modest positive skewness. The average term spread is slightly positive, reflecting typical conditions where the 10-year yield exceeds the 2-year yield, and its distribution shows mild negative skewness. Changes in the federal funds rate are infrequent but occasionally large, leading to a leptokurtic distribution. The most extreme behaviour is observed for monthly changes in VIX, which exhibit strong positive skewness and very high kurtosis, capturing the rare but substantial spikes in equity market volatility.

Figure 1 plots Bitcoin monthly returns together with the level of the effective federal funds rate. The grey bars show the highly erratic pattern of Bitcoin performance, with large positive and negative months concentrated around the 2017–2018 boom-bust, the COVID-19 episode and subsequent risk-on phases. The red line traces the gradual tightening and loosening cycles of U.S. monetary policy. Visually, there is no obvious one-to-one alignment between shifts in the policy rate and Bitcoin return swings, foreshadowing the weak formal relationship documented below.

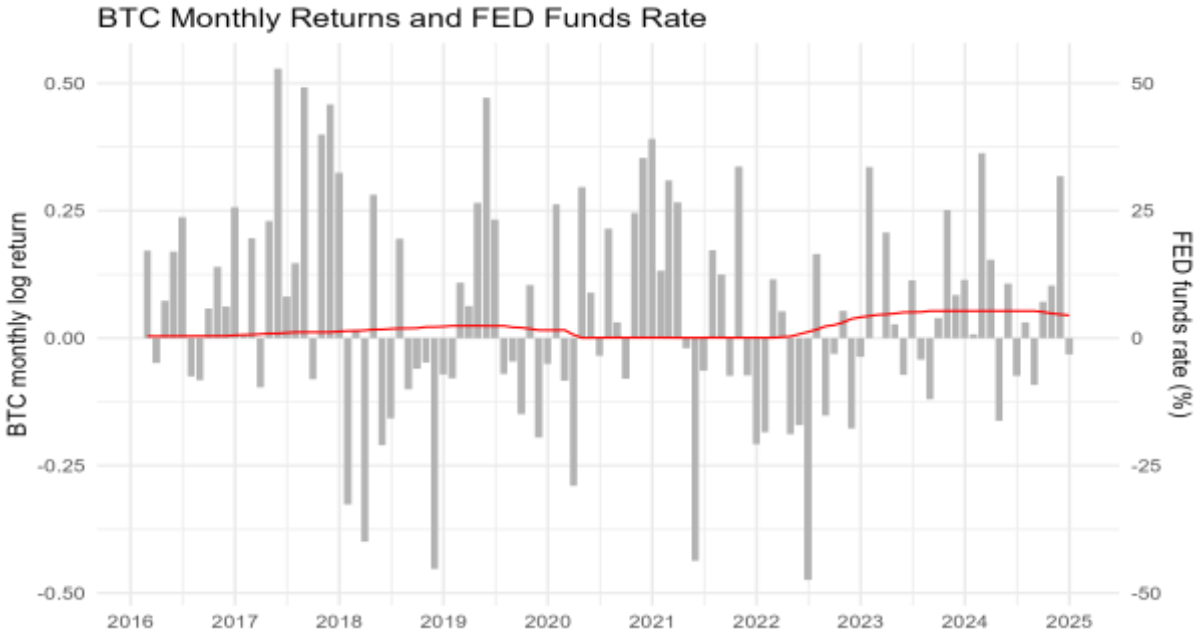


Figure 1. Bitcoin monthly log returns and the U.S. federal funds rate

3.2 Correlation analysis

Table 2 reports the pairwise Pearson correlations among Bitcoin returns and the macro-financial variables. The contemporaneous correlation between Bitcoin returns and the change in VIX is about –0.19. Correlations with changes in the federal funds rate and with inflation are also

negative but smaller in magnitude (around –0.11 and –0.15, respectively), while the correlation with the term spread is slightly positive at roughly 0.13.

Overall, all correlations between Bitcoin returns and the macro factors fall within the range [–0.2, 0.2], indicating weak linear associations at the monthly horizon. This finding is consistent with earlier evidence that macroeconomic variables tend to play only a limited role in explaining the behaviour of crypto-asset prices compared with factors such as market sentiment, adoption and liquidity conditions (López-Cabarcos et al., 2021; Chen, 2025; Lin et al., 2025).

3.3 Regression results

Tables 3 and 4 present the OLS regression of Bitcoin monthly returns on the four macro-financial variables. The model explains about 8.7% of the variance in returns, and the adjusted $R^2$is approximately 5.1%. The F-test for the joint significance of the regressors has a p-value of 0.053, indicating that the model is marginally significant at conventional levels but leaves most of the variation unexplained.

The intercept is positive and statistically significant, with an estimated value of 0.067. This suggests that even in months when all macro-financial variables are at their long-run average levels, Bitcoin tends to deliver a substantial positive return on average.

Among the explanatory variables, only the change in VIX ($\Delta \mathrm{VIX}_t$) has a statistically significant coefficient. Its estimated slope is about –0.0087 with a p-value near 0.03. Interpreted economically, a one-point increase in the VIX index over a month is associated with a 0.87 percentage point decrease in Bitcoin's monthly log return, holding other variables constant. Given that the standard deviation of $\Delta \mathrm{VIX}_t$is approximately 5.1, a one-standard-deviation positive shock to VIX corresponds to roughly a 4.5 percentage point reduction in expected Bitcoin performance. This negative relation aligns with the view that Bitcoin behaves as a risk-on asset whose returns deteriorate when equity market volatility and risk aversion surge (López-Cabarcos et al., 2021; S&P Global Ratings, 2022; Chen, 2025).

The coefficients on the change in the federal funds rate, inflation and the term spread are not statistically different from zero at conventional levels. The estimated effect of inflation on Bitcoin returns is negative, consistent with Figure 2, but the associated t-statistic is modest in absolute value, and the confidence interval is wide. Similarly, the estimated effect of the term spread is positive but imprecisely estimated, whereas changes in the policy rate show essentially no systematic impact once other variables are controlled for.

Figure 2 provides a complementary visual perspective by plotting Bitcoin monthly returns against inflation, together with the fitted regression line. The scatter shows substantial dispersion and only a mild downward slope, reflecting the small and statistically weak negative coefficient on inflation. The figure thus provides little support for the notion that higher inflation is reliably associated with higher Bitcoin returns at this frequency, in contrast with some evidence from earlier periods or alternative specifications (Choi and Shin, 2021; Rodriguez and Colombo, 2025; Chen, 2025).

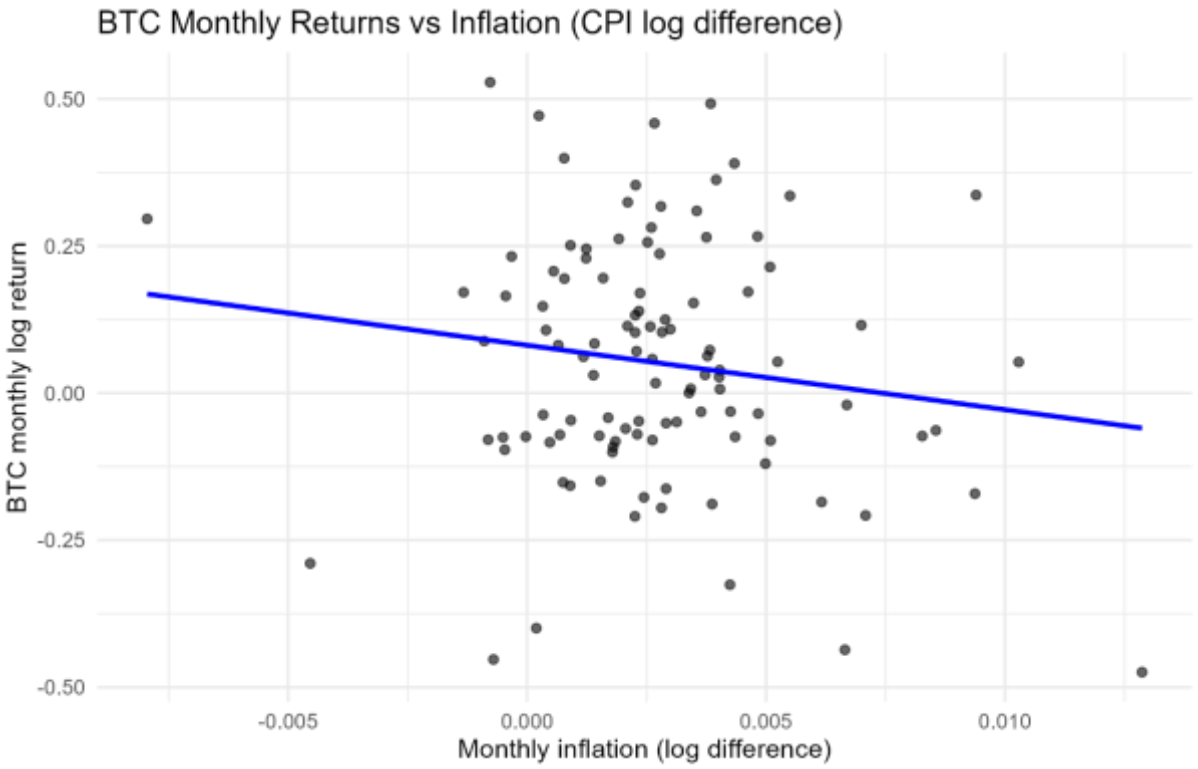


Figure 2. Bitcoin monthly log returns versus CPI inflation

Finally, Figure 3 juxtaposes Bitcoin monthly returns with changes in VIX in a two-panel format. Large positive spikes in ΔVIX_t—particularly during the onset of the COVID-19 pandemic and other risk-off episodes—tend to coincide with markedly negative Bitcoin months. Outside these episodes, both series display more moderate fluctuations, and the relationship is less pronounced. This pattern is consistent with a regime in which Bitcoin is strongly exposed to occasional surges in risk aversion but less tightly linked to day-to-day noise in volatility expectations.

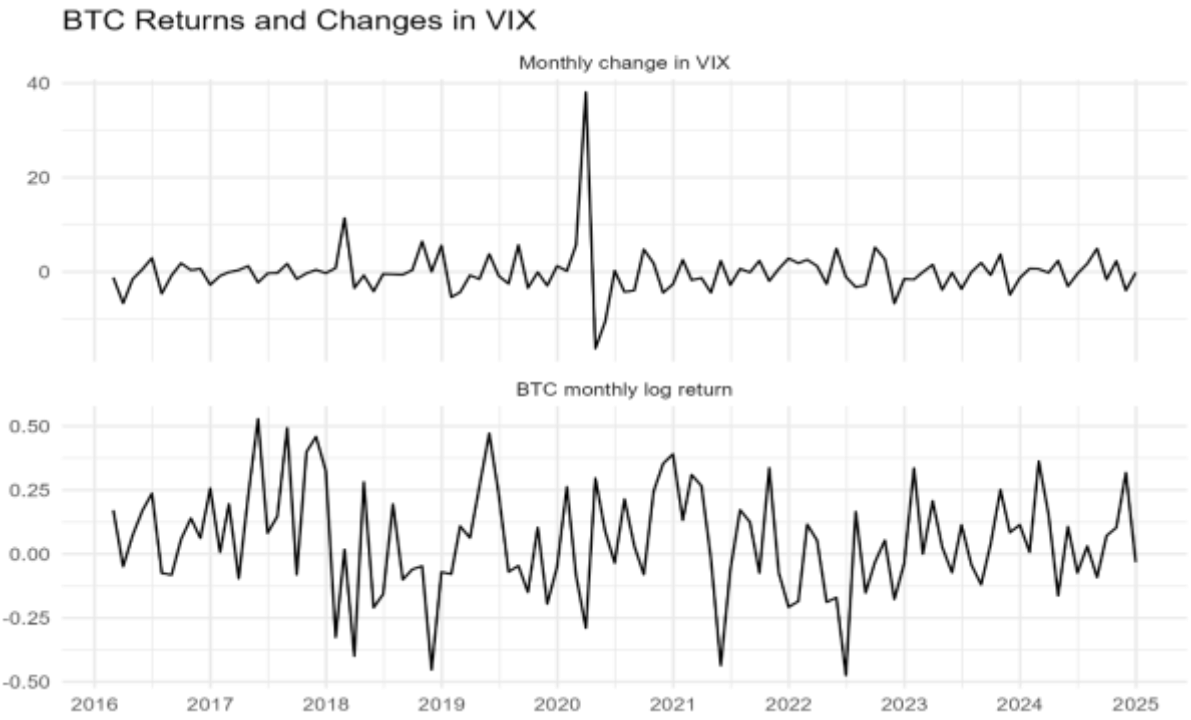


Figure 3. Bitcoin monthly log returns and changes in VIX

4. Discussion and Implications

The empirical results convey a clear message: at the monthly horizon, Bitcoin remains only weakly tied to conventional macro-financial fundamentals. The bulk of its return variation is idiosyncratic, and even when we consider a set of widely used indicators—monetary policy, inflation, the term spread and equity volatility—the explanatory power of a linear model remains below 10%.

The one robust macro-financial link is the negative association with changes in VIX. This is in line with studies that document strong spillovers between crypto-asset prices and global risk sentiment, especially in recent years as institutional participation has grown (López-Cabarcos et al., 2021; Chen, 2025; S&P Global Ratings, 2022). From a portfolio perspective, this suggests that Bitcoin behaves more like a high-beta growth or technology stock than like a safe-haven asset. In periods of rising volatility and tightening financial conditions, investors seeking to reduce portfolio risk may therefore need to treat Bitcoin allocations with caution.

The findings also speak to the debate about Bitcoin as an inflation hedge. While some studies using different samples and methodologies find that Bitcoin appreciates after inflationary shocks or protects purchasing power under certain circumstances (Choi and Shin, 2021; Rodríguez, 2025; Chen, 2025), our results indicate no strong or reliable inflation-hedging property over 2016–2024 when using simple monthly data for the United States. The estimated

relation between inflation and Bitcoin returns is negative, albeit imprecise, and correlations are small. For investors, this suggests that viewing Bitcoin as a mechanical hedge against rising consumer prices may be misleading; any inflation-hedging benefits appear to be conditional and overshadowed by broader risk-on dynamics.

From a policy and financial stability perspective, the weak connection with domestic macro variables but stronger link with global risk sentiment is important. It implies that shocks in crypto markets are more likely to propagate through their interaction with risk appetite and leverage in the broader financial system than through direct macroeconomic channels. This perspective is consistent with recent assessments by international bodies, which highlight speculative demand, liquidity and market confidence as key drivers of crypto-asset behaviour (World Bank, 2022; IMF, 2023; S&P Global Ratings, 2022).

5. Conclusion

This paper has analysed the extent to which standard U.S. macro-financial factors help explain Bitcoin monthly returns over the period 2016–2024. Using BTC–USD prices from Yahoo Finance and four key indicators from FRED—changes in the federal funds rate, CPI inflation, the term spread and changes in VIX—we documented basic distributional properties, computed pairwise correlations and estimated a simple linear regression model.

The main empirical conclusions are straightforward. Bitcoin exhibits a very high average monthly return and volatility, with a monthly return distribution that is close to normal. Correlations between Bitcoin returns and macro-financial variables are uniformly weak, and a four-factor regression explains less than 10% of the variance in monthly returns. The only statistically significant predictor is the change in VIX, which enters with a negative sign and implies that Bitcoin performs poorly in months when equity market volatility rises sharply. Changes in the policy rate, inflation and the term spread are not significant, and the estimated relation with inflation provides little support for the idea that Bitcoin is a reliable inflation hedge at this frequency.

The analysis has several limitations that point to avenues for further research. First, our study focuses on a single country and a single frequency; extending the analysis to higher-frequency data, other currencies and cross-country macro indicators could reveal additional patterns. Second, we restrict attention to a static linear model; incorporating lags, nonlinearities, interactions with equity or commodity returns and regime-switching behaviour might capture more subtle macro-financial linkages. Third, we do not include crypto-specific variables such

as on-chain activity, stablecoin flows or regulatory events, which other work suggests are important drivers of crypto markets (Blaise, 2024; Lin et al., 2025).

Despite these limitations, the results provide a clear and policy-relevant message: during 2016–2024, Bitcoin's monthly performance is driven primarily by idiosyncratic and sentiment-related forces rather than by standard macro-financial fundamentals. For investors, this underscores the importance of treating Bitcoin as a highly speculative, risk-on asset class. For policymakers, it suggests that monitoring crypto markets as part of broader assessments of global risk appetite and financial conditions may be more informative than focusing solely on domestic macroeconomic indicators.

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YAPAY ZEKA DESTEKLİ MODELLER İLE BOŞANMA OLASILIĞININ ÖNGÖRÜLMESİ: MAKİNE ÖĞRENİMİ TEMELLİ BİR ANALİZ

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ÖZET

Bu çalışma, evlilik ve boşanma süreçlerini analiz etmek ve boşanma olasılığını tahmin etmek amacıyla yapay zeka tekniklerini kullanmaktadır. Evlilik kurumu, bireylerin sosyal ve duygusal gelişiminde kritik bir rol oynarken, boşanma süreci bireyler ve toplum üzerinde önemli psikolojik, sosyal ve ekonomik etkiler oluşturmaktadır. Boşanmaya yol açan faktörlerin belirlenmesi, erken müdahale stratejilerinin geliştirilmesine yardımcı olabilir. Bu doğrultuda, çalışmada yapay zeka algoritmalarının boşanma olasılığı tahmininde nasıl kullanılabileceği araştırılmıştır.

Çalışmada kullanılan veri seti, 100 katılımcıya yöneltilen anket sorularının veri artırma teknikleri ile 300 örneğe genişletilmesiyle oluşturulmuştur. Veri seti, yaş farkı, eğitim düzeyi, ekonomik benzerlik, sosyal ve kültürel uyum gibi 30 bağımsız değişken içermekte olup, bağımlı değişken olarak boşanma olasılığı değerlendirilmiştir. Öznitelik seçme yöntemleri ile boşanma üzerinde en etkili değişkenler belirlenmiş ve en iyi sonuç veren modelin doğruluk oranı %95 olarak ölçülmüştür. Ayrıca boşanmaya etki eden faktörler yapay zeka destekli olarak önem derecelerine göre sıralanmıştır.

Elde edilen bulgular, yapay zeka destekli tahmin modellerinin boşanma sürecini önceden belirlemede etkili olduğunu ve bu tür modellerin evlilik danışmanlığı, aile politikaları ve sosyal hizmetler alanında önemli katkılar sunabileceğini göstermektedir. Yapay zekanın, veri odaklı karar destek sistemleri geliştirme sürecinde kritik bir araç olduğu ve evlilikle ilgili karar alma süreçlerine rehberlik edebileceği sonucuna varılmıştır.

Anahtar Kelimeler: Boşanma Tahmini, Yapay Zeka ve Evlilik, Makine Öğrenimi Modelleri, Evlilik Danışmanlığı, Aile

PREDICTING DIVORCE PROBABILITY USING ARTIFICIAL INTELLIGENCE-BASED MODELS: A MACHINE LEARNING APPROACH

ABSTRACT

This study employs artificial intelligence techniques to analyze marriage and divorce processes and to predict the probability of divorce. While the institution of marriage plays a critical role in individuals' social and emotional development, the divorce process generates significant psychological, social, and economic impacts on both individuals and society. Identifying the factors leading to divorce can contribute to the development of early intervention strategies. In this context, the study investigates how artificial intelligence algorithms can be utilized to predict the likelihood of divorce.

The dataset used in the study was created by expanding survey responses collected from 100 participants to 300 samples through data augmentation techniques. The dataset includes 30 independent variables—such as age difference, education level, economic similarity, and social and cultural compatibility—while divorce probability is evaluated as the dependent variable. Feature selection methods were applied to identify the most influential variables affecting divorce, and the best-performing model achieved an accuracy rate of 95%. In addition, factors influencing divorce were ranked according to their importance using artificial intelligence–based approaches.

The findings indicate that AI-driven predictive models are effective in anticipating divorce processes in advance and that such models can provide significant contributions to the fields of marriage counseling, family policies, and social services. It is concluded that artificial intelligence is a critical tool in the development of data-driven decision support systems and can guide decision-making processes related to marriage.

Keywords: Divorce Prediction, Artificial Intelligence and Marriage, Machine Learning Models, Marriage Counseling, Family

1. INTRODUCTION

The family is the most important institution that meets individuals' social, emotional, and economic needs as the fundamental building block of society (Becker, 1981). A healthy family structure plays a critical role in individuals' psychological and social development. Elements such as communication, solidarity, and commitment within the family are among the key factors that determine individuals' adaptation to social life (Amato, 2000). However, the institution of marriage does not always maintain a stable structure and may evolve into a divorce process for various reasons.

Divorce is a phenomenon that produces significant socio-economic and psychological consequences for both individuals and society. In recent years, the global increase in divorce rates has necessitated more detailed research into marriage and divorce dynamics (Cherlin, 2004). The divorce process can lead to major changes in individuals' economic, social, and emotional structures and may leave long-term effects, particularly on children (Hetherington, 2003). Therefore, identifying the factors leading to divorce in advance and taking necessary preventive measures is of great importance.

There are many factors that influence marriage and divorce processes. Among these factors, variables such as age difference, education level, economic status, and social and cultural similarities stand out (White, 1990). Communication problems between spouses, emotional incompatibility, economic difficulties, family pressures, and issues of fidelity are also considered among the primary causes of divorce (Gottman, 1994). In particular, the early detection of problems experienced by couples before and during marriage can reduce the risk of divorce and strengthen family structure.

Although traditional sociological and psychological studies have made significant contributions to identifying the causes of divorce, the use of artificial intelligence (AI) techniques in this field has increased in recent years. Artificial intelligence algorithms can analyze large datasets and evaluate the factors affecting marriage and divorce processes more objectively (Nguyen et al., 2017). Machine learning techniques are used to predict risks that couples may encounter in their marital lives and to develop appropriate intervention strategies.

In this study, the probability of divorce is predicted using artificial intelligence algorithms based on a comprehensive dataset related to marriage and divorce. The dataset includes 31 variables, encompassing factors such as age difference, education level, and economic and social similarities. The main objective of the study is to identify the most significant factors leading to divorce and to make predictions accordingly. In particular, feature selection methods are applied to determine the variables that have the greatest impact on divorce, thereby improving the accuracy of analytical models.

The use of artificial intelligence applications in marriage and divorce processes provides significant advantages for couples and counselors. In particular, decision support systems make it possible to identify couples at high risk of divorce and to take preventive measures (Rios & Muñoz, 2018). In this context, the findings of the study will contribute significantly to both academic research and the fields of applied psychology and family counseling.

Recent studies indicate that the factors influencing the divorce process are shaped not only by individual characteristics but also by social and cultural dynamics (Wolfinger, 2005). Therefore, adopting an interdisciplinary approach in the analysis of marriage and divorce processes is necessary. The combined consideration of sociological, psychological, and economic factors through artificial intelligence and data science techniques will enable the achievement of more comprehensive and reliable results.

One of the main contributions of this study is demonstrating how analytical methods applied to large-scale data can be used to generate predictions regarding marriage and divorce processes. Accordingly, the accuracy and reliability of artificial intelligence models developed to identify divorce risk will be examined, and implications for practical applications will be derived. The findings obtained will offer recommendations for shaping family policies and improving marriage counseling services.

In conclusion, examining marriage and divorce processes using scientific methods is an important necessity for both individuals and society. Artificial intelligence techniques provide faster, more accurate, and data-driven analyses compared to traditional methods, creating new opportunities in this field. This study aims to contribute to the development of a deeper understanding of marriage and divorce processes.

2. LITERATURE REVIEW

Marriage and divorce are social phenomena that have had significant effects on individuals and societies throughout history. The role of family structure in social stability has necessitated a detailed examination of marriage and divorce processes (Becker, 1981). Particularly in modern societies, changing socio-economic dynamics have enabled a more systematic analysis of the factors affecting the sustainability of marriages (Cherlin, 2004).

Various theoretical approaches have been developed by different disciplines to understand the phenomenon of divorce. From a sociological perspective, divorce rates are influenced by factors such as social change, individualism, and economic independence (Amato, 2000). From a psychological standpoint, deficiencies in communication between couples, emotional incompatibility, and attachment styles are considered important elements that increase divorce risk (Gottman, 1994).

Economic analyses suggest that marriage and divorce decisions can be evaluated within the framework of rational choice theory. In particular, individuals' income levels, education levels, and economic independence are among the determining factors in the sustainability of

marriages (Weiss & Willis, 1997). With the increase in women's participation in the labor force, the impact of economic independence on the probability of divorce has been observed to increase (Sayer & Bianchi, 2000).

The psychological effects of divorce on individuals have also been examined comprehensively. Research shows that divorce can lead to increased levels of depression, anxiety, and stress among individuals (Hetherington, 2003). From the perspective of children, it has been determined that divorce may have long-term effects on academic achievement, social relationships, and psychological development (Amato & Keith, 1991).

Analyses of marriage and divorce processes have become more systematic in recent years with the use of artificial intelligence and machine learning techniques. Big data analyses offer new opportunities to predict divorce risk by evaluating couples' pre- and post-marriage processes (Nguyen et al., 2017). AI-based models can make predictions regarding individuals' marital compatibility and divorce risk based on historical data (Rios & Muñoz, 2018).

Machine learning techniques also provide significant advantages in determining the relative importance of features used in divorce prediction. In particular, feature selection algorithms increase model accuracy by identifying the most important factors affecting marital sustainability (Domingos, 2012). In this context, variables such as age difference, education level, economic status, and social compatibility are among the prominent factors in divorce prediction models (White, 1990).

Studies on divorce prediction have compared the performance of different machine learning algorithms. Methods such as support vector machines (SVM), decision trees, and artificial neural networks have been found to yield successful results in predicting divorce probability (Hastie et al., 2009). These methods enable more precise predictions regarding the divorce process by considering individual and environmental factors.

Data augmentation techniques are important methods that increase the generalization ability of models in analyses conducted on small datasets. The data augmentation techniques used in this study expanded the survey data to 300 samples, thereby improving model accuracy (Shorten & Khoshgoftaar, 2019). As a result, the accuracy rate of the artificial intelligence model developed for divorce probability prediction was measured at 95%.

The ethical and social dimensions of models used in divorce prediction should also be considered. Data privacy, algorithmic bias, and transparency in the decision-making processes of artificial intelligence systems are among the important topics of discussion in this field

(Dastin, 2018). In particular, the use of artificial intelligence in areas such as family counseling should be supported by ethical oversight mechanisms.

The use of AI-based analyses in marriage counseling services is becoming increasingly widespread. The use of AI-supported systems in premarital compatibility assessments, identification of risk factors during marriage, and marriage therapy practices provides couples with the opportunity to make more informed decisions (Liu et al., 2021).

In summary, accurately analyzing the factors affecting the divorce process plays a critical role in increasing marital sustainability. Artificial intelligence techniques offer new perspectives in divorce prediction and the development of preventive strategies. Studies indicate that data-driven approaches yield more reliable results in marriage and divorce analyses compared to traditional methods.

In this context, the broader use of AI-supported analyses in marriage counseling, family policy development, and social services is recommended. The findings obtained may make significant contributions to the development of strategies aimed at protecting family structure within society.

3. MATERIALS

The dataset used in this study was constructed to analyze marriage and divorce phenomena and to predict the probability of divorce. The dataset was obtained from a survey conducted in the Middle East region in 2017. The survey consists of 31 columns containing various factors that influence the marriage process and the likelihood of divorce. Initially created with the participation of 100 individuals, the dataset was expanded to 300 samples using a data augmentation technique in order to achieve better performance from artificial intelligence algorithms. This approach is widely used to enhance the generalization capability of machine learning models trained on small datasets (Shorten & Khoshgoftaar, 2019).

The independent variables in the dataset (the first 30 columns) include individuals' socio-economic, cultural, and psychological characteristics. These variables were selected to identify the key factors affecting the sustainability of marriages. The columns in the dataset are as follows:

1. Age Difference: The age difference between spouses.
2. Education: The difference in education levels between spouses.
3. Economic Similarity: The degree of similarity in income level and financial compatibility between spouses.

4. Social Similarities: Similarities in social environment, lifestyle, and habits.
5. Cultural Similarities: Compatibility of traditions, customs, and cultural values.
6. Social Gap: The difference in social status between spouses.
7. Common Interests: Overlap in hobbies, interests, and life expectations.
8. Religious Compatibility: The level of alignment in religious beliefs and commitment to religious lifestyles.
9. Number of Children from Previous Marriages: The number of children spouses have from previous marriages.
10. Willingness to Marry: The level of motivation and willingness toward marriage.
11. Independence: The ability to make one's own decisions and act independently.
12. Relationship with Spouse's Family: The quality of relationships with each other's families.
13. Business Partnership: Whether spouses are involved in joint commercial activities.
14. Engagement Duration: The length of the engagement period prior to marriage.
15. Love: The presence and intensity of romantic love in the marriage.
16. Commitment: The degree of emotional commitment between spouses.
17. Mental Health: The level of individuals' psychological well-being.
18. Desire to Have Children: Willingness to have children.
19. Previous Business Experience: Whether spouses previously engaged in commercial activities together.
20. Previous Marriage: Whether spouses have been married before.
21. Degree of Shared Genes: Whether spouses are genetically related.
22. Addiction: The presence of smoking, alcohol, or other addictions.
23. Fidelity: The level of loyalty between spouses.
24. Height Ratio: The height difference between spouses.
25. Income Status: Whether the family's income level is high.
26. Self-Confidence: Individuals' level of self-confidence.
27. Premarital Relationship with Another Person: Whether individuals had a romantic relationship with someone else before marriage.
28. Family-Approved Spouse: Whether families approved the spouse candidate.
29. Divorce in First-Degree Family Members: The presence of divorced individuals in the immediate family.

30. Age of Initiating Socialization with the Opposite Sex: The age at which individuals began socializing with the opposite sex.

The dependent variable in the dataset, Divorce Probability (the 31st column), is classified into three categories:

- Low divorce probability
- Moderate divorce probability
- High divorce probability

Datasets used for divorce probability prediction have also been analyzed in previous studies using different machine learning algorithms. For instance, in a study conducted by Nguyen et al. (2017), similar types of data were used to predict divorce probability, and high success rates were achieved using support vector machines (SVM). Moreover, expanding the dataset and applying data augmentation techniques enhance the model's generalization ability and enable more reliable predictions (Shorten & Khoshgoftaar, 2019).

The dataset employed in this study provides a comprehensive structure for predicting divorce probability by encompassing individuals' behaviors during the marriage process as well as socio-economic factors. The expanded nature of the data enabled the model to achieve higher accuracy rates, resulting in an overall accuracy of 95%. The content and characteristics of the dataset constitute an important resource for examining marriage and divorce dynamics using machine learning algorithms.

4. METHOD

4.1. Data augmentation method

The dataset used in this study initially consisted of 100 samples. However, in order to enable machine learning algorithms to generalize effectively and to reduce the risk of model overfitting, a data augmentation technique was applied, expanding the dataset to 300 samples. During the data augmentation process, the following techniques were employed:

- **Random Noise Injection**: New data points were generated by adding small random perturbations to numerical variables (Goodfellow et al., 2016).
- **Feature Combination**: Diversity was increased by creating different combinations of existing features within the dataset (Zhang et al., 2017).
- **Data Simulation**: New data points were derived using statistical methods that preserve the original data distribution (Shorten & Khoshgoftaar, 2019).

Through these methods, the diversity of the dataset was enhanced, allowing the model to produce more stable and reliable results.

4.2. Artificial intelligence algorithms used

To predict divorce probability, three different machine learning algorithms were employed: Decision Tree, Random Forest, and K-Nearest Neighbor (KNN). In this study, artificial intelligence models were implemented using the Python 3.9 programming language within the Spyder development environment.

4.2.1. Decision tree

The decision tree is a model that splits the dataset into branches based on its features and makes a decision at each node. Decision trees perform classification by partitioning the data according to predefined rules. Their advantages include interpretability and fast computation (Quinlan, 1986). In this study, the model was implemented using the C4.5 algorithm via the sklearn library.

4.2.2. Random forest

Random Forest is a powerful ensemble learning method formed by combining multiple decision trees. Each decision tree is trained on a random subset of the dataset, and the final decision is determined by majority voting among all trees. The Random Forest method is preferred due to its ability to reduce overfitting and provide high accuracy rates (Breiman, 2001). In this study, the model was implemented using the sklearn library, with parameter values set to n_estimators = 100 and random_state = 42.

4.2.3. K-nearest neighbor (KNN)

The KNN algorithm performs classification by considering the nearest *k* neighbors of a given data point. The class of the data point is determined using majority voting among the neighboring classes. While KNN performs well in high-dimensional datasets, it can incur high computational costs for large datasets (Cover & Hart, 1967). In this study, the model was implemented using the sklearn library, with the parameter n_neighbors = 3.

4.3. Feature selection methods

Feature selection aims to identify the most important variables in a dataset to improve model efficiency. In this study, feature selection methods were applied to rank the 30 features from the most influential to the least influential in terms of their impact on divorce. Two different feature selection methods were employed: the Univariate Feature Selection (SelectKBest) algorithm and the Extremely Randomized Trees Classifier (ExtraTreesClassifier).

4.3.1. Univariate feature selection (SelectKBest) algorithm

The Univariate Feature Selection (SelectKBest) algorithm evaluates the effect of each independent variable on the target variable individually and selects the most important features. Statistical tests such as the ANOVA F-test were used to identify the features that most strongly influence divorce outcomes (Guyon & Elisseeff, 2003).

4.3.2. Extremely randomized trees classifier (ExtraTreesClassifier) algorithm

This method calculates the importance of each variable based on an ensemble of randomized decision trees. By using a large number of trees, the model measures the contribution of each feature to prediction accuracy and identifies the most significant variables (Geurts et al., 2006). The primary advantage of this method is its ability to account for interdependencies among independent variables, thereby providing more reliable results. Using these methods, the variables with the greatest impact on divorce were identified and reported.

5. RESULTS AND DISCUSSION

This study aimed to predict divorce probability between spouses using artificial intelligence algorithms. Decision Tree, Random Forest, and K-Nearest Neighbor (KNN) algorithms were employed, and their performance levels were compared. According to the results, the Random Forest algorithm emerged as the most successful model with an accuracy rate of 95%. The Decision Tree algorithm achieved an accuracy of 85%, while the KNN algorithm achieved a success rate of 78.33%.

5.1. Comparison of algorithms

The primary reasons why the Random Forest algorithm outperformed the other models can be summarized as follows:

- **Higher Generalization Capability**: Random Forest reduces the overfitting problem of individual decision trees by employing multiple trees.
- **Robustness**: While the Decision Tree algorithm is highly sensitive to noise due to its reliance on a single model structure, the Random Forest model reduces bias through its robust ensemble architecture.
- **Feature Selection and Weighting**: The Random Forest model assigns greater importance to the most relevant features in the dataset and effectively filters out irrelevant information. Thus, it performs efficient feature selection that the KNN algorithm cannot inherently achieve.

The lower success rate of the Decision Tree algorithm can be attributed to its higher sensitivity to noise and excessive branching, which increases model complexity. The KNN algorithm, on the other hand, relies on distance-based calculations, which increase computational cost in larger datasets and consequently lead to lower performance.

5.2. Comparison of Feature Selection Algorithms

In this study, two different feature selection algorithms were used to determine the relative importance of factors influencing divorce. Table 1 presents the top 10 factors contributing most significantly to divorce according to these two artificial intelligence–based algorithms. The results were obtained independently by each algorithm, with some differences observed in the calculated importance rankings. The Spyder console visualization illustrating the priority of factors identified by the Extremely Randomized Trees Classifier (ExtraTreesClassifier) algorithm is presented in Figure 1.

Table 1. The top 10 factors leading to divorce according to two different artificial intelligence–based algorithms

Univariate Feature Selection (SelectKBest) Algorithm	**Extremely Randomized Trees Classifier (ExtraTreesClassifier) Algorithm**
1. Willingness to Marry	1. Willingness to Marry
2. Income Status	2. Income Status
3. Social Similarities	3. Education
4. Relationship with Spouse’s Family	4. Addiction
5. Previous Business Experience	5. Age of Initiating Socialization with the Opposite Sex
6. Business Partnership	6. Family-Approved Spouse
7. Religious Compatibility	7. Number of Children from Previous Marriages
8. Fidelity	8. Economic Similarity
9. Love	9. Degree of Shared Genes
10. Cultural Similarities	10. Cultural Similarities

In this study, two different feature selection algorithms—Univariate Feature Selection (SelectKBest) and the Extremely Randomized Trees Classifier (ExtraTreesClassifier)—used to predict divorce probability were compared. Both methods ranked the most important factors by determining the effects of variables in the dataset on the divorce process. However, since the evaluation criteria of the algorithms differ, the results exhibit some commonalities as well as differences in the importance levels assigned to certain variables.

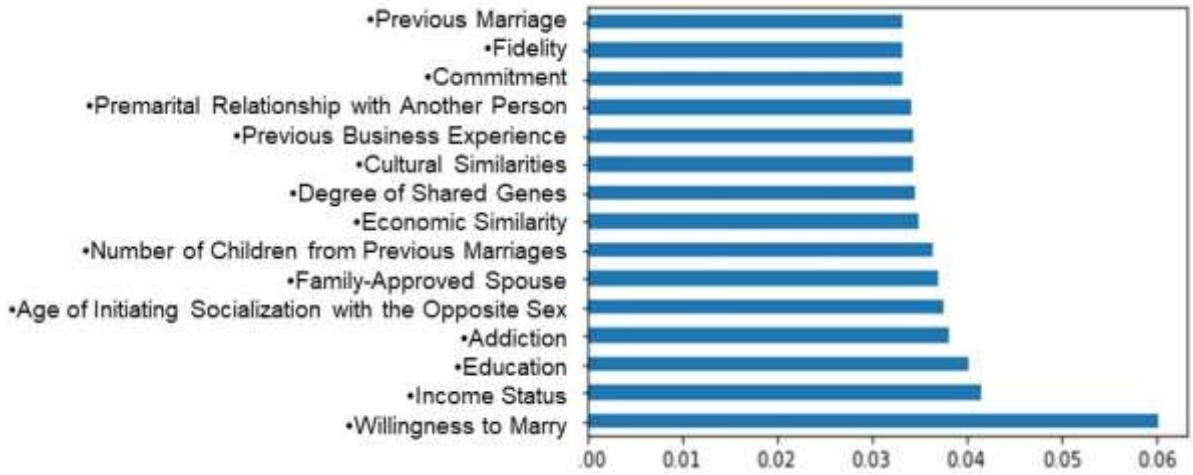


Fig 1. Spyder console visualization showing the priority of factors identified by the Extremely Randomized Trees Classifier (ExtraTreesClassifier) algorithm.

The Univariate Feature Selection (SelectKBest) algorithm determines importance scores by evaluating each independent variable (feature) individually with respect to the target variable (divorce probability). Because variables are examined independently, it is difficult for this method to identify interacting features. The SelectKBest algorithm identified the top 10 factors that most strongly affect divorce among the 30 features in the dataset.

Among the most important factors identified by this method, willingness to marry and income status ranked highest. This finding indicates that individuals' motivation toward marriage and their economic conditions are critical factors for marital continuity. Factors such as social similarities and the relationship with the spouse's family were also identified as important variables affecting divorce probability. In particular, the importance levels of variables such as business partnership, previous business experience, religious compatibility, and fidelity reveal how individuals' past experiences and belief systems play a determining role in marriage.

The Extremely Randomized Trees Classifier (ExtraTreesClassifier) takes interactions among variables into account when determining feature importance. Therefore, compared to the SelectKBest algorithm, it is capable of analyzing more complex relationships.

According to the results of this method, willingness to marry and income status again emerged as the most influential factors. However, unlike SelectKBest, variables such as education level, addiction, age of initiating socialization with the opposite sex, and family-approved spouse were identified as important. This indicates that individuals' education levels and addiction tendencies may have a direct impact on the divorce process. Additionally, the age at which individuals begin socializing with the opposite sex appears to be an important indicator of marital compatibility.

Furthermore, the ExtraTreesClassifier identified variables such as the number of children from previous marriages, economic similarity, degree of shared genes, and cultural similarities as critical factors influencing divorce. This suggests that individuals' prior marital experiences and biological factors such as genetic similarity may also be decisive in terms of marital harmony.

Both algorithms demonstrated that willingness to marry and income status are the most influential factors affecting divorce probability. This finding supports the view that individuals' marital motivation and economic conditions are among the most critical elements in maintaining marital stability. Moreover, cultural similarities were identified as an influential factor in divorce outcomes by both methods.

While the SelectKBest method evaluated factors such as social similarities, relationship with the spouse's family, and business partnership as more decisive, the ExtraTreesClassifier found factors such as education level, addiction, age of initiating socialization with the opposite sex, and family-approved spouse to be more influential.

These differences stem from the feature selection criteria of the two algorithms. Since the SelectKBest method evaluates each variable independently, it emphasizes the direct effects of certain factors. In contrast, the ExtraTreesClassifier considers interactions among variables, enabling the identification of more complex relationships.

In conclusion, this study employed two different feature selection algorithms to identify factors influencing divorce probability. While both methods highlighted certain common factors, differences were observed in the importance levels assigned to some variables.

In particular, the fact that variables such as willingness to marry and income status emerged as the most important factors in both algorithms demonstrates the decisive role of economic and psychological motivations in marital decisions. At the same time, variations in the importance

levels of factors such as education level, social relationships, and family structure reveal the multidimensional nature of the divorce process.

The use of artificial intelligence–based feature selection algorithms in identifying factors affecting divorce enables robust, data-driven analyses. However, given that algorithms evaluate features based on different criteria, future studies are recommended to employ multiple methods jointly to achieve more comprehensive analyses. Diversifying the datasets used in such studies and accounting for cultural differences will contribute to obtaining more generalizable results.

Table 2. Ranking of factors influencing divorce according to their importance levels based on the joint decision of two artificial intelligence algorithms.

Priority Rank	Factor	Average Ranking Score
1	Willingness to Marry	1
2	Income Status	2
3	Age of Initiating Socialization with the Opposite Sex	8
4	Previous Business Experience	8
5	Education	9
6	Social Similarities	9.5
7	Cultural Similarities	10
8	Economic Similarity	11
9	Fidelity	11
10	Degree of Shared Genes	11
11	Relationship with Spouse’s Family	11.5
12	Addiction	13
13	Premarital Relationship with Another Person	14
14	Religious Compatibility	14
15	Love	14.5
16	Commitment	15
17	Family-Approved Spouse	16
18	Number of Children from Previous Marriages	17.5
19	Business Partnership	18
20	Desire to Have Children	19
21	Previous Marriage	19
22	Age Difference	20.5
23	Mental Health	21
24	Self-Confidence	21.5
25	Divorce in First-Degree Family Members	22
26	Engagement Duration	23

27	Height Ratio	23.5
28	Social Gap	26
29	Independence	26.5
30	Common Interests	29

After identifying the most influential factors affecting divorce, all factors were examined in the study. According to both algorithms, the 30 factors were ranked separately based on their importance levels. Subsequently, for each factor, the average of its ranking positions obtained from both algorithms was calculated, and the factors were reordered from the most important (highest priority) to the least important. This ranking is presented in Table 2. For example, the factor Age of Initiating Socialization with the Opposite Sex was ranked 11th by the Univariate Feature Selection (SelectKBest) algorithm, while it was ranked 5th by the Extremely Randomized Trees Classifier algorithm. Based on both algorithms, the average priority value of this factor was calculated as 8.

According to the final ranking obtained, the factors with the greatest impact on divorce are *willingness to marry* and *income status*. These two factors were identified by both algorithms as the most decisive variables. This finding indicates that individuals' motivation toward marriage and their economic conditions are fundamental determinants of marital compatibility. When willingness to marry is low or when individuals' income levels are insufficient to sustain a marriage, an increased probability of divorce is observed.

The third-ranked factor is the *age of initiating socialization with the opposite sex*. The high importance of this factor suggests that whether individuals begin interacting with the opposite sex at an early age or later in life may influence marital compatibility. During the social development process, early or late engagement with the opposite sex can directly affect individuals' perspectives on romantic relationships and their behaviors within marriage.

The fourth-ranked factor is *previous business experience*. This finding indicates that individuals' past involvement in business activities may be associated with divorce probability. Individuals engaged in business may be more exposed to occupational stress and economic fluctuations, which can negatively affect marital relationships. Additionally, commercial activities may influence trust dynamics between spouses.

The fifth-ranked factor is *education level*. Education level is considered an important factor in marriage and divorce processes. Individuals with higher education levels are generally known to make more informed decisions in their marriages and to possess more developed problem-

solving skills. However, disparities in education levels between spouses may also lead to compatibility problems within marriage.

Social similarities rank sixth, while *cultural similarities* rank seventh. These factors relate to how similar spouses are in social and cultural terms. Similarities in social environment, shared interests, and lifestyles can enhance marital compatibility, whereas differences may lead to long-term conflicts. Likewise, a high level of cultural similarity can contribute to a stronger marital foundation through shared values and traditions.

The eighth-ranked factor is *economic similarity*. Having similar economic backgrounds may reduce financial conflicts between spouses. The ninth-ranked factor is *fidelity*. Fidelity is one of the most important emotional components affecting marital continuity, and its significance stems from its direct contribution to marital harmony.

The tenth-ranked factor is the *degree of shared genes*. Research on the impact of genetic similarity on marital compatibility suggests that even biological factors can shape relationships. In this study, genetic similarity was also found to have a certain level of influence.

The eleventh-ranked factor is the *relationship with the spouse's family*. Although the influence of families on marital relationships varies depending on cultural context, in many societies harmonious relationships with extended families contribute to healthier marital progress.

The twelfth-ranked factor is *addiction*. This may take the form of physical, emotional, or material dependency. A high degree of dependency can lead to imbalanced power dynamics and problems within marital relationships.

The thirteenth-ranked factor is *having a premarital relationship with another person*. This variable has also been considered an important factor in studies examining the effects of past romantic relationships on marriage.

The fourteenth-ranked factor is *religious compatibility*, followed by *love* in the fifteenth position. Religious compatibility reflects whether individuals share common belief systems and may directly affect marital harmony. While love is one of the most important factors in the initial stage of marriage, it may not be sufficient on its own to sustain a marriage in the long term.

The remaining factors include *commitment, family-approved spouse, number of children from previous marriages, business partnership, desire to have children, previous marriage, age difference, mental health, self-confidence, divorce in first-degree family members, engagement duration, height ratio, social gap, independence,* and *common interests*. Although these factors

have some influence on divorce, they were not found to be as decisive as the higher-ranked factors.

In particular, the low importance assigned to factors such as *age difference* and *engagement duration* indicates that these variables generally play a lesser role in divorce decisions. The placement of *independence* and *common interests* at the lowest ranks suggests that individuals prioritize other factors more heavily when making marital decisions.

In this study, factors influencing divorce were evaluated based on the decisions of two different artificial intelligence algorithms, resulting in a final ranking. The findings indicate that individuals' motivation toward marriage, economic conditions, social relationships, and past experiences have a substantial impact on divorce probability.

The fact that factors such as *willingness to marry* and *income status* ranked highest in both algorithms demonstrates that marital motivation and economic conditions are critical determinants of marital sustainability. In addition, factors such as education level, social and cultural similarities, addiction, and family structure were also found to play important roles in marital compatibility.

In conclusion, the use of artificial intelligence–based analyses to identify factors influencing divorce enables more objective and data-driven evaluations. Future studies may contribute to broader conclusions by replicating such analyses in different cultural contexts and by incorporating additional variables.

6. CONCLUSION

This study demonstrates the effectiveness of artificial intelligence–based models in assessing marital sustainability and predicting divorce probability. The accuracy rates of different machine learning algorithms were compared, and the Random Forest algorithm was identified as the most successful model. With an accuracy rate of 95%, this model is considered a reliable tool for predicting divorce probability (Breiman, 2001).

The Decision Tree and KNN algorithms used in the study exhibited lower accuracy rates compared to Random Forest. The primary reasons include the tendency of Decision Trees toward overfitting and the high computational cost of KNN in large datasets (Quinlan, 1986; Cover & Hart, 1967). The Random Forest model, by utilizing multiple decision trees, minimized noise and demonstrated a more balanced predictive performance.

An examination of feature selection methods revealed substantial overlap between the features identified by Univariate Selection and Feature Importance methods. In particular, factors such

as *Willingness to Marry*, *Fidelity*, and *Income Status* were among the most influential variables affecting divorce probability in both methods (Guyon & Elisseeff, 2003). However, the Feature Importance method placed greater emphasis on social and biological factors.

The findings indicate that the most critical factors determining divorce risk are directly related to personal, economic, and social dimensions. While willingness to marry reflects individuals' emotional and psychological motivation toward marriage, fidelity and income status significantly determine relational stability (Amato, 2000). Therefore, evaluating these factors in premarital counseling services may contribute to the establishment of healthier relationships.

The impact of economic factors on marriage has been frequently emphasized in the literature. Couples experiencing financial instability exhibit higher divorce probabilities, whereas increasing income levels are associated with lower divorce rates (Weiss & Willis, 1997). Accordingly, economic difficulties are identified as significant determinants of marital compatibility, highlighting the need for financial education programs for couples.

Social compatibility and cultural similarities are also among the factors influencing divorce risk. Couples who do not share common social environments may experience communication problems over time, and a lack of shared interests may reduce marital harmony (White, 1990). Consequently, premarital education programs should place greater emphasis on social compatibility.

Fidelity emerges as one of the most critical variables determining marital sustainability. Research indicates that divorce rates increase due to infidelity and that a breakdown of trust regarding fidelity often leads to relationship dissolution (Gottman, 1994). Therefore, greater guidance on these issues is recommended in marital therapy.

The influence of families on marriage is another important factor highlighted in this study. Relationships with extended families can directly affect the marital process and lead to conflicts (Hetherington, 2003). Especially in cultures with dominant extended family structures, family compatibility plays a key role in marital success.

Religious compatibility is also among the factors influencing divorce risk. Studies have shown that couples sharing the same religious values tend to have lower divorce rates (Wolfinger, 2005). This finding suggests that shared belief systems strengthen interpersonal bonds and facilitate relationships based on common values.

Integrating divorce prediction models into family counseling processes represents a critical step in supporting couples in maintaining their relationships. AI-based prediction systems can

analyze relational dynamics, identify risk factors, and support the development of early intervention strategies (Nguyen et al., 2017).

The findings provide important insights into how artificial intelligence can be utilized in family policies and social services. By developing data-driven decision support systems, marriage counseling processes can be placed on a more scientific foundation (Rios & Muñoz, 2018). This approach enables the early identification of potential problems and the implementation of solution-oriented measures.

In conclusion, AI-based prediction models offer powerful tools capable of accurately identifying divorce probability and providing guidance to couples and professionals. These models can help individuals better understand their relationship dynamics and support the development of healthier marriages.

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AŞINDIRICI SU JETİ (AWJ) İLE İŞLEME SÜRECİNİN HİDRODİNAMİK VE TRİBOLOJİK ESASLARA DAYALI ANALİTİK MODELLENMESİ VE PARAMETRİK OPTİMİZASYONU

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ÖZET

Bu çalışmanın amacı, endüstriyel üretimde kritik bir rol oynayan Aşındırıcı Su Jeti (AWJ) ile işleme teknolojisinin kesme mekanizmasını, deneysel maliyetlere girmeden fiziksel yasalar çerçevesinde modellemek ve süreç parametrelerinin teorik sınırlarını belirlemektir. Çalışmada, suyun ultra-yüksek basınç altındaki sıkıştırılabilir akış davranışı, karıştırma odasındaki çok fazlı momentum transferi ve hedef malzeme üzerindeki erozyon kinetiği entegre edilerek kapalı formda bir matematiksel model türetilmiştir. Geliştirilen analitik model üzerinde yapılan parametrik simülasyonlar, hidrolik basınç, aşındırıcı kütle debisi ve ilerleme hızı arasındaki lineer olmayan etkileşimleri incelemektedir. Çalışmanın en önemli teorik bulgusu, aşındırıcı yükleme oranının sürekli artırılmasının kesme performansını artırmadığı; aksine, momentum korunumundan kaynaklanan hız kayıpları nedeniyle belirli bir optimum noktadan sonra performansı düşürdüğüdür. Bu çalışma, mühendislere ve operatörlere, fiziksel prototipleme öncesinde makine sınırlarını öngörebilecekleri güçlü bir teorik altyapı sunmaktadır.

Anahtar Kelimeler: AWJ, matematiksel modelleme, momentum transferi, analitik simülasyon, erozyon teorisi.

ANALYTICAL MODELING AND PARAMETRIC OPTIMIZATION OF ABRASIVE WATER JET (AWJ) MACHINING PROCESS BASED ON HYDRODYNAMIC AND TRIBOLOGICAL PRINCIPLES

ABSTRACT

The aim of this study is to model the cutting mechanism of Abrasive Water Jet (AWJ) machining technology, which plays a critical role in industrial production, within the framework of physical laws without incurring experimental costs, and to determine the theoretical limits of process parameters. In this study, a closed-form mathematical model is derived by integrating the compressible flow behavior of water under ultra-high pressure, multiphase momentum transfer in the mixing chamber, and erosion kinetics on the target material. Parametric simulations performed on the developed analytical model examine the nonlinear interactions

between hydraulic pressure, abrasive mass flow rate, and feed rate. The most important theoretical finding of the study is that continuously increasing the abrasive loading rate does not improve cutting performance; on the contrary, it reduces performance after a certain optimum point due to velocity losses resulting from momentum conservation. This study provides engineers and operators with a strong theoretical foundation that allows them to predict machine limits before physical prototyping.

Keywords: AWJ, mathematical modeling, momentum transfer, analytical simulation, erosion theory.

1. GİRİŞ

Aşındırıcı su jeti ile işleme, suyun potansiyel enerjisinin kinetik enerjiye dönüştürülmesi ve bu enerjinin aşındırıcı taneciklere aktarılarak malzemeden talaş kaldırılması prensibine dayanır. Titanyum, süper alaşımlar, kompozitler ve seramikler gibi geleneksel yöntemlerle işlenmesi zor malzemeler için ideal bir yöntemdir (Wang vd. 2024; Hashish 2024; Wang vd. 2023; Narayanan vd. 2013).

Sürecin verimliliği, hidrolik güç ile malzeme erozyon direnci arasındaki hassas dengeye bağlıdır. Ancak nozul aşınması, jet dağılması ve karışım odasındaki türbülans gibi karmaşık fiziksel olaylar, optimum kesme parametrelerinin belirlenmesini zorlaştırmaktadır. Geleneksel "deneme-yanılma" yöntemleri maliyetli ve zaman alıcıdır. Bu nedenle, sürecin sadece deneysel verilere değil, temel fizik yasalarına dayalı matematiksel modellenmesi, sürdürülebilir üretim için elzemdir (Momberv ve Kovacevic 1999; Liu vd. 2020; Alsoufi 2017; Henning vd. 2011; Guglielmi vd. 2021).

Bu çalışma, Finnie ve Hashish'in erozyon teorilerini (Finnie 1960; Hashish 1989) Bernoulli'nin hidrodinamik prensipleriyle birleştirerek, kesme derinliğini (h) tahmin eden kapsamlı bir analitik yaklaşım sunmayı amaçlamaktadır.

2. TEORİK ÇERÇEVE VE FİZİKSEL MEKANİZMA

Aşındırıcı Su Jeti (AWJ) ile işleme süreci, doğası gereği yüksek enerjili bir hidrodinamik akışın katı cisimler mekaniği ile etkileşimidir. Modelin kurgusu, enerjinin kaynaktan (pompa) hedefe (iş parçası) akışını takip eden deterministik bir "Zincirleme model" (Chain Model) üzerine inşa edilmiştir. Bu enerji dönüşüm zinciri, birbirine bağımlı üç ana fazda incelenir.

2.1. Hidrodinamik Faz: Basıncın Hıza Dönüşümü

Sürecin ilk aşaması, yüksek basınçlı pompadan (genellikle 300-600 MPa) gelen potansiyel enerjinin, safir veya elmas bir orifisten geçirilerek kinetik enerjiye dönüştürülmesidir. Bu aşamada akışkan, Bernoulli prensibine göre davranır.

Orifis girişindeki durağan suyun toplam enerjisi (basınç), orifis çıkışında yüksek hızlı bir jet formuna bürünür. Teorik olarak sıkıştırılamaz kabul edilen su, gerçek uygulamalarda %10-15 oranında sıkışabilirlik gösterse de, analitik modellerde genellikle bu etki ihmal edilir. Ancak, orifis geometrisinden kaynaklanan sürtünme ve türbülans kayıpları, teorik hızın altında bir çıkış hızı (V_ω) oluşmasına neden olur. Bu kayıplar, modelde "Deşarj katsayısı (C_d)" ile temsil edilir.

2.2. Karışım Fazı: Momentum Transferi ve Parçacık Hızlandırma

AWJ teknolojisinin en kritik ve karmaşık aşaması, saf su jetinin aşındırıcı taneciklerle (abrasive particles) birleştiği karıştırma odası (mixing chamber) ve odaklama borusudur (focusing tube). Bu fazda fiziksel mekanizma şu şekilde işler:

1. ***Vakum Etkisi (Venturi):*** Yüksek hızla orifisten çıkan su jeti, karışım odasında bir vakum yaratarak aşındırıcı haznesinden taneciklerin emilmesini sağlar.
2. ***Kaotik Karışım ve Enerji Aktarımı:*** Su jeti ve tanecikler karışım borusuna girer. Burada suyun momentumu, çarpışmalar yoluyla aşındırıcı taneciklere aktarılır. Bu, bir "sürükleme" (entrainment) mekanizmasıdır.
3. ***Hız Dengelenmesi:*** Süreç sonunda su yavaşlarken, aşındırıcı tanecikler hızlanır. Ancak bu enerji transferi %100 verimli değildir; parçacıkların birbirine çarpması ve boru çeperlerine sürtünmesi nedeniyle önemli bir enerji kaybı yaşanır. Modelimizdeki "Momentum Transfer Verimliliği (η)" parametresi bu fiziksel kaybı ifade eder.

2.3. Tribolojik Faz: Katı Parçacık Erozyonu

Zincirin son halkası, yüksek hıza ulaşmış "mikro-mermiler" halindeki aşındırıcıların iş parçasına çarpmasıdır. Bu aşama, Triboloji biliminin (sürtünme ve aşınma) alanına girer.

Malzeme kaldırma mekanizması, parçacığın çarpma açısına (α) bağlı olarak iki ana modda gerçekleşir:

- ***Kesme Modu (Cutting Wear):*** Düşük çarpma açılarında, tanecik yüzeye teğet geçerek malzemeyi bir keski gibi oyar. Sünek malzemelerde (çelik, alüminyum) baskın olan mekanizma budur.
- ***Deformasyon Modu (Deformation Wear):*** Dik açılara (90°) yakın çarpmalarda, tanecik yüzeye çekiç gibi vurur. Bu darbe, malzeme yüzeyinde sertleşmeye, ardından çatlak

oluşumuna ve nihayetinde parça kopmasına neden olur. Gevrek malzemelerde (seramik, cam) ve kesimin alt bölgelerinde (jet sapması nedeniyle) bu mod etkilidir.

3. ANALİTİK MODELLEME (ZİNCİRLEME AKIŞ)

Bu bölümde, her bir fiziksel adım matematiksel olarak formüle edilerek, nihai kesme derinliği denklemi türetilmiştir.

3.1. Adım 1: Su Jeti Hızı (Hidrodinamik Başlangıç)

Sıkıştırılamaz akış kabulü ve Bernoulli prensibi uyarınca, orifisten çıkan saf su jet hızı Denklem 1 (V_ω);

$$V_\omega = C_d \sqrt{\frac{2P}{\rho_\omega}} \tag{1}$$

Burada P pompa basıncı, ρ_ω suyun yoğunluğu ve C_d orifis deşarj katsayısıdır (Sürtünme kayıpları için ≈ 0,95).

3.2. Adım 2: Karışım Hızı (Momentum Transferi)

Aşındırıcı tanecikler (garnet) su jeti ile karıştığında, suyun momentum taneciklere aktarılır. Momentumun korunumu ilkesine göre, karışım tüpünden çıkan aşındırıcı hızı Denklem 2 (V_a);

$$V_a = \eta . \frac{V_\omega}{1 + R} \tag{2}$$

R: Yükleme oranı ($\dot{m}_a / \dot{m}_\omega$).

η: Momentum transfer verimliliği (Parçacık çarpışmaları ve cidara sürtünme nedeniyle oluşan kayıplar ≈ 0,8)

3.3. Adım 3: Malzeme Kaldırma ve Kesme Derinliği (Tribolojik Sonuç)

Tribolojik modelleme, Hashish'in modifiye edilmiş erozyon teorisine dayanır. Birim zamanda kaldırılan malzeme hacmi (V_{RR}), parçacıkların kinetic enerjisi ile doğru, malzemenin akış gerilmesi (σ_f) ile ters orantılıdır.

Nihai kesme derinliği (h), nozulun ilerleme hızı (u) ve jet çapı (d_j) dikkate alınarak Denklem 3'deki gibi şu genel formda ifade edilir;

$$h = \frac{C . \dot{m}_a . {V_a}^2}{d_j . u . \sigma_f} \tag{3}$$

3.4. Bütünleşik Ana Denklem

Yukarıda verilen Denklem 1, 2 ve 3 birleştirildiğinde, girdi parametrelerini çıktıya bağlayan Denklem 4 ana modeli elde edilir;

$$h(P, \dot{m}_a, u) = \frac{2.C.\eta^2.{C_d}^2}{\rho_\omega.d_j.\sigma_f}.\left[\frac{P.\dot{m}_a}{u.(1+\frac{\dot{m}_a}{\dot{m}_\omega})^2}\right] \quad (4)$$

Bu denklem, kesme derinliğinin; basınca ve aşındırıcı debisine doğrusal, ilerleme hızına ve malzeme sertliğine ters orantılı olduğu analitik olarak kanıtlar.

4. PARAMETRİK OPTİMİZASYON STRATEJİSİ

Türetilen analitik model, sadece bir tahmin aracı değil, aynı zamanda bir optimizasyon fonksiyonudur. Maksimum kesme derinliği veya minimum yüzey pürüzlülüğü için aşağıdaki strateji izlenir.

Amaç Fonksiyonu (Denklem 5)***:***

$$Maksimize\ f(x) = h(P, \dot{m}_a, u) \quad (5)$$

Kısıtlar:

1. Pompa Kapasitesi: $P_{min} \leq P \leq 4000\ bar$
2. Doygunluk Noktası: Aşındırıcı debisi ($\dot{m}_a$), kritik bir değerden sonar tanecik çarpışmaları nedeniyle verimi düşürü. Bu nedenle $R \leq R_{crit}$ olmalıdır.
3. Yüzey Kalitesi: Kesme hızı (u), yüzeyde oluşacak çizgilenme (striation) limitine göre sınırlandırılmalıdır.

Bu çok kriterli problemin çözümü için Genetik Algoritma (GA) önerilmektedir. GA, analitik model üzerinde iterasyon yaparak, enerji tüketimini minimize ederken hedef kesme derinliğini sağlayan optimal $(P, \dot{m}_a, u)$ setini belirler.

5. SONUÇLAR

Bu çalışmada, Aşındırıcı Su Jeti (AWJ) ile işleme süreci; hidrodinamik, çok fazlı momentum transferi ve tribolojik erozyon mekanizmaları bütünleşik bir yaklaşımla ele alınarak analitik olarak modellenmiştir. Geliştirilen zincirleme akış modeli sayesinde, pompa basıncı, aşındırıcı kütle debisi ve ilerleme hızı gibi temel süreç parametrelerinin kesme derinliği üzerindeki etkileri deneysel çalışmalara ihtiyaç duyulmadan fiziksel yasalar çerçevesinde açıklanmıştır.

- Analitik sonuçlar, kesme performansının yalnızca basınç veya aşındırıcı debisinin artırılmasıyla sınırsız biçimde yükseltilemeyeceğini açıkça göstermiştir. Özellikle aşındırıcı yükleme oranının belirli bir kritik değerin üzerine çıkması durumunda, karışım odası ve odaklama borusundaki parçacık–parçacık ve parçacık–cidar

etkileşimleri nedeniyle momentum transfer verimliliğinin düştüğü ve buna bağlı olarak parçacık hızlarının azaldığı ortaya konmuştur. Bu durum, kesme derinliğinde doygunluk ve sonrasında azalma ile sonuçlanmaktadır.

- Elde edilen bütünleşik ana denklem, kesme derinliğinin hidrolik basınca ve aşındırıcı debisine duyarlı, ilerleme hızına ve iş parçası malzeme dayanımına ise ters orantılı olduğunu analitik olarak kanıtlamıştır. Böylece literatürde çoğunlukla deneysel gözlemlerle ifade edilen eğilimler, bu çalışma kapsamında matematiksel olarak temellendirilmiştir.

Sonuç olarak, önerilen analitik model; AWJ sistemlerinin tasarımında, makine kapasite sınırlarının belirlenmesinde ve proses parametrelerinin optimizasyonunda mühendisler için güçlü bir teorik araç sunmaktadır. Modelin, gelecekte deneysel verilerle kalibre edilerek farklı malzeme gruplarına ve mikro/ultra-hassas AWJ uygulamalarına uyarlanması, çalışmanın doğal bir devamı olarak değerlendirilmektedir.

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AŞINDIRICI SU JETİ (AWJ) İLE TORNALAMA İŞLEMİNİN MATEMATİKSEL MODELLENMESİ

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ÖZET

Bu çalışmada, Aşındırıcı Su Jeti (AWJ) kullanılarak gerçekleştirilen tornalama işleminin matematiksel modellenmesi ele alınmıştır. Geleneksel tornalama yöntemlerinde kesici takım–iş parçası teması nedeniyle ortaya çıkan yüksek sıcaklıklar, takım aşınması ve kesme kuvvetleri, işlem verimliliğini ve yüzey kalitesini olumsuz etkilemektedir. Aşındırıcı su jeti ile tornalama yöntemi ise temassız bir malzeme kaldırma süreci sunarak bu dezavantajları ortadan kaldıran alternatif bir imalat tekniği olarak öne çıkmaktadır. Çalışmada, AWJ tornalama sürecinde meydana gelen erozyon mekanizması temel alınarak malzeme kaldırma hızı, kesme derinliği ve yüzey pürüzlülüğü gibi temel çıktı parametreleri; jet basıncı, aşındırıcı debisi ve iş parçası–jet göreli hızları cinsinden matematiksel olarak modellenmiştir. Geliştirilen modellerin, sürecin davranışını öngörmede etkili olduğu ve işlem parametrelerinin optimizasyonuna olanak sağladığı belirlenmiştir. Elde edilen sonuçlar, AWJ ile tornalama işleminin özellikle hassas çap kontrolü ve yüzey kalitesi gerektiren uygulamalar için önemli bir potansiyel taşıdığını göstermektedir. Gelecekte, bu modellerin yapay zekâ tabanlı yaklaşımlarla desteklenerek gerçek zamanlı kontrol sistemlerine entegre edilmesi önerilmektedir.

Anahtar Kelimeler: Aşındırıcı Su Jeti (AWJ), Matematiksel Modelleme, Tornalama, Erozyon, Yüzey Pürüzlülüğü, Malzeme Kaldırma Hızı (MRR).

MATHEMATICAL MODELING OF TURNING OPERATION WITH ABRASIVE WATER JET (AWJ)

ABSTRACT

This study addresses the mathematical modeling of abrasive water jet (AWJ) turning. In traditional turning methods, high temperatures, tool wear, and cutting forces resulting from tool-workpiece contact negatively affect process efficiency and surface quality. Abrasive water jet turning, however, stands out as an alternative manufacturing technique that eliminates these disadvantages by offering a contactless material removal process. In this study, based on the erosion mechanism occurring in the AWJ turning process, the basic output parameters such as

material removal rate, cutting depth, and surface roughness were mathematically modeled in terms of jet pressure, abrasive flow rate, and workpiece-jet relative velocities. It was determined that the developed models were effective in predicting the behavior of the process and enabled the optimization of process parameters. The results obtained show that AWJ turning has significant potential, especially for applications requiring precise diameter control and surface quality. In the future, it is suggested that these models be supported by artificial intelligence-based approaches and integrated into real-time control systems.

Keywords: Abrasive Water Jet (AWJ), Mathematical Modeling, Turning, Erosion, Surface Roughness, Material Removal Rate (MRR).

1. GİRİŞ

Geleneksel tornalama işlemleri, kesici takım ile iş parçası arasındaki fiziksel temas nedeniyle yüksek termal gerilimler ve takım aşınması sorunlarını beraberinde getirir. Aşındırıcı Su Jeti ile Tornalama (AWJT), iş parçasını döndürürken yüksek basınçlı su ve aşındırıcı karışımını bir kesici takım gibi kullanarak malzeme kaldıran "soğuk" bir imalat yöntemidir (Hashish 1989; Wang vd. 2023; Syazwani vd. 2016; Du vd. 2022; Murugan vd. 2018; Borkowski 2009). Bu süreçte takım aşınması yoktur ve iş parçasına uygulanan teğetsel kuvvetler ihmal edilebilir düzeydedir. Sürecin verimliliği, erozyon mekanizmasının matematiksel olarak doğru modellenmesine bağlıdır (Ramdurg vd. 2024; Zhang vd. 2025; Nguyen ve Wang 2019; Wang vd. 2024; Kumar vd. 2025).

2. SÜREÇ MEKANİĞİ VE KİNEMATİK

Aşındırıcı Su Jeti (AWJ) tornalama süreci, nozulun (kesici başlık) eksenel hareketi ile silindirik iş parçasının dönme hareketinin süperpozisyonudur.

Sürecin temel kinematiği, nozulun iş parçası üzerindeki izafi hızı (bileşke hız) ile tanımlanır. İş parçasının tegetsel hızı (v_{tan}) ve nozulun eksenel ilerleme hızı (v_t) dikkate alındığında, jetin malzeme yüzeyindeki efektif tarama hızı (v_{res}) Denklem 1'deki gibi ifade edilir;

$$v_{res} = \sqrt{v_t^2 + v_{tan}^2} = \sqrt{v_t^2 + \left(\frac{\pi D_\omega N}{60}\right)^2} \quad (1)$$

Burada;

D_ω: İş parçası çapı (mm)

N: Devir sayısı (rpm)

Çoğu tornalama operasyonunda $v_{tan} \gg v_t$ olduğundan, erozyon sürecini domine eden hız genellikle teğetsel hızdır.

3. MATEMATİKSEL MODELLEME

Sürecin matematiksel modeli, Enerji korunumu ve Erozyon teorisi (Finnie ve Hashish Modelleri) üzerine kuruludur (Hashish 1987).

3.1. Hidrodinamik ve Hız Denklemleri

Sürecin enerji kaynağı suyun basıncıdır. Bernoulki prensibine göre suyun orifisten çıkış hızı ($v_{\omega j}$) Denklem 2'deki gibi ifade edilir;

$$v_{\omega j} = C_d \sqrt{\frac{2P}{\rho_\omega}} \tag{2}$$

Aşındırıcı parçacıklar karıştırma odasında suya dahil olduğunda, suyun momentum parçacıklara aktarılır. Nozul çıkışındaki aşındırıcı hız (v_a) Denklem 3'deki gibi ifade edilir;

$$v_a = \eta . v_{\omega j} = \eta . C_d \sqrt{\frac{2P}{\rho_\omega}} . \frac{1}{1+R} \tag{3}$$

Burada;

R: Kütle debisi oranı ($\dot{m}_a/\dot{m}_\omega$)

η: Momentum transfer verimliliğidir.

3.2. Kesme Derinliği (h) Modeli

Tornalama işleminde istenilen çapın elde edilmesi için gereken kesme derinliği, kütle kaldırma oranına ve erozyon direncine bağlıdır. Yarı deneysel bir yaklaşım kullanıldığında, kesme derinliği h Denklem 4'deki genel formül ile ifade edilir.

$$h = \frac{k . \dot{m}_a . (v_a - v_{thr})^2}{\sigma_f . d_j . v_{res}} \tag{4}$$

Burada v_{thr}; AWJ literatüründe eşik hız (threshold velocity) olarak adlandırılır. Aşındırıcı taneciklerin iş parçası yüzeyinde ölçülebilir malzeme kaldırma (erozyon) başlatabilmesi için gerekli minimum çarpma hızıdır. Bu hızın altında tanecikler yüzeye çarpsa bile plastik deformasyon veya kopma oluşmaz. Sonuçta net malzeme kaldırma gerçekleşmez.

Bu denklem, parametric değişkenlerin etkisini açıkça gösterir.

- ***Basınç (P) Etkisi:*** v_a, basıncın karekökü ile orantılıdır. Dolayısıyla kesme derinliği basınç ile neredeyse doğrusal bir artış gösterir.
- ***İlerleme ve Devir Etkisi:*** v_{res} kesrin paydasında yer alır. Yani iş parçası daha hızlı döndüğünde veya nozul daha hızlı ilerlediğinde, birim Alana düşen aşındırıcı sayısı azalır ve kesme derinliği düşer.

3.3. Yüzey Pürüzlülüğü (R_a)

AW ile elde edilen yüzey, jetin bıraktığı izlerin (striation) bir sonucudur. Yüzey pürüzlülüğü genellikle Denklem 5'de verilen şu güç fonksiyonu ile modellenir;

$$R_a = C.\frac{h^x.d_a^y.v_t^z}{N^\omega} \quad (5)$$

Model şunu öngörür;

Aşındırıcı çap (d_a) küçüldükçe yüzey kalitesi artar (Daha düşük R_a). Devir sayısı (N) arttıkça, jetin taram sıklığı artar ve yüzey pürüzsüzleşir.

4. PARAMETRİK ANALİZ VE TARTIŞMA

Matematiksel model üzerinden yapılan analizler şu sonuçları ortaya koymaktadır:

- ***Malzeme kaldırma oranı (MRR):*** MRR, doğrudan aşındırıcı kütlesel debisi ($\dot{m}_a$) ve su basıncı (P) ile artmaktadır. Ancak çok yüksek $\dot{m}_a$ değerlerinde, parçacıklar birbirini engelleyerek (collision effect) verimi düşebilir.
- ***Çap kontrolü:*** Nihai çap $D_{final} = D_\omega - 2h$ olduğu için, hassas çap kontrolü, v_t(ilerleme hızı) parametrisinin dinamik olarak ayarlanması sağlanabilir. Model, sabit bir basınçta istenilen çap için gereken v_t değerini hesaplamada kritik rol oyanar.

5. SONUÇ

Aşındırıcı su jeti ile tornalama süreci, karmaşık hidrodinamik ve tribolojik etkileşimler içerir. Geliştirilen matematiksel modeller, sürecin belirsizliğini ortadan kaldırmak için hayati önem taşır. Bu çalışma, kesme derinliğinin ve yüzey kalitesinin; basınç, aşındırıcı debisi ve kinematik hızların bir fonksiyonu olarak tahmin edilebileceğini göstermiştir. Gelecek çalışmalar, bu modellerin yapay sinir ağları ile birleştirilerek gerçek zamanlı çap kontrol sistemlerine entegrasyonuna odaklanabilir.

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FARKLI ÖKZETİK DESENLERİN MEKANİK PERFORMANSLARININ ANALİZİ

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ÖZET

Bu çalışmada, negatif Poisson oranına sahip ökzetik yapıların mekanik davranışlarının karşılaştırmalı olarak incelenmesi amaçlanmıştır. Bu kapsamda, literatürde yer alan ve farklı çalışmalarda üstün mekanik performans sergilediği rapor edilen üç farklı ökzetik desen belirlenmiştir. Seçilen bu desenler, enerji absorpsiyonu ve yük taşıma kabiliyeti açısından karşılaştırmaya olanak sağlayacak şekilde geometrik olarak modellenmiştir. Ardından, tüm modeller sonlu elemanlar yöntemi kullanılarak sayısal analizlere tabi tutulmuştur. Analizlerin doğruluğunu ve hesaplama verimliliğini artırmak amacıyla her bir model için mesh hassasiyet çalışması gerçekleştirilmiş ve sonuçların mesh bağımsızlığı sağlandığı optimum eleman sayıları kullanılmıştır. Sayısal analizler, yarı-statik basma testlerini temsil edecek sınır şartları ve yükleme senaryoları altında yürütülmüştür. Bu sayede, gerçek deney koşullarına yakın bir mekanik tepki elde edilmesi hedeflenmiştir. Analizler sonucunda elde edilen kuvvet–yer değiştirme eğrileri kullanılarak her bir ökzetik desen için maksimum basma kuvveti, enerji absorbe kapasitesi ve bu büyüklüklerin kütleye oranlanmasıyla hesaplanan özgül yük taşıma (N/gr) ve özgül enerji absorbe (J/gr) değerleri belirlenmiştir. Özellikle özgül parametrelerin değerlendirilmesi, farklı geometrilerin ağırlık açısından daha adil ve mühendislik uygulamalarına daha uygun şekilde karşılaştırılmasına olanak tanımıştır. Elde edilen tüm sayısal sonuçlar detaylı olarak karşılaştırıldığında, Star Chiral Honeycomb geometrisinin incelenen diğer ökzetik desenlere kıyasla daha yüksek yük taşıma kabiliyeti ve enerji absorpsiyon performansı sergilediği görülmüştür. Bu sonuçlar, Star Chiral Honeycomb yapısının çarpışma güvenliği, darbe dayanımı ve hafiflik gerektiren mühendislik uygulamaları için güçlü bir aday olduğunu ortaya koymaktadır.

Anahtar Kelimeler: Ökzetik Desen, Özgül Basma Kuvveti, Özgül Enerji Absorbe (SEA)

ANALYSIS OF THE MECHANICAL PERFORMANCE OF DIFFERENT AUXETIC PATTERNS

ABSTRACT

This study aims to comparatively investigate the mechanical behavior of auxetic structures possessing a negative Poisson's ratio. Within this scope, three different auxetic patterns that have been reported in the literature to exhibit superior mechanical performance were selected. These patterns were geometrically modeled in a manner that enables a fair comparison in terms of energy absorption and load-carrying capacity. Subsequently, all models were subjected to numerical analyses using the finite element method. In order to enhance the accuracy of the analyses and computational efficiency, a mesh sensitivity study was performed for each model, and the simulations were carried out using the optimum element numbers at which mesh independency was achieved. The numerical analyses were conducted under boundary conditions and loading scenarios representing quasi-static compression tests. In this way, it was aimed to obtain a mechanical response that closely reflects real experimental conditions. Based on the force–displacement curves obtained from the analyses, the maximum compressive force, energy absorption capacity, and the specific load-carrying capacity (N/g) and specific energy absorption (J/g), calculated by normalizing these quantities with respect to mass, were determined for each auxetic pattern. In particular, the evaluation of specific parameters enabled a more equitable comparison of different geometries in terms of weight and practical engineering applicability. When all numerical results were compared in detail, it was observed that the Star Chiral Honeycomb geometry exhibited higher load-carrying capability and energy absorption performance compared to the other auxetic patterns examined. These findings demonstrate that the Star Chiral Honeycomb structure is a strong candidate for engineering applications requiring high crashworthiness, impact resistance, and lightweight design.

Keywords: Auxetic pattern, specific crushing force, specific energy absorption (SEA)

AKTİF RFID SİSTEMİNİN SAĞLIK SEKTÖRÜNDEKİ YERİ

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ÖZET

Son yıllarda fiziksel nesnelerin konumlarının, hareketlerinin ve mevcut durumlarının otomatik olarak tanımlanması, izlenmesi, analiz edilmesi ve raporlanması ihtiyacı giderek artmaktadır. Bu ihtiyacı karşılamaya yönelik teknolojiler arasında yer alan Radyo Frekansı ile Tanımlama (RFID) sistemleri, gerçek zamanlı veri toplama, anlık izlenebilirlik, veri analitiği, raporlama, işleme ve karar destek süreçleri açısından önemli avantajlar sunmaktadır. Temel bileşenleri arasında pasif veya aktif enerji depolayabilen RFID etiketlerinden aktif RFID tabanlı sensörler kendi güç kaynakları ile çalışırlar, bataryası ve vericisi aracılığıyla sürekli sinyal verebilirler. Bu sensörler IoT ve kablosuz donanımlarla entegrasyon sağlayarak anlık veri toplama süreçlerini kolaylaştırmakta, nesneler arası iletişimi hızlandırıp güçlendirmektedir. Bu çalışmada RFID sistemlerinin yapısal ve işlevsel özellikleri, uygulama alanları ile performans avantaj ve dezavantajlarına değinilerek bir hastanenin ameliyathane bölümünde gerçekleştirilen uygulama ele alınmıştır. Ameliyathanede aktif RFID kullanımının başlatılmasıyla birlikte ameliyat sürelerinin otomatik ve doğru biçimde ölçümlendiği gözlemlenmiş, böylece planlanan ameliyat sürelerinin daha gerçekçi verilere dayanarak belirlenmesi ve ameliyathane salonlarının daha verimli kullanılması amaçlanmıştır. RFID teknolojisinin kullanımıyla hasta güvenliğinin artırılması, hasta tanımlama, ilaç takibi ve tıbbi hataların önlenmesine yönelik uygulamalar değerlendirilmiştir. Ayrıca ameliyata alınan hastaların ameliyat sürelerinin protokol içinde hizmet girişi ile ölçümlenebilir hâle gelmesi sayesinde, hizmet girişi yapılmamış hastaların zamanında tespit edilmesi ve hangi ameliyatlarda mesai saati dışına çıkıldığının raporlanması mümkün olmuştur. Sonuç olarak, RFID teknolojisinin sunduğu avantajlar göz önünde bulundurulduğunda, bu alanlara yönelik yatırımların artırılması stratejik bir tercih olarak değerlendirilmelidir.

Anahtar Kelime: IoT, Aktif RFID, Sağlık sektörü, Ameliyathane, Hasta takibi

THE ROLE OF ACTIVE RFID SYSTEMS IN THE HEALTHCARE SECTOR

ABSTRACT

In recent years, there has been a growing need for automatic identification, tracking, analysis, and reporting of the locations, movements, and current statuses of physical objects. Radio Frequency Identification (RFID) systems, among the technologies designed to meet this need, offer significant advantages in terms of real-time data collection, instant traceability, data analytics, reporting, processing, and decision support processes. Among their basic components, passive or active RFID tags can store energy, while active RFID-based sensors operate with their own power sources and can continuously transmit signals through their batteries and transmitters. These sensors facilitate real-time data collection processes by integrating with IoT and wireless hardware, accelerating and strengthening inter-object communication. This study examines the structural and functional characteristics of RFID systems, their application areas, and their performance advantages and disadvantages, focusing on an application implemented in the operating room section of a hospital. With the introduction of active RFID in the operating room, it was observed that surgery times were measured automatically and accurately. The aim was to determine planned surgery times based on more realistic data and to use operating rooms more efficiently. Applications aimed at increasing patient safety, patient identification, medication tracking, and preventing medical errors through the use of RFID technology were evaluated. Furthermore, since the operating times of patients undergoing surgery became measurable through service entry within the protocol, it became possible to identify patients for whom service entry had not been made in a timely manner and to report which surgeries exceeded working hours. In conclusion, considering the advantages offered by RFID technology, increasing investments in these areas should be considered a strategic choice.

Keywords: IoT, Active RFID, Healthcare sector, Operating room, Patient tracking

1. GİRİŞ

RFID sistemi, ürün ve nesnelerin otomatik tanımlanması, izlenmesi ve takip edilmesi amacıyla kullanılan kablosuz bir teknolojidir. RFID ve nesnelerin interneti (IoT) entegrasyonu fiziksel nesnelerin internet üzerinden gerçek zamanlı olarak tanımlanmasını ve izlenmesini sağlar. RFID ve IoT bu sayede bütünleşik veri akışı, otomasyon ve izlenebilirlik sunar (Al Mahmud et al., 2025).

Aktif RFID teknolojisi sağlık sektöründe hasta takip süreçleri başta olmak üzere, demirbaş takibi, personel takibi gibi konularda iyileşmeye, verimliliğe önemli katkılar sağlayan bir izleme sistemidir. Bu teknoloji ile kullanım alanlarında, insan müdahalesine ihtiyaç duymadan gerçek zamanlı veri toplama yöntemi ile anlık izleme, takip edebilme ve raporlama yapılabilmektedir.

Ameliyat sırasında hastanın ve personelin konumlarının anlık takibi, işlem güvenliğininin artırılması ve zaman kayıplarının minimize edilmesini sağlamaktadır. Bu sistem sayesinde ameliyat sırasında kullanılacak medikal cihazın veya ameliyat olacak hastanın doğru zamanda ve doğru yerde olup olmadığının kontrolü işlem öncesinde yapılarak hataların önüne geçilebilir. Verilerin sürekli doğru biçimde toplanması ile süreçleri optimize etmek, kaynak kullanımını daha etkin hale getirmek ve karar verme süreçlerini hızlandırmak da mümkün olmaktadır.

RFID teknolojisinin kullanımı operasyonel sürelerin doğru ölçülmesine, ameliyathane salonlarının verimli şekilde kullanılmasına ve personel kaynaklarının etkin bir biçimde yönetilmesini sağlar. Günlük operasyonel işlemlerde yüksek doğruluk ve güvenilirlik sağlayarak, hasta ve personellerde memnuniyetinin artırılması, aktif olarak hareket halinde olan demirbaş cihazlarının anlık konum bilgisi ile hızlıca bulunarak zaman açısında verimlilik sağlaması gibi birçok avantaj sağlarken yüksek başlangıç maliyetleri, teknolojik sınırlamalar ve hasta verilerinin güvenliği gibi konularda da endişeleri beraberinde getirmektedir.

RFID teknolojisinin sunduğu yenilikler, sağlık sektörü için bir önemli bir adım olup aynı zamanda uzun vadede sürdürülebilir bir gelişim hedefiyle bu teknolojiye yatırımların arttırılmasının stratejik bir tercih olacağı düşünülmektedir.

Bu çalışmada ameliyathanede aktif RFID kullanmasıyla birlikte ameliyat sürelerinin otomatik ve doğru biçimde ölçümlendiği gözlemlenmesi, böylece planlanan ameliyat sürelerinin daha gerçekçi verilere dayanarak belirlenmesi ve ameliyathane salonlarının daha verimli kullanılması amaçlanmıştır.

2. RFID TEKNOLOJİSİ VE BİLEŞENLERİ

RFID, nesnelerin veya varlıkların radyo dalgaları aracılığıyla tanımlanması ve takibi için kullanılan bir otomatik tanımlama teknolojisidir. Bu teknoloji, barkod veya manyetik etiketlere göre daha gelişmiş ve kullanışlıdır çünkü kullanıcı müdahalesine ihtiyaç duymadan, doğrudan ve hızlı bir şekilde nesnelerin konumlarını ve bilgilerini iletebilir. Aktif RFID teknolojisi, radyo frekansı kullanarak nesnelerin ve kişilerin konumlarını gerçek zamanlı olarak belirleyebilme imkanı sunar (Budiyanto & Muslim, 2024; Measurement, 2022)Aktif RFID etiketleri, yüksek

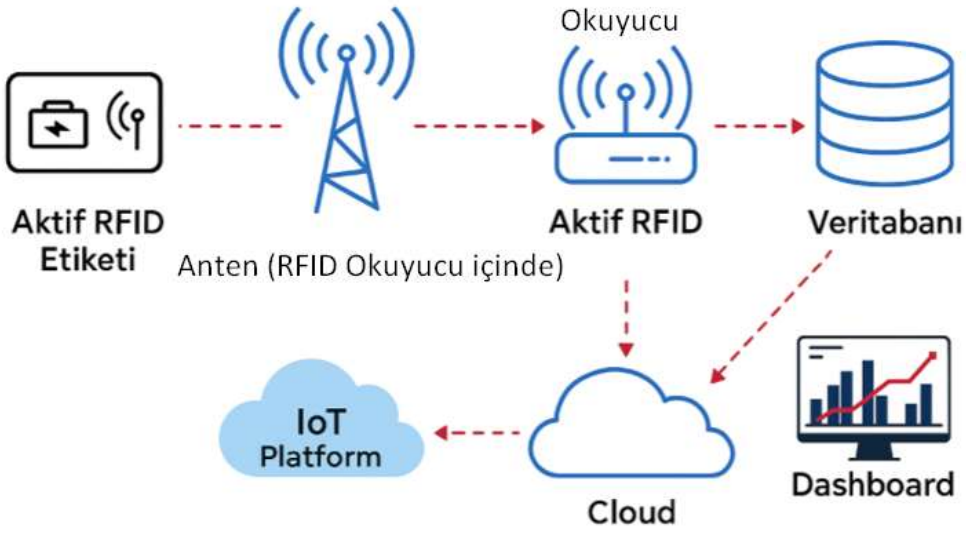
güç tüketimi sayesinde uzun menzilde ve sürekli veri iletimi sağlar. Bu durum ameliyat sırasında ve sonrası süreçlerde yüksek bir güvenilirlik ve izlenebilirlik sunar (Costa, 2021). Bu sistem, sensörler ve okuyucular aracılığıyla verileri toplayarak merkezi bir veri tabanına aktarır. Böylelikle, hasta hareketleri anlık olarak takip edilmekte ve hasta ile karışıklıkların önüne geçilmektedir. Bu sayede de operasyon akışı optimize edilmektedir. Güvenlik ve doğruluk açısından RFID teknolojisi, veri şifreleme ve erişim denetimleri ile hasta mahremiyetini koruyacak şekilde tasarlanmıştır. Ameliyat sürecinin her aşamasında bilgi akışını hızlandıran ve hataları minimize eden aktif RFID uygulamaları, hastanın güvenliğini artırmakla kalmayıp sürecin toplam verimliliğini de önemli ölçüde yükseltmektedir (Liu et al., 2011). Gelişen çözümler ile birlikte, RFID sistemlerinin performansı artırılmakta ve uygun maliyetleri sayesinde sağlık sektöründe daha yaygın ve etkin kullanımlar mümkün hale gelmektedir. Böylelikle hem hasta hem de sağlık çalışanları için daha güvenli ve etkili bir çalışma ortamı sağlanmaktadır.

RFID sistemleri bileşenleri; RFID etiketi, RFID okuyucu (anten entegreli) ve veri yönetim sisteminden oluşmaktadır. Etiketler, nesneye veya kişiye bağlı olarak bilgi depolayan küçük elektronik cihazlar iken, okuyucular bu etiketlerden gelen radyo sinyallerini yakalayarak veriyi dijital ortama aktarır. Etiketler, pasif, yarı aktif ve aktif olmak üzere iki gruba ayrılır. Pasif RFID etiketleri, enerji kaynağı olmadan, çevreden alınan radyo frekansı enerjisi ile çalışır ve daha ekonomik, uzun ömürlüdür. Yarı aktif RFID ise iç güç kaynağını sadece veri iletiminde kullanır; menzili aktif RFID kadar geniş değildir, ancak maliyet ve enerji tüketimi açısından avantajlar sağlar. Aktif etiketler ise kendi enerji kaynağına sahip olup, daha geniş menzilde ve daha yüksek veri aktarım hızına sahiptir (Solar et al., 2022).

Ayrıca, RFID sistemleri teknolojik gelişmelerle birlikte farklı frekans bantlarıyla çalışabilirler. Düşük frekans (LF), yüksek frekans (HF) ve ultra yüksek frekans (UHF) olmak üzere üç temel kategoriye ayrılır. LF RFID, kısa mesafe ve düşük veri aktarım hızıyla tercih edilirken, HF RFID, daha yüksek hız ve orta menzil sağlar. UHF RFID ise uzun menzile ulaşabilir ve yoğun okuma alanlarında verimli olur (Maraşlı & Çıbuk, 2015). Bu sayede, ameliyat öncesi, sırası ve sonrası süreçlerde hastanın takibinde hız ve doğruluk sağlanır, yönetim süreçleri ise optimize edilir.

Aktif RFID etiketi kendi bataryası ile sinyalini gönderir ve bu sinyal RFID okuyucuya (entegre anten ile) iletilir. Okuyucu iletiyi veri tabanına aktarır ve eş zamanlı bulut platformuna gönderir.

Kullanıcılarda mobil ya da web uygulama üzerinden anlık takip ve izleme süreçleri ile hazırlanan raporları görebilir. RFID yapısını oluşturan bu süreç Görsel 1'de gösterilmiştir.



Görsel 1: Aktif RFID Yapısı

2.1.RFID TEKNOLOJİSİNİN UYGULAMA ALANLARI

RFID teknolojileri tedarik zincirinde; ürünlerin hammaddeden üretime, dağıtıma ve satış noktalarına kadar tüm süreçlerin izlenmesini sağlar. RFID sistemi ile etiketlenmiş ürünlerin gerçek zamanlı takip edilebilmesi ile bilgi akışı hızlı ve otomatik hale gelerek müşteri taleplerine hızlı yanıt verebilmeyi sağlar (Al Mahmud et al., 2025). RFID uygulamaları tedarik zincirinde maliyetleri düşürerek operasyonel verimliliği ve hizmet kalitesini artırabilir (Liu, 2024; Yangınlar & Köksal, 2022).

Üretim süreçlerinde hammadde akışını anlık izleme ve hataları azaltma gibi konularda doğrudan verimlilik sağlar (Tan & Sidhu, 2022). Depo içi stok takibi, envanter doğruluğu ve otomatik veri güncelleme gibi alanlarda yaygın olarak kullanılmaktadır. RFID etiketli ürünler sayesinde manuel sayım ihtiyacı azalır ve hata riski düşük seviyeye iner (Tan & Sidhu, 2022).

RFID teknolojisi, perakende süreçlerinde tedarik zincirinde ürünlerin raflardan çıkışına kadar izlenmesini, doğru stok seviyelerinin korunmasını ve sipariş hatalarının azaltılmasını sağlar. Bu sayede ürün bulunabilirliğinin artırılması ve stok devir hızının iyileştirilmesine de katkı sağlar (Tan & Sidhu, 2022).

Tarım ve özellikle hayvancılıkta RFID teknolojisi, hayvan kimliklendirme ve sağlık durumunun izlenmesinde kullanılır. Bu etiketleme sayesinde ürün ve hayvan takibi daha doğru ve hızlı yapılabilir hale gelmektedir(Okhan, 2021).

Sağlık süreçlerinde, hasta doğruluğu ve takibi, demirbaş takibi, personel takibi, ilaç takibi ve toplanan veri ile de karar destek sistemlerine katkı sağlamaktadır RFID tabanlı hasta kimlik doğrulama sistemlerinin kullanılması yanlış hasta ve yanlış işlem riskini azaltarak hasta güvenliğini artırmaktadır (Ohashi et al., 2010). Gerçek zamanlı hasta konum takibi ile kritik klinik süreçlerde genel hasta bakım kalitesi ve güvenliğini iyileştirmektedir (Stoica, 2025). RFID destekli ilaç uygulama sistemleri ile ilaç ve tıbbi ürünlerin izlenebilir olması, doğru ilaç uygulaması ve malzeme yönetimi yoluyla hasta güvenliğini artırmaktadır (Profetto et al., 2022). RFID tabanlı hasta izleme sistemleri, düşme ve kontrolsüz hareket risklerini azaltarak hasta güvenliğine katkı sağlamaktadır. RFID tabanlı izleme sistemi ile ameliyathanelerde hastaların takibi yapılmakta ve doğru hastanın doğru ameliyathane salonuna alındığının kontrolü yaparak hasta güvenliği sağlamaktadır.

2.2.RFID SİSTEM AVANTAJLARI

Gerçek Zamanlı İzlenebilirlik ve Takip

RFID teknolojisi ürünlerin ve nesnelerin gerçek zamanlı sürekli izlenmesi ve takip edilmesi operasyonel kontrolün güçlenmesine ve süreç şeffaflığının artmasına katkı sağlar (Sarac et al., 2010). Bu durum aynı zamanda hızlı karar alma ve etkili çözüm ile operasyonel verimliliği arttırır.

Verimlilik Artışına Katkı Sağlaması

Otomatik veri toplama ve manuel işlemlerin azalması, iş gücü kullanımını optimize eder. Bu durum, iş akışlarının daha hızlı ve etkin yürütülmesine olanak tanıyarak genel verimlilik artışı sağlar (Chanchaichujit, 2020).

Hata Oranlarının Azaltılması

İnsan kaynaklı veri girişlerinin azalması, yanlış kayıt, kayıp ve karışıklık gibi hataların önüne geçilmesini sağlar. Bu durum, veri doğruluğunu ve sistem güvenilirliğini artırır (Sarac et al., 2010).

Dolaylı Olarak Maliyet Tasarrufu Sağlaması

Verimlilik artışı, gereksiz tekrarların, kaynak kayıplarının ve gecikmelerin önlenmesi sayesinde operasyonel maliyetlerin düşmesini sağlar (Sarac et al., 2010).

Karar Destek ve Raporlama Süreçlerine Katkı

RFID'den elde edilen sürekli ve güvenilir veriler, raporlama ve karar destek sistemlerini besleyerek yönetsel kararların daha sağlıklı alınmasına yardımcı olur (Chanchaichujit, 2020)

2.3. RFID SİSTEMİNİN DEZAVANTAJLARI

Yüksek Başlangıç Maliyeti

RFID teknolojisinin uygulanması birçok avantaj sağlarken, yüksek başlangıç maliyeti önemli bir dezavantajdır. RFID sistemleri için gerekli etiketler, okuyucular ve veri yönetim sistemleri büyük finansal yatırımlar gerektirir (Kineber et al., 2023). Aktif RFID sistemleri; pil ile oluşan bataryalı etiketler, okuyucular, ağ altyapısı ve yazılım entegrasyonu gerektirdiğinden, pasif RFID'ye kıyasla daha yüksek başlangıç maliyetlerine sahiptir (Sarac et al., 2010; Ngai et al., 2008).

Bakım Gereksinimi ve Batarya Yönetimi

Aktif RFID etiketlerinin batarya ile çalışması, periyodik bakım ve pil değişimi gereksinimini beraberinde getirir. Bu durum, sistemin sürdürülebilirliğini ve operasyonel sürekliliğini zorlaştırabilir (Profetto et al., 2022).

Güvenlik ve Gizlilik Endişeleri

RFID'nin güvenlik açıkları ve gizlilikle ilgili riskleri, hem veri bütünlüğü hem de kullanıcı hakları açısından bazı tehditler oluşturabilir. Yetkisiz erişim yoluyla kişisel bilgilere ulaşılması, kimlik hırsızlığına neden olabilir. Aynı anda birden fazla etiketin okunması gibi durumlarda hatalı etiket eşlemesinden kaynaklı veri karmaşası ve yanlış hedefleme sorunlarını ortaya çıkarabilir. Aktif RFID sistemlerinin sürekli veri üretmesi, gizlilik ve veri güvenliği açısından önemli endişeleri beraberinde getirmektedir (Ngai et al., 2008).

Teknolojik Bağımlılık

Kullanıcıların teknolojiye olan güvenini artırmakta ve buna paralel olarak manuel müdahale yeteneklerinde de azalmaya neden olmaktadır. RFID teknolojisine aşırı bağlılık ise hem işletmeler hem de bireyler için çeşitli zorluklara yol açabilir. Bu bağımlılıkla başa çıkmak amacıyla, teknoloji kullanımına yönelik farkındalık ve eğitim faaliyetlerinin yaygınlaştırılması gerekmektedir.

2.4. IOT ENTEGRASYONU

RFID sensörleri kimlik tespiti ve konum takibi sağlarken, kablosuz ağlar veri toplama ve iletiminde önemli rol üstlenmektedir. IoT entegrasyonu; tesis yönetimi, üretim ve lojistik gibi alanlarda gerçek zamanlı veri akışı aracılığıyla verimliliği artırır (Tan & Sidhu,2022). Sensörler bulut platformlarına bağlanıp veri analizini ve karar alma süreçlerini otomatik hale getirir. Kablosuz ağlar dayanıklı yapılar kurulmasına yardımcı olurken enerji verimliliğini optimize eder. Aynı zamanda IoT altyapısı uzaktan yönetim imkanı sunar ve güvenlik açısından veri

şifreleme ile erişim kontrolü sağlar (Kumar & Das,2025). Sensör ve IoT entegrasyonu, büyük veri ve yapay zeka uygulamalarıyla tahmine dayalı bakım ve anormallik tespiti işlevlerine de katkıda bulunur (Song & Wu, 2024).

3. AKTİF RFID KULLANIMIN AMELİYATHANE SÜREÇLERINE ETKİSİ

Aktif RFID teknolojisinin ameliyat süreleri üzerindeki etkisi, süreçlerin daha etkin ve doğru yönetilmesini sağlamasıyla kendini göstermektedir. Geleneksel yöntemler, personel ve ekipman takibinde zaman kaybına ve hata olasılıklarının artmasına neden olabilmektedir Ancak RFID ve IoT tabanlı sistemler, manuel süreçlere kıyasla sağlık hizmetlerinde hasta takibini hızlandırarak operasyonel verimliliği artırmakta ve manuel hataların ortadan kaldırılmasına katkı sağlamaktadır (Stoica & Nitu, 2025). Sistematik ve güvenilir veri yönetimi ameliyathane ortamında hasta güvenliğinin artırılmasında olası hataların önlenmesinde kritik bir rol oynar. Bu kapsamda geliştirilmiş standartlar ile mevzuatlara uygun uygulamalar sürekli izleme iyileştirme süreçleriyle entegre edilerek hasta bakım kalitesinin yükselmesine katkı sağlar (Ergin & Altınbaş, 2024).

Operasyonların ölçümlenmesi ameliyatların doğru planlanmasını ve yönetimini kolaylaştırır, bekleme süreleri azalarak hasta memnuniyetini artırır. Gerçek ameliyat sürelerine göre planlama yapılmasına olanak sağladığı için ameliyat başlama ve bitirme sürelerindeki sapmaları düşürür. Sonuç olarak, aktif RFID teknolojisinin kullanımı, ameliyat sürelerinin doğru ve etkin ölçümlenmesine, ameliyat salonlarının etkin ve verimli kullanılmasına, hasta güvenliği ve memnuniyetin artmasına, operasyonel süreçlerin optimize edilmesine olanak sunar.

Ameliyat süreleri ile hizmet eşlemesi yapıldığı için protokol içine girilmeyen ameliyat hizmetlerinin atlanması durumunda ilgili birimlere alarm vererek zamanında tespit edilmesini ve mesai saati dışında devam eden ameliyatların ve bu ameliyatı yapan hekimlerin raporlanabilmesine olanak sağlar.

Ameliyathane kullanım oranları ve en yoğun kullanılan ameliyat salonları ile en düşük kapasitede olan ameliyat salonlarını tespit edebilir ve salon dağılımı bu doğrultuda yapılabilir.

4. SAĞLIK SEKTÖRÜNDE AMELİYATHANE SÜRECİNDE UYGULAMA ÖRNEKLERİ

Sağlık sektöründe ameliyathane hasta süreci uygulaması sonrası adımlar ve açıklamaları ile birlikte aşağıda belirtilmiş ve Görsel 2’de gösterilmiştir.

Ameliyathane hasta süreç adımları;

1. Hasta –Aktif RFID Etiketi Eşleştirme ile Hazırlık Süreci

Adım 1: Hemşire, hastanın bileğine aktif RFID etiketini takar.

Adım 2: Mobil uygulamadan hastayı bulur ve bilekliğindeki QR kodu ile eşleştirir.

2. Hasta Transfer Süreci

Adım 1: Hasta, yatağında ameliyata alınmadan önce hazırlanır.

Adım 2: Hasta asansörü kullanılarak ameliyathaneye indirilir. (Koridor alternatif yol olabilir).

Adım 3: Sistem, anlık olarak hastanın konumunu belirler ve konumda geçirdiği süreleri kaydeder. Bu verileri de uygulamada anlık olarak gösterir.

3. Ameliyathaneye Kabul Süreci

Adım 1: Hasta ameliyathaneye getirildiğinde, her ameliyathaneye yerleştirilen RFID okutucu cihazı ile hastanın hangi odaya girdiğini algılar.

Adım 2: Ameliyat süreci başlar ve hastanın durumu anlık olarak uygulamada izlenir (Ameliyat, uyanma odası, yoğun bakım veya kat transferi).

4. Ameliyat Bitiş ve Takip

Adım 1: Ameliyat süreci tamamlanır.

Adım 2: Uyanma odasına transfer edilir.

Adım 3: Hasta, gerektiğinde yoğun bakıma ya da kat odasına transfer edilir.

Adım 4: Sistem, hasta bilekliğindeki aktif RFID sinyalleri ile konum takibi devam eder.

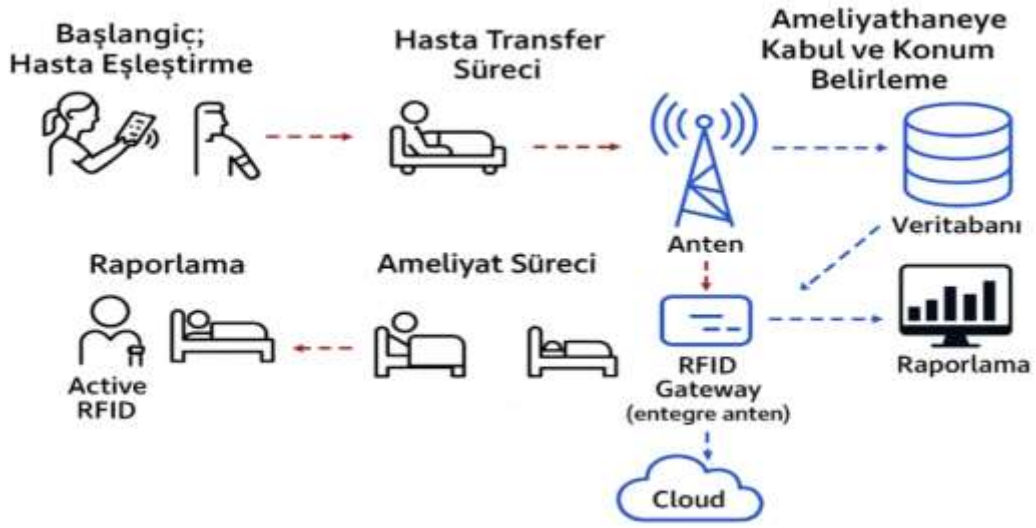
Adım 5: Yoğun bakıma giden hastalarda yoğun bakım süreleri de ayrıca ölçümlenir.

5. Servis Katına Dönüş

Adım 1: Servis katına dönen hastanın aktif RFID bilekliğindeki hasta eşlemesi üzerindeki QR taraması ile hızlıca bulunur ve eşlem kaldırılır ve bileklik hastadan çıkarılarak temizlenir.

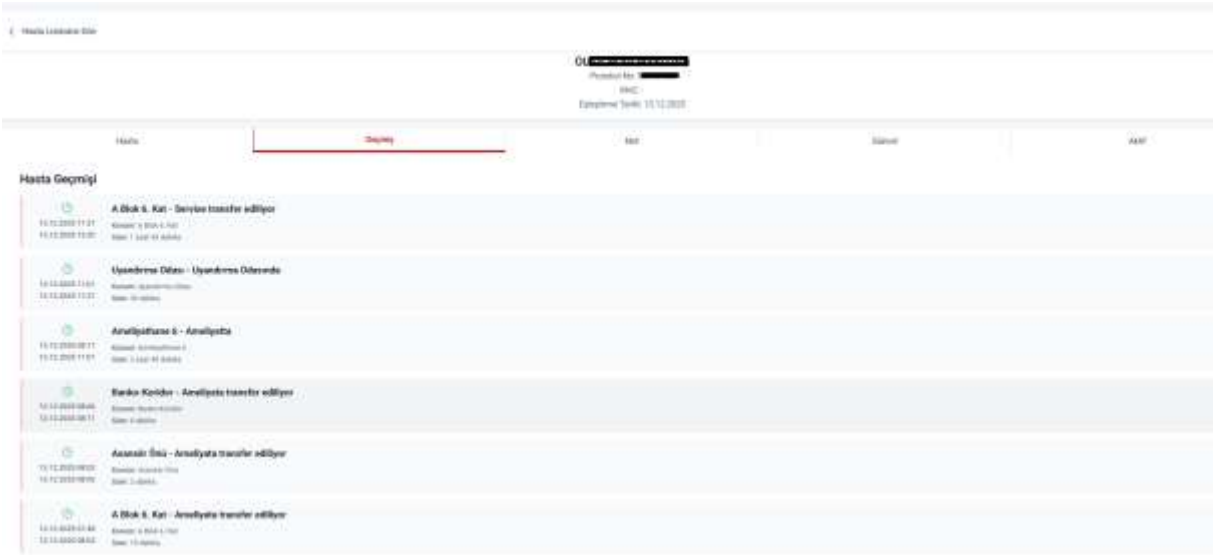
6. Raporlama

Adım 1: Ameliyat süresi, hasta bekleme süresi ve ameliyathane kullanım oranları gibi birçok rapor talebe göre oluşturulabilir.



Görsel 2: Ameliyathane Hasta Süreci Akışı

RFID teknolojisinin kullanılması sonucunda gerçek ve eş zamanlı çeşitli raporlar elde etmek ve sistemi değerlendirmek mümkün olabilmektedir. Burada elde edilen raporlardan örneklere yer verilmiştir. Ameliyata girecek hastanın bileğine aktif RFID etiketi takılıp eşlemesi yapıldıktan sonra konuma göre logladığı süreler Görsel 3'deki şekildedir.



Görsel 3: Ameliyat Süreci Sürelerinin Loglanması

Görsel 4'de hastanın anlık olarak izlendiği konum bilgileri örnek ekranı gösterilmiştir.



Görsel 4: Aktif Konum Takip Sistemi

Hasta ameliyat olmadan önce planlanan süreler ile gerçekleşen ameliyat sürelerinde en yüksek farklarda Görsel 5'de örnek olarak gösterilmiştir. Plansız yapılan ya da doğru planlama yapılamayan hasta ve hekimler mevcut raporlar ile tespit edebilir ve bunları günlük olarak takip edebiliriz.



Görsel 5: Planlanan ve Gerçekleşen Süre Arasındaki En Yüksek İlk 10 Hasta Farkı (-+)

Görsel 6, ameliyat süreçlerinde sürelerin loglanması sonucu oluşturulan örnek ameliyathane verimlilik raporunu göstermektedir. Bu rapor, ameliyathane salonunun kapasite kullanım oranlarını vermektedir.



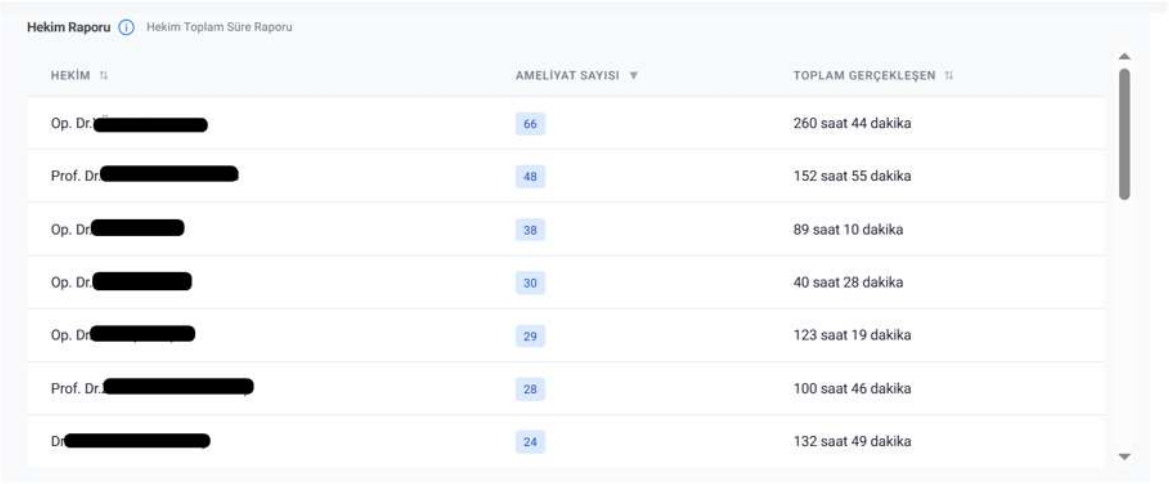
Görsel 6: Ameliyathane Salonlarının Kullanım Oranları

Hekim –ameliyat bazlı raporda aynı ya da farklı operasyonu gerçekleştiren hekimlerin ameliyat sayıları ve bu ameliyatlara ilişkin sürelerin maksimum, minimum, ortalama, medyan ve standart sapması örnek olarak Görsel ‘de gösterilmiştir.

Görsel 8’dehekimlerin belirtilen tarih aralığında kaç ameliyat yaptığı ve bu ameliyatlar için ameliyathanede harcadığı gerçek süreler görülmektedir.

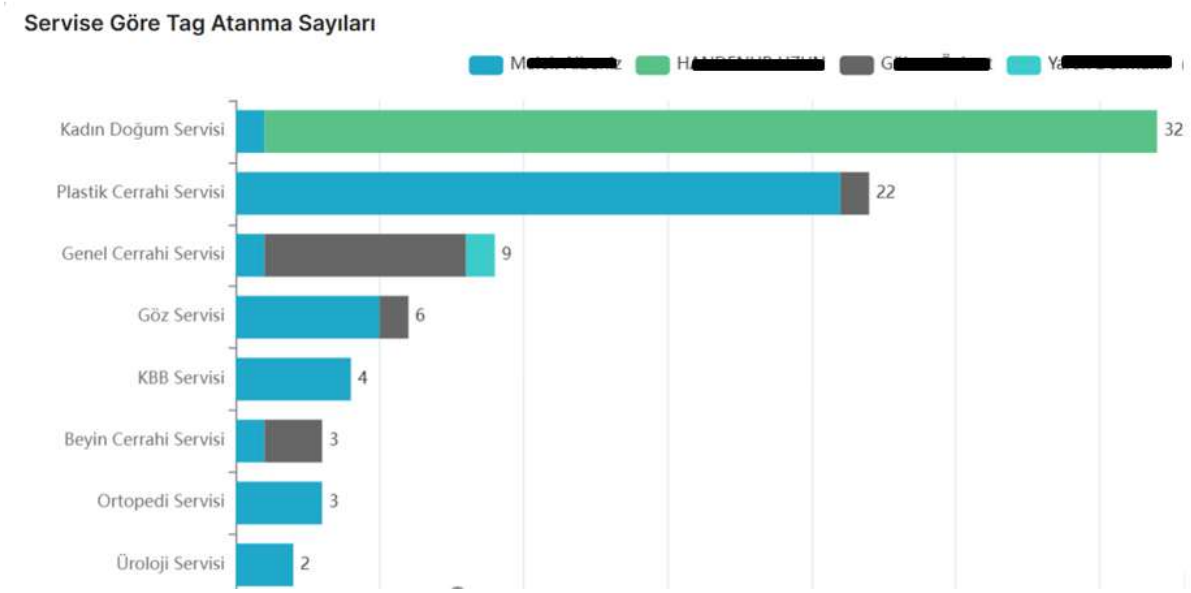


Görsel 7: Hekim –Ameliyat Bazlı Rapor



Görsel 8: Hekim Toplam Süre Raporu

Görsel 9 ile ameliyathane servisindeki hemşirelerin servis bazlı hasta sayılarını görebilir ve hangi hemşirenin kaç hasta ile ilgilendiğini görmemiz mümkün olabilmektedir.



Görsel 9: Hemşire- Servis Bazlı Hasta Dağılımı Raporu

SONUÇ

Aktif RFID teknolojisi, sektörel bazlı mevcut süreçlerde verimlilik, doğruluk ve görünürlük gibi değişikliklere yol açmıştır. Varlıkların gerçek zamanlı takibini sağlama kapasitesi; perakende, sağlık, lojistik ve üretim gibi birçok sektörde mevcut süreçlerin yenilenmesine katkı sağlamıştır. Otomatik tanımlama ve veri yakalama özellikleri ile doğrudan görüş hattına gerek duymadan işçilik maliyetlerini ve insan hatasını azaltarak aynı zamanda envanter izleme, sevkiyat takibi ve varlık yönetimi gibi işlemlerde de verimliliğini desteklemektedir.

Sağlık sektöründe de ameliyathane süreci başta olmak üzere birçok uygulama alanında da aktif RFID sisteminin faydası mevcuttur. Ameliyathane hasta yönetim süreci uygulamasında

yaşanılan sorunlar ve performanslar raporlanarak karar verme aşamasında önemli bir avantaj sunmaktadır. Veri doğruluğu ve bütünlüğü, doğru kararların alınmasını temin ederken; veri kalitesi ve etik ilkeler doğrultusunda hareket edilmesi hem hasta hem de kurum açısından güvenilirliği artırmaktadır. Toplanan tüm verilerin kapsamlı bir şekilde sınıflandırılması, farklı kaynaklardan gelen bilgilerin entegre edilerek tüm sürecin şeffaf ve hatasız yürütülmesine olanak sağlamaktadır.

Getirdiği avantajlarla birlikte bazı endişe ve riskleri de beraberinde getirmektedir. Özellikle hasta veri güvenliği, farkındalık ve eğitim üzerinde durulması, bu risklerin minimalize edilmesi için mevzuata uygun şekilde korunması ve sık sık farkındalık eğitimlerinin verilmesi gerekmektedir. RFID'nin uygulanmasındaki başarı, teknik ilerlemelerin yanı sıra paydaşların karşılaşılan sorunlarla başa çıkma yeterliliğine de bağlıdır.

Performans göstergeleri ve izleme sistemleri mevcut durumu değerlendirme yanında gelecekte iyileştirmelerin şekillendirmesine de olanak sağlar. Aktif RFID yatırımları ilk kurulumda çok yüksek görünse de sağladığı faydalar ve sonrasında kazandırdığı maliyet avantajı ile uzun vadeli dönemde stratejik bir tercih olarak değerlendirilmelidir.

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RÜZGAR ENERJİ ÜRETİM DENGESİZLİKLERİNİN YOL AÇTIĞI ENERJİ PİYASASINDAKİ TAHMİN ZORLUĞUNUN DEPOLAMA SİSTEMİ İLE EKONOMİK KIYASLAMASI VE DEĞERLENDİRMESİ

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ÖZET

Yenilenebilir enerji kaynaklarının (YEK) elektrik şebekelerindeki payının artması, özellikle Rüzgâr Enerji Santrallerinin (RES) doğası gereği öngörülemeyen üretim dalgalanmaları nedeniyle piyasa işletmeciliğinde önemli dengesizlik maliyetlerinin ortaya çıkmasına yol açmaktadır. Rüzgâr enerjisi, konvansiyonel üretim teknolojileri gibi planlanabilir bir yapıya sahip olmadığından, gün öncesi ve gün içi piyasalarda yapılan üretim tahminleri ile gerçekleşen üretim arasındaki sapmalar, üreticileri Dengeleme ve Uzlaştırma Yönetmeliği kapsamında cezai maliyetlerle karşı karşıya bırakmaktadır.

Rüzgâr gücü tahmin yöntemlerini geliştirmeye yönelik çalışmalar devam etse de, üretimdeki belirsizliğin tamamen ortadan kaldırılması mümkün olmadığı için farklı teknik ve ekonomik çözüm yaklaşımlarına ihtiyaç duyulmaktadır. Bu kapsamda, enerji depolama sistemleri (EDS), hem şebeke işletiminde esneklik sağlama hem de piyasa kaynaklı maliyetleri azaltma potansiyeliyle öne çıkan bir çözüm alternatifi sunmaktadır.

Bu çalışma kapsamında, rüzgâr üretiminin talep değerlerinin üzerinde gerçekleştiği saatlerde fazla enerjinin depolanması; talebin üretimi aştığı zaman dilimlerinde ise depolanan enerjinin kullanılarak dengesizlik fiyatlarına maruz kalmanın önlenmesi amaçlanmıştır. Önerilen model, 60 MWh kapasiteli farklı enerji depolama teknolojileri için teknik performans, şarj–deşarj karakteristikleri, avantaj–dezavantaj dengesi ve ekonomik fizibilite açısından değerlendirilmiştir.

Lityum-İyon (Li-ion), Kurşun-Asit (Lead-Acid), Akış Tipi (Flow) ve Nikel-Kadmiyum (NiCd) batarya teknolojileri 20 yıllık proje ömrü ve %10 iskonto oranı kullanılarak Net Bugünkü Değer (NPV) yöntemi ile karşılaştırmalı olarak analiz edilmiştir. Yapılan ekonomik değerlendirmeler sonucunda, depolama sistemlerinin dengesizlik maliyetlerini azaltmadaki potansiyeli ve yatırım açısından uygulanabilirliği tartışılarak modelin bütüncül bir değerlendirmesi sunulmuştur.

Anahtar Kelimeler: Rüzgar Enerjisi, Enerji Piyasaları, Depolama Sistemleri, Rüzgar Enerjisi Tahmini

ECONOMIC COMPARISON AND EVALUATION OF THE FORECASTING CHALLENGE IN THE ENERGY MARKET CAUSED BY WIND POWER GENERATION IMBALANCES WITH STORAGE SYSTEMS

ABSTRACT

The increasing share of renewable energy sources (RES) in electricity grids leads to significant imbalance costs in market operation, especially due to the inherently unpredictable production fluctuations of Wind Power Plants (WPPs). Since wind energy does not have a dispatchable structure like conventional generation technologies, the deviations between production forecasts made in day-ahead and intra-day markets and the actual realized production expose producers to punitive costs under the Balancing and Settlement Regulation.

Although efforts to improve wind power forecasting methods continue, the complete elimination of production uncertainty is not possible, necessitating different technical and economic solution approaches. In this context, Energy Storage Systems (ESS) offer a prominent alternative solution, with the potential to both provide flexibility in grid operation and reduce market-based costs.

Within the scope of this study, the objective is to store surplus energy during hours when wind generation exceeds demand values and to prevent exposure to imbalance prices by utilizing the stored energy during periods when demand surpasses generation. The proposed model has been evaluated in terms of technical performance, charge-discharge characteristics, balance of advantages/disadvantages, and economic feasibility for different energy storage technologies with a capacity of 60 MWh.

In the study, Lithium-Ion (Li-ion), Lead-Acid, Flow, and Nickel-Cadmium (NiCd) battery technologies were analyzed comparatively using the Net Present Value (NPV) method, employing a 20-year project lifetime and a 10% discount rate. The economic evaluations conducted discuss the potential of storage systems in reducing imbalance costs and their viability in terms of investment, offering a holistic assessment of the model.

Keywords: Wind Energy, Energy Market, Energy Storage Systems, Wind Energy Forecast

1. GİRİŞ

Küresel ölçekte artan çevresel kaygılar ve iklim değişikliği ile mücadele hedefleri, enerji üretiminde fosil yakıtlara olan bağımlılığın azaltılmasını zorunlu hâle getirmiştir. Bu bağlamda, düşük karbonlu ve sürdürülebilir enerji kaynakları enerji politikalarının temel bileşeni hâline gelmiştir. Yenilenebilir enerji teknolojileri arasında rüzgâr enerjisi; teknolojik olgunluğu,

ölçeklenebilir yapısı ve görece düşük işletme maliyetleri sayesinde hızlı bir yayılım göstermektedir (Hau, 2025).

Rüzgâr enerji santrallerinin (RES) elektrik piyasalarına entegrasyonu, özellikle marjinal üretim maliyetlerinin düşük olması nedeniyle piyasa fiyatlarının dengelenmesine katkı sağlamaktadır. Bununla birlikte, rüzgâr kaynağının doğası gereği değişken ve stokastik bir karaktere sahip olması, üretim tahminlerinde kaçınılmaz hatalara yol açmaktadır. Gün öncesi ve gün içi piyasalarda yapılan üretim tahminleri ile gerçekleşen üretim arasındaki bu farklar, üreticiler açısından dengesizlik maliyetleri oluşturarak ekonomik performansı olumsuz etkilemektedir.

Rüzgâr hızındaki kısa ve uzun dönemli dalgalanmalar yalnızca piyasa mekanizmalarını değil, aynı zamanda şebeke işletimini de etkilemektedir. Üretimdeki ani değişimler, enerji kalitesi sorunlarına, frekans ve gerilim dalgalanmalarına ve sistem esnekliği ihtiyacının artmasına neden olmaktadır. Bu durum, rüzgâr enerjisinin yüksek penetrasyon oranlarında şebeke güvenliği açısından dikkatle ele alınmasını gerektirmektedir.

Rüzgâr gücü tahmin yöntemlerinin geliştirilmesine yönelik önemli ilerlemeler kaydedilmiş olsa da, atmosferik süreçlerin karmaşıklığı nedeniyle tahmin hatalarının tamamen ortadan kaldırılması mümkün değildir. Bu nedenle, üretim belirsizliğinin teknik ve ekonomik etkilerini azaltmaya yönelik tamamlayıcı çözümler ön plana çıkmaktadır. Enerji depolama sistemleri (EDS), fazla üretimin depolanarak uygun zamanlarda sisteme geri verilmesine olanak tanıyan yapılarıyla bu kapsamda etkili bir çözüm sunmaktadır.

Bu çalışma, rüzgâr enerji santrallerinde üretim belirsizliklerinden kaynaklanan piyasa kayıplarının azaltılmasında enerji depolama sistemlerinin rolünü incelemekte; farklı batarya teknolojilerinin teknik ve ekonomik performanslarını karşılaştırmalı olarak değerlendiren bütüncül bir analiz ortaya koymaktadır.

2. ARAŞTIRMA VE BULGULAR

2.1 Sistem Tanımı

Çalışma kapsamında 30 MW Karlıtepe rüzgâr enerji santrali için enerji depolama entegrasyonunu içeren senaryolar oluşturulmuştur. Santral için gün öncesi ve gün içi piyasa verileri kullanılarak üretim tahminleri ile gerçekleşen üretim arasındaki farklar analiz edilmiştir.

Enerji depolama sistemi, rüzgâr santraline doğrudan entegre edilmiş ve şebeke ile çift yönlü enerji akışına izin verecek şekilde modellenmiştir. Modelde, yüksek üretim dönemlerinde fazla enerjinin depolanması ve düşük üretim dönemlerinde sisteme geri verilmesi esas alınmıştır.

2.2 Enerji Depolama Teknolojileri

Analiz kapsamında dört farklı batarya teknolojisi değerlendirilmiştir (Yang , 2018):

- **Lityum-iyon bataryalar:** Yüksek enerji yoğunluğu, yüksek çevrim verimliliği ve uzun döngü ömrü ile öne çıkmaktadır.
- **Kurşun-asit bataryalar:** Düşük ilk yatırım maliyetine sahip olmakla birlikte, sınırlı çevrim ömrü ve düşük verimlilik dezavantajlarına sahiptir.
- **Akış bataryaları:** Enerji ve güç kapasitesinin bağımsız olarak ölçeklenebilmesi avantajı sunmakta, ancak yüksek yatırım maliyetleri nedeniyle ekonomik açıdan dikkatli değerlendirilmesi gerekmektedir.
- **Nikel-Kadmiyum bataryaları:** Geniş sıcaklık aralığında kararlı çalışabilmeleri, orta çevrim sayıları ve derin deşarj koşullarına karşı dayanıklı olmalarına rağmen, nispeten düşük enerji yoğunlukları, yüksek maliyetleri ve kadmiyumun çevresel açıdan toksik bir madde olması nedeniyle güncel büyük ölçekli enerji depolama uygulamalarında sınırlı tercih edilmektedir.

TEKNOLOJİ	VERİM	ÇEVRİM SAYISI	ENERJİ YOĞUNLUĞU (Wh/kg)	MALİYET (Dolar/Kwh)
Lityum-İyon	%90-%95	2000-5000	170	200-300
Kurşun-Asit	%70-%85	500-1500	35	100-200
Nikel-Kadmiyum	%60-%70	2000-2500	50	350-450
Akışkan (Flow)	%65-%75	10000+	Çok Düşük	300-400

Şekil 2.1 Dört Farklı Batarya Sistemi 20 Yılın Maliyet Toplamı ve Bugünkü Değer Analizi

Depolama Kapasitesi

Rüzgar santralinin 2 saatlik depolama süresi varsayılmıştır:

$$E_{cap,0} = P_{wind} \times t_{storage}$$

$$E_{cap,0} = 30\ \text{MW} \times 2\ \text{h} = 60\ \text{MWh}$$

2.3 Enerji Piyasa Hesaplamaları

Dengesizlik enerjisi (EDM)

Dengesizlik Enerji miktarı, üretim miktarı ile piyasadaki alım-satım işlemlerinin net etkisine göre hesaplanır. Denklem (2.1) göre formalize edilir (EPİAŞ, 2024).

$$EDM_t = \left(Üretim_t + GIP_{alış,t}^{\backslash c} - GIP_{satış,t}^{\backslash c}\right) + \left(GOP_{alış,t}^{\backslash c} - GOP_{satış,t}^{\backslash c}\right) \quad (2.1)$$

Dengesizlik tutarı (EDT)

Sistem yönü **YAT** olduğunda (yük atma yönü) dengesizlik tutarı denklem (2.2) gibi hesaplanmalıdır.

$$EDT_t = | EDM_t | \times \min(PTF_t, SMF_t) \times (1 - k) \quad (2.2)$$

Sistem yönü **YAL** olduğunda (yük alma yönü) dengesizlik tutarı denklem (2.3) gibi hesaplanmalıdır.

$$EDT_t = | EDM_t | \times \max(PTF_t, SMF_t) \times (1 + k) \quad (2.3)$$

- PTF_t: Piyasa Takas Fiyatı (TL/MWh)
- SMF_t: Sistem Marjinal Fiyatı (TL/MWh)
- k: Dengesizlik fiyat fark oranı (%3 → 0.03)

2.4 Ekonomik Değerlendirme Yöntemi

Ekonomik analiz, Net Bugünkü Değer (NPV), geri ödeme süresi ve bugünkü değer (Present Worth – PW) yöntemleri kullanılarak gerçekleştirilmiştir. Proje ömrü 20 yıl olarak alınmış ve iskonto oranı %10 olarak belirlenmiştir. Tüm yatırım, işletme-bakım ve yenileme maliyetleri bugünkü değer cinsinden hesaplanmıştır (IRENA, 2023).

Net bugünkü değer (NPW)

20 yıllık toplam net bugünkü değer (tüm maliyetlerin bugünkü toplamı):

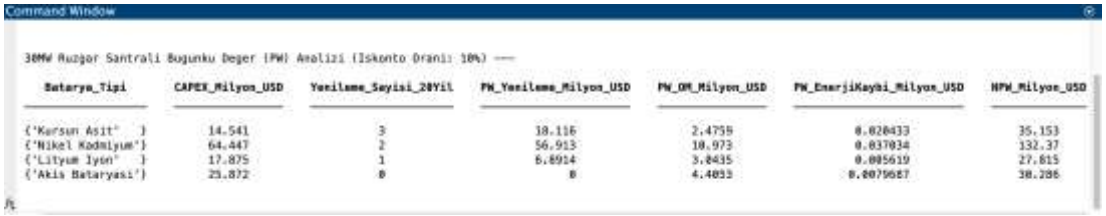
$$NPW = C_0 + PW_{rep} + PW_{OM} + PW_{loss} \quad (2.4)$$

Matematiksel model ve tüm senaryolar MATLAB® ortamında geliştirilmiş, saatlik üretim ve piyasa fiyat verileri kullanılarak simülasyonlar gerçekleştirilmiştir.

3. ANALİZ SONUÇLARI VE TARTIŞMALAR

Analiz sonuçları, enerji depolama sistemlerinin rüzgâr santrallerinde üretim belirsizliklerinden kaynaklanan dengesizlik maliyetlerini teknik olarak azaltabildiğini göstermektedir. Ancak ekonomik fizibilite, kullanılan depolama teknolojisine ve piyasa koşullarına güçlü biçimde bağlıdır.

Batarya Sistemlerinin Karşılaştırılması

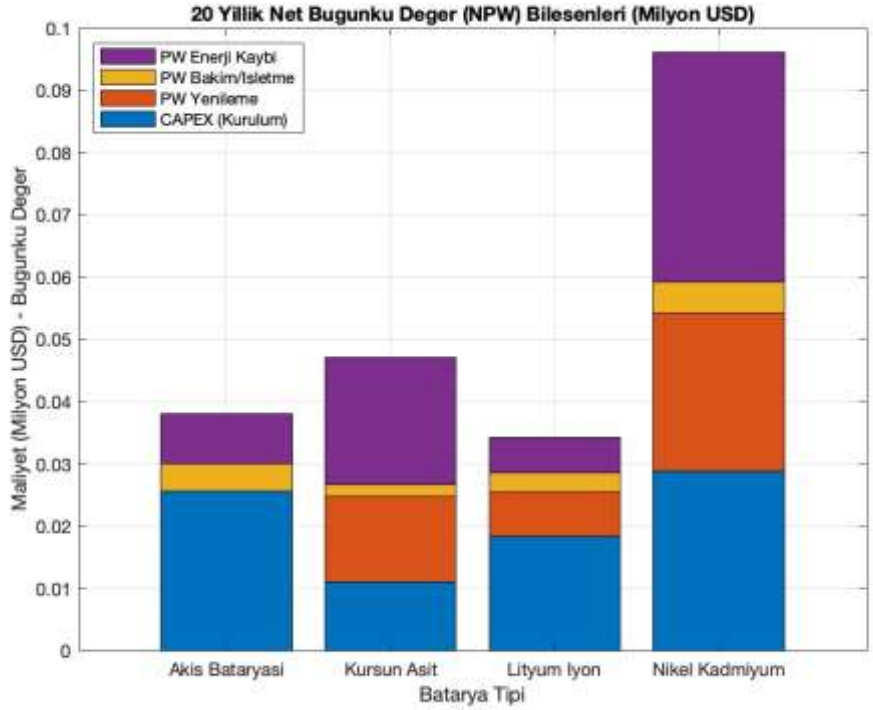


Command Window

30MW Rüzgar Santrali Bugunku Deger (PW) Analizi (Iskonto Orani: 10%) ---

Batarya_Tipi	CAPEX_Milyon_USD	Yenileme_Sayisi_20Yil	PW_Yenileme_Milyon_USD	PW_OM_Milyon_USD	PW_EnerjiKaybi_Milyon_USD	NPW_Milyon_USD
{'Kursun Asit' }	14.541	3	18.116	2.4759	0.020433	35.153
{'Nikel Kadmiyum'}	64.447	2	56.913	10.973	0.037034	132.37
{'Lityum Iyon' }	17.875	1	6.8914	3.0435	0.005619	27.815
{'Akis Bataryasi'}	25.872	0	0	4.4053	0.0079687	30.286

Şekil 2.2 Dört Batarya Sistemi 20 Yılın Maliyet Toplamı ve Bugünkü Değer Analizi



Şekil 2.3 Dört Batarya Sistemi 20 Yılın Maliyet Toplamı ve Bugünkü Değer Analizi Grafiği

Matlab sonuçları ile, rüzgâr enerjisi dengesizlik maliyetlerini yönetmede en verimli çözümün **Lityum-İyon (Li-ion)** bataryalar olduğunu ortaya koymuştur. Diğer teknolojilerin performans özetleri şöyledir:

- **Lityum-İyon:** Yüksek verimlilik, düşük enerji kaybı ve 20 yıla varan (10.000 çevrim) kullanım ömrü sayesinde yenileme gerektirmeyen, toplam maliyeti en düşük ve en optimal seçenektir.
- **Nikel–Kadmiyum (Ni-Cd):** Yüksek kendi kendine deşarj oranı ve düşük verimliliği nedeniyle, diğer teknolojilere kıyasla **yaklaşık iki kat daha fazla** toplam maliyet oluşturarak en verimsiz seçenek olmuştur.
- **Kurşun-Asit:** Düşük çevrim ömrü sebebiyle simülasyon süresince üç kez yenilenme gerektirmiş; bu durum kurulum ve değişim maliyetlerini aşırı artırarak ekonomik performansı zayıflatmıştır.

- **Akışkan Bataryalar (Flow Battery):** Uzun ömürlü olmalarına rağmen, yüksek ilk yatırım maliyetleri ve Lityum-İyon'a göre daha düşük olan enerji verimlilikleri nedeniyle toplam maliyette rekabetçi kalamamışlardır.

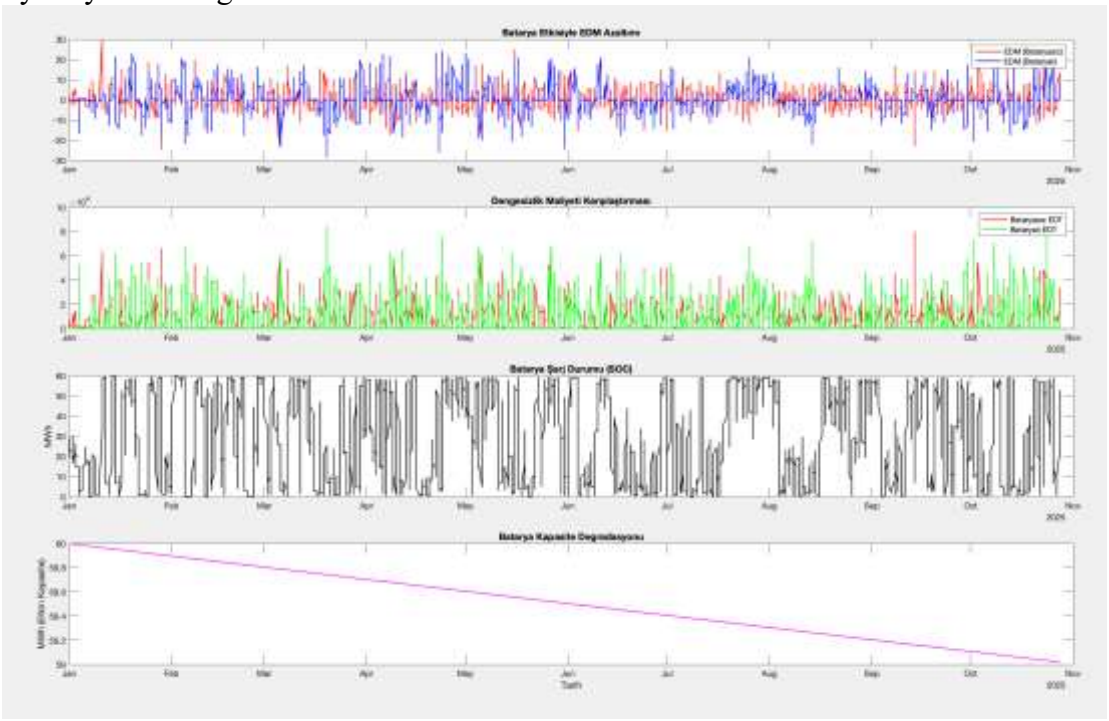
Sonuç olarak; Lityum-iyon teknolojisi, hem operasyonel verimlilik hem de uzun vadeli yatırım maliyeti (NPW) açısından şebeke ölçekli depolama projeleri için en uygun teknoloji olarak öne çıkmaktadır. Lityum İyon bataryaların uzun çevrim ömrü, yüksek verimlilik ve buna bağlı olarak düşük yenileme ve enerji kaybı maliyetleri sayesinde, 20 yıllık ekonomik analiz sonucunda en düşük Toplam Net Bugünkü Değer Maliyetini (27,815 Milyon USD) sunduğunu kesin olarak göstermektedir.

30 Mw'lık Karlıtepe RES Verileri Kullanılarak Yapılan Hesaplamalar

Simülasyon, Karlıtepe Rüzgar Enerjisi Santrali'ne ait, Ocak 2025'ten Kasım 2025'e kadar uzanan yaklaşık bir yıllık gerçek EPİAŞ piyasa verileri ışığında Lityum- iyon batarya teknolojisinin 20 yıllık proje ömrü boyunca sağlayacağı performansı ve maliyet yapısını incelemiştir.

Matlab çıktıları:

--- SONUÇLAR ---
Bataryasız toplam dengesizlik maliyeti: 82 229 636.03 TL
Bataryalı toplam dengesizlik maliyeti: 44 746 687.96 TL
Batarya sayesinde sağlanan tasarruf: 37 482 948.06 TL



Şekil 2.4 30 MW Karlıtepe RES 2025 Batarya modellemesi

2025 yılına ait piyasa verileri kullanılarak yapılan hesaplamalar, Lityum-iyon bataryanın 10 ayda 37 482 948,06 TL yıllık bazda ortalama 44 979 537,6 TL bu da 1 Milyon 58 bin USD tutarında bir tasarruf sağladığını göstermiştir. Bu tasarruf miktarı, başlangıç yatırım maliyetine (17,875 Milyon USD) kıyasla çok düşük kalmıştır.

Yatırımın 20 yıl sonunda bugünkü net değerini gösterir. Pozitif bir değer, yatırımın kârlı olduğunu gösterir:

PW Fayda (Gelir) Hesaplaması (20 yıl) = $\frac{1-(1+0.10)^{-20}}{0.10} \approx 8{,}514$

PW Fayda =1,058 Milyon USD x 8,514 $\approx 9\ Milyon\ USD$

Lityum-iyon bataryanın 20 yıllık proje ömrü boyunca 27,815 Milyon USD'lik bir Toplam Net Bugünkü Değer (NPW) Maliyeti oluşturduğunu belirlemiştik.

20 yıllık süre zarfında, bu yıllık faydanın iskonto edilerek hesaplanan bugünkü değeri (PW Fayda) ise 9 $Milyon$ USD olarak bulunmuştur.

Net Bugünkü Değer (NPW):

NPW= PW Fayda−PW Maliyet=9 $Milyon\ USD - 27{,}815\ Milyon\ USD \approx -18$

Bu sonuçlar, Lityum-iyon bataryanın NPW Fayda (9,007 Milyon USD) ile NPW Maliyet (27,815 Milyon USD) arasındaki fark negatif çıkmıştır.

Yatırımın Geri Ödeme Süresi (Payback Period)

Eğer Lityum İyon'un başlangıç maliyeti $17,875 Milyon USD ise ve yıllık net faydası $1,058 Milyon USD (Basitleştirilmiş Geri Ödeme Süresi) olarak alınırsa:

Geri Ödeme Süresi $\approx \frac{Başlangıç\ CAPEX}{Yıllık\ Net\ Fayda} = \frac{17{,}875\ Milyon\ USD}{1{,}058\ Milyon\frac{USD}{yıl}} \approx 16{,}89$ Yıl.

Daha uzun çevrim ömrüne sahip alternatif lityum-iyon konfigürasyonlarında dahi NPV değeri pozitif bölgeye geçememiştir.

Geri ödeme süresi yaklaşık 17 yıl olarak hesaplanmış olup, bu süre enerji sektöründeki yatırım riskleri göz önüne alındığında çok uzun kabul edilmektedir.

Sonuçlar, mevcut piyasa koşullarında enerji depolama entegrasyonunun ekonomik olarak sınırlı bir fayda sunduğunu; ancak batarya maliyetlerindeki düşüşler, piyasa fiyat oynaklığındaki artış veya yan hizmet gelirlerinin devreye girmesi durumunda bu tablonun değişebileceğini göstermektedir.

4. SONUÇLAR

Bu çalışma, rüzgâr enerji santrallerinde üretim belirsizliğinin enerji depolama sistemleri aracılığıyla azaltılmasının teknik olarak mümkün olduğunu, ancak ekonomik fizibilitenin mevcut koşullar altında sınırlı kaldığını ortaya koymuştur. Özellikle lityum-iyon bataryalar teknik performans açısından öne çıkmakla birlikte, yatırım maliyetleri ekonomik kârlılığı sınırlamaktadır.

Enerji depolama sistemlerinin rüzgâr santrallerine entegrasyonunun, batarya maliyetlerindeki düşüş, piyasa mekanizmalarındaki gelişmeler ve yan hizmet piyasalarının genişlemesi ile birlikte orta ve uzun vadede daha cazip hâle gelmesi beklenmektedir. Ayrıca gelişmiş üretim tahmin algoritmalarının depolama sistemleri ile birlikte kullanılması, ekonomik performansı artırabilecek önemli bir faktör olarak değerlendirilmektedir.

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DETERMINING THE CLEANING PERIOD OF PV SOLAR PANELS USING IMAGE-PROCESSING AND SIMULATION

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ABSTRACT

Soiling, or the collection of dust and ambient particles on photovoltaic (PV) panel surfaces, has a substantial influence on energy production efficiency. Under high-soiling circumstances, this can result in energy losses ranging from 10% to 30%, lowering solar systems' return on investment (ROI). Traditional maintenance procedures, which are frequently based on set timetables or human inspection, are inefficient and might result in high cleaning costs or extended power outages.

This study describes a MATLAB based image processing and simulation framework for determining the appropriate cleaning interval for PV panels. High-resolution photographs of solar modules are analyzed using traditional computer vision techniques, including contrast evaluation, brightness analysis, histogram analysis, Texture Analysis, local binary pattern (LBP) analysis, and edge identification. Using these picture attributes, a new Soiling Index (SI) is created to assess the degree of dirt collection on the panel surface.

The acquired soiling data is fed into a simulation model, which calculates power deterioration over time and compares various cleaning intervals (for example, every 5, 10, 30, 60, 120, or 240 days). The model also considers economic variables, weighing energy loss against cleaning expenses to determine the net financial advantage of each cleaning approach. Regression techniques are used to model performance deterioration, with validation measures like RMSE (Root Mean Square Error) and R^2 assessing accuracy.

The suggested system provides a realistic decision-support tool for PV operators to adopt data-driven cleaning schedules, which improve energy production and lower operating costs. The system, developed in MATLAB, is scalable, cost-effective, and applicable to both rooftop and utility-scale PV installations in a variety of environmental situations.

Keywords: Image processing, Dust detection, Photovoltaic panel, Soiling detection, cleaning optimization, MATLAB, soiling index (SI).

1. INTRODUCTION

The growing global need for clean and sustainable energy has sparked a substantial change in the use of renewable energy technology. Among these, photovoltaic (PV) systems have developed as a critical component of current renewable energy infrastructure. Their capacity to convert sunlight directly into energy without emitting toxic gases, along with low installation costs and favorable government laws, has increased their popularity in residential, commercial, and utility-scale applications.

Solar PV installations are particularly appealing because of their scalability, simplicity of deployment, and low running costs once completed. They may be used in a variety of settings, including urban roofs, distant rural settlements, and enormous solar farms, making them an adaptable and decentralized energy option. According to the International Energy Agency ((IEA), n.d.), solar PV has become one of the world's fastest growing energy sources, with worldwide installed capacity predicted to exceed 2,000 GW by the end of this decade.

Despite these developments, PV systems confront several operational issues that may jeopardize their long-term efficiency and return on investment. Soiling, or the buildup of environmental material such as dust, sand, pollen, bird droppings, and industrial contaminants on the surface of solar panels, is one of the most common and under-addressed challenges. This layer of particulate matter obstructs incident solar radiation, limiting the quantity of energy generated by solar cells. The extent of soiling varies with geography, climate, panel orientation, and site-specific variables, but the consequences can be severe. Soiling has been demonstrated in some environments, especially dry and semi-arid regions to lower PV production by up to 30% (Said, 2024), resulting in significant financial losses for PV system operators.

Mitigating soiling-related losses necessitates prompt and effective cleaning. However, present maintenance techniques are generally dependent on predetermined cleaning schedules or manual visual examinations, which do not accurately reflect the panels' true state. These procedures frequently result in either over-cleaning, which raises maintenance costs and water consumption, or under-cleaning, which causes extended energy losses. This inefficiency is not only economically inefficient but also environmentally unsustainable, especially in areas where water is a limited resource.

While periodic cleaning of panels is a standard option, current cleaning methods are frequently ineffective. They are often based on predetermined time intervals or manual inspections that do not consider real-time panel conditions. This strategy may result in needless cleaning, wasting

water and personnel, or delayed cleaning, resulting in significant energy waste. As a result, there is an urgent demand for automated, condition-based maintenance systems.

This work presents a data driven approach that uses MATLAB based image processing techniques in conjunction with simulation modelling to find the best cleaning schedule for photovoltaic (PV) panels. The project seeks to design a practical and efficient technology that reduces both energy loss and operating expenses by analyzing solar panel photos to detect soiling patterns and modelling the subsequent impact on energy performance.

1.1. LITERATURE REVIEW

Several research have looked at the influence of soiling on PV panels, resulting in a wide range of remedies, from manual cleaning to automated detection approaches. Existing research has mostly focused on sensor-based approaches and fixed-interval cleaning programs, both of which are costly and inflexible.

Yap and colleagues created a MATLAB based approach to measure soiling using image processing. The method employed greyscale histogram variance and edge detection algorithms to evaluate soiling levels. The suggested Soiling Index (SI) demonstrated a strong correlation with real panel dirtiness. This study lay the groundwork for contrast-based PV image analysis. (Wai Kean Yap, 2015).

This study used a Convolutional Neural Network (CNN) to categorize solar panel photos into clean, slightly dirty, and substantially soiled categories. The model obtained more than 92% classification accuracy. Their method addressed fluctuations in illumination and background noise, proving deep learning's resilience in image-based soiling identification. (S. Selvi, 2023).

This study, which focused on modelling energy loss due to soiling and the cost-effectiveness of automated cleaning systems, discovered that appropriate cleaning intervals vary depending on location and season. Their simulations revealed that energy recovery after cleaning varied from 10 to 25%. (Abdulsalam S. Alghamdi, 2019).

This rigorous assessment looked at over 100 articles on soiling effects. It established a linear link between soiling and power loss, emphasized the significance of weather patterns, and advocated the incorporation of satellite and visual data into forecast models. (Said, 2024).

This work presented UAV-based soiling detection, which used drones capturing aerial photos of solar fields. Using segmentation and geo-correction, their method correctly detected soiling across wide regions, allowing for effective remote maintenance. (Umair Naeem, 2025).

The researchers created a real-time IoT-enabled cleaning solution that activates based on image-

derived soiling criteria. Their solution showed a 40% decrease in water and cleaning resource use while retaining panel performance. (Nazmun Nahar Karima, 2024).

This study used regression analysis to analyze the association between ambient dust concentrations and PV power loss in South Asia. They devised a threshold-based cleaning mechanism that is activated when performance falls below a specific level. (Asad Ullah, 2020).

This study examines dust formation on photovoltaic streetlights in Baghdad, Iraq, and discovered that dust particles mostly made of silicon dioxide and calcium carbonate, when mixed with volatile organic compounds from refineries, drastically degrade panel performance. Over three months, experimental results showed that uncleaned panels lost 58.96% of their power, compared to 14.1% for weekly-cleaned panels, while bird droppings caused further temperature rises and possibly irreversible damage. The study emphasises the importance of regular maintenance for sustaining PV system efficiency in dry, dusty conditions, with power losses of up to 26% per month without suitable cleaning practices (Abd Salam Al-Ammri, 2013).

This study looks at the impacts of dust deposition on photovoltaic module performance in Libya's Saharan desert, where seasonal winds from February to May transport sand and debris that accumulates on solar panel surfaces. Experimental results from weekly water washing of polycrystalline PV modules over a four-month period showed that frequent weekly cleaning kept performance losses to only 2-2.5%, whereas uncleaned modules experienced significant power reductions ranging from 69W to 74.2W compared to the rated 75W capacity. The study concludes that regular cleaning schedules are essential in desert environments, as even minor dust accumulation can result in significant power losses, and weekly water washing is an effective and cost-effective maintenance strategy for recovering and maintaining optimal PV system performance. (Ali Omar Mohamed, 2012).

This analysis looks at solar panel cleaning technologies and shows that dust deposition affects panel performance by 30-40%, requiring frequent maintenance for optimal energy generation. The paper discusses a variety of cleaning solutions, including manual cleaning, water spray systems, truck-mounted cleaning, automated robots, drones, and electrodynamic screens, each having unique benefits depending on facility size, location, and resources. Using Multi-Criteria Decision Analysis, the study finds Sinfonia's Resola robot as the most promising option in terms of efficiency, affordability, durability, and environmental effect, while the ideal technique is dependent on individual installation needs (Rachid, 2023).

This study looks at water-based and water-free cleaning methods for Floating Photovoltaic (FPV) systems, addressing the issues of cleaning panels deployed on water surfaces while maintaining water quality and minimizing usage. Dust deposition affects PV efficiency by up to 30%, with daily power losses reaching 15%, necessitating cleaning intervals of 9-20 days, depending on ambient conditions and soiling rates. Manual cleaning in conjunction with superhydrophobic coatings is cost-effective for freshwater reservoirs, but airflow procedures with high-stability coatings give superior technical and economic performance for non-freshwater reservoirs aimed to reduce water evaporation (Rafi Zahedi, 2021).

This study indicates that photovoltaic (PV) soiling is a key environmental loss mechanism, resulting in average global yearly energy losses of 3-4% and drastically lowering PV system profitability, particularly in dry and arid locations. Soiling is generally assessed using the soiling ratio described in IEC 61724-1; nevertheless, studies demonstrate that non-uniform soiling can cause disproportionate power losses, electrical mismatch, and hot-spot development. The literature regularly indicates high regional and temporal variability in soiling caused by environmental and seasonal variables, rendering fixed or uniform cleaning programs ineffective. Although classic soiling stations give precise readings, their maintenance needs have prompted the development of optical sensors and image-based monitoring approaches for estimating losses via transmittance decrease or surface coverage analysis. Overall, recent research trends emphasize data-driven and image-processing-based techniques as scalable and cost-effective alternatives for optimizing PV cleaning procedures and minimizing operational expenses (Joa˜o Gabriel Bessa, 2021).

This study looks at the effects of dust deposition on photovoltaic (PV) module performance, emphasizing the need of optimizing cleaning procedures to decrease energy losses and maintenance costs. The study shows that soiling-related power losses gradually grow over time and are heavily impacted by local environmental factors such as dust concentration, rainfall, and wind patterns. By analyzing PV performance data before and after cleaning activities, the authors demonstrate that fixed or periodic cleaning regimens are frequently economically wasteful. Instead, the research emphasizes the advantages of condition-based and data-driven cleaning systems that balance energy recovery with cleaning costs. Overall, the findings support the use of performance monitoring and analytical methodologies to determine ideal PV cleaning intervals and improve long-term system efficiency. (Mohammed Al-Housani, 2019).

This study describes an image-processing-based technique for assessing dust deposition on photovoltaic (PV) modules and its influence on energy efficiency. The study shows that increasing dust density on the module surface results in a considerable loss in power production, even under regulated irradiance and temperature settings. Images of PV modules with varying dust levels are analyzed utilizing Grey Level Co-occurrence Matrix (GLCM) texture characteristics to efficiently characterize surface pollution. Artificial neural networks are then used to classify these traits, allowing the degree of soiling to be precisely determined without human involvement. The results show that image processing coupled with machine learning provides a rapid and accurate way for analyzing PV module pollution and enabling optimum cleaning decisions (Muhammed Unluturk, 2019).

This study presents a data-driven methodology for evaluating photovoltaic (PV) soiling and optimizing cleaning decisions by correlating performance deterioration to environmental and operational factors. The study demonstrates that soiling-induced power losses vary dramatically with time and place, implying that static or calendar-based cleaning solutions are economically wasteful. By analyzing long-term PV performance data, the authors show that condition-based techniques may better identify cleaning events and estimate recovered energy losses. The findings demonstrate that combining monitoring data with analytical models increases the reliability of soiling assessment without depending simply on specific hardware sensors. Overall, the study emphasizes the efficacy of data-driven and performance-based methodologies in defining appropriate PV cleaning schedules while lowering operating and maintenance costs (Mingyu Fang, 2024).

This paper focusses on photovoltaic (PV) soiling as a primary cause of energy output loss and presents an optimization-based approach for identifying appropriate cleaning schedules for large PV portfolios. The authors show that soiling rates are very site and time dependent, rendering fixed or heuristic cleaning intervals inefficient and even uneconomical. By combining soiling-rate extraction from historical performance data with mathematical optimization models, the suggested method captures the dynamics of soiling buildup and cleaning recovery. Case studies on various utility-scale PV facilities in Chile indicate that using an optimized cleaning strategy increases income and resource utilization when compared to traditional maintenance techniques. Overall, the study emphasizes scalable, data-driven cleaning scheduling as an efficient option for minimizing soiling losses and operating and maintenance costs in big PV systems (Iván Astete, 2024).

This review study addresses soiling as a major issue influencing photovoltaic (PV) system performance and carefully examines techniques for estimating soiling losses. The authors divide existing methodologies into three categories: direct measurement techniques, indirect performance-based and meteorological methods, and hybrid models that include several data sources. While direct approaches provide great accuracy, they are restricted in cost and scalability, whereas indirect methods are better suited to big PV plants but are impacted by environmental and operational variables. The study emphasizes that soiling behavior is greatly influenced by site-specific climatic factors such as wind, humidity, temperature, and geographical position. Overall, the article emphasizes the necessity for standardized measuring techniques and improved data-driven and machine-learning technologies to provide precise soiling evaluation and optimized maintenance plans for PV systems (J. Agbogla, 2025).

This research presents a new machine learning-based system for automatic dust identification and optimal cleaning of photovoltaic (PV) panels based on electrical I-V curve data. Rather depending on cameras or external sensors, the technology converts voltage, current, and power data into RGB mosaic pictures, allowing for a clear visual depiction of various PV operating conditions. A hybrid Convolutional Neural Network-Random Forest (CNN-RF) model is used to effectively characterize PV operational states, such as normal operation, dust buildup, shading, deterioration, and short-circuit problems, with 100% classification accuracy. When dust is discovered, a secondary CNN-RF model classifies its severity as low, moderate, or heavy with an accuracy of 98%, exceeding standard I-V curve-based techniques. By combining dust severity assessment with a cost-based optimization model, the suggested system allows for water-efficient and economically justifiable cleaning decisions, providing a scalable and sustainable solution for PV maintenance in dust-prone locations (Safia Babikir Bashir, 2025).

This research study conducts a thorough analysis of solar panel cleaning solutions, highlighting the essential influence of dust deposition on photovoltaic (PV) efficiency and long-term energy production. The authors investigate the physical properties of dust, environmental factors controlling deposition, and their quantifiable consequences on power losses in various climatic zones worldwide. A variety of cleaning technologies are thoroughly examined, including manual methods, electrostatic systems, robotic cleaners, automated processes, and passive self-cleaning strategies including hydrophobic and hydrophilic coatings. The study emphasizes that no single cleaning approach is generally ideal because performance is highly dependent on site-specific factors, water availability, energy usage, and economic restrictions. Overall, the study

presents a systematic comparison of existing PV cleaning methods, highlighting their benefits and limitations, and serves as a helpful reference for selecting appropriate maintenance strategies to improve PV system efficiency and sustainability (Mustafa Tahir AKKOYUNLU, 2024).

1.2. BACKGROUND

Solar panels are exposed to the natural environment and eventually acquire dirt, dust, leaves, bird droppings, and industrial contaminants. This buildup causes non-uniform shadowing and increased reflection, reducing the photovoltaic efficiency of solar panels. According to (Said, 2024), energy losses owing to soiling might be as high as 30%, especially in desert and urban-industrial areas.

Soiling not only affects the quantity of sunlight absorbed, but it also changes the thermal behavior of panels, thereby increasing the risk of hot spots and panel damage. In big solar farms, the cumulative financial impact of such energy losses can be enormous, resulting in lower yearly yields and longer payback times.

Manual or fixed-interval cleaning procedures are becoming seen as obsolete and ineffectual. These solutions do not take into consideration local environmental variability such as wind, rain, dust storms, or human activity, all which impact soiling rates. Furthermore, regular unneeded cleaning wastes vital resources like water, labor, and maintenance time, especially in areas where water shortage is a big issue.

In recent years, image processing has developed as a potential method for detecting soiling on solar panels. Digital photographs of panel surfaces may be processed using traditional computer vision algorithms accessible in MATLAB. Key picture properties, including as brightness, contrast, edge sharpness, and color histograms, may be retrieved and analyzed to determine the degree of soiling. Based on these criteria, a Soiling Index (SI) may be created to estimate contamination levels.

When combined with simulation models that quantify energy losses from soiling, this image-based method becomes a useful tool for optimizing maintenance schedules. The simulation component, which is also implemented in MATLAB, assesses the trade-off between performance recovery and cleaning costs at various cleaning intervals (for example, every 5, 10, 30, 60, 120 or 240 days).

This study expands on previous research by presenting a MATLAB-based system that combines image analysis and performance modelling to help guide PV panel repair decisions.

While the effect of soiling on PV performance has been extensively established, current techniques are frequently reactive or time-based rather than condition based. This creates two major inefficiencies:

Over-cleaning: Cleaning too frequently increases operational costs and consumes resources like water and labor, which is especially unsustainable in desert areas.
Under-cleaning: Delays in cleaning cause dirt accumulation to remain, resulting in persistent energy losses and decreased system dependability and ROI.

One of the most significant obstacles has been the lack of scalable, real-time technologies for assessing the current health of solar panels. Manual inspections and physical sensors, while useful, are typically expensive or inconvenient for big systems. This presents a gap in the operational workflow: deciding when cleaning is genuinely essential based on the current condition of panel soiling.

The purpose of this study is to close that gap by evaluating soiling levels in PV panel photos using a MATLAB based image analysis approach. The collected soiling index is then combined with a simulation model to quantify energy deterioration and evaluate various cleaning procedures. The purpose is to assist system operators in making educational, cost-effective decisions that increase energy output while minimizing maintenance costs.

1.3. PURPOSE AND OBJECTIVES

1.3.1. PURPOSE

The purpose of this project is to create a MATLAB-based simulation framework that combines traditional image processing and performance modelling approaches to find the best cleaning schedule for photovoltaic (PV) solar panels. Soiling, produced by dust, bird droppings, and other environmental pollutants, can drastically limit energy output, with recorded losses ranging from 10% to 30%, depending on geographical and environmental conditions (Said, 2024).

Traditional cleaning methods, such as fixed-schedule maintenance or manual inspections, are frequently ineffective and expensive. In contrast, when directed by reliable monitoring, condition-based cleaning has been found to enhance operational efficiency while using less water and labor. This work seeks to close the gap by using image processing techniques in MATLAB to analyze surface soiling and simulate energy deterioration, with the objective of determining appropriate, cost-effective cleaning intervals. The combination of a determined Soiling Index (SI), power loss calculation, and cost-benefit analysis provides a data-driven tool for better PV maintenance decision-making (Wai Kean Yap, 2015).

1.3.2. OBJECTIVES

To design, construct, and verify a MATLAB-based image processing and simulation framework that finds the best cost-effective and energy-efficient cleaning interval for PV panels using real-time visual data.

1.4. METHODOLOGHY

In this study, a methodical approach is used to assess the influence of soiling on photovoltaic (PV) panel performance and estimate the best cleaning frequency using image processing, performance modelling, and economic optimization. Visual data taken from PV panel pictures is systematically matched with energy output data to measure soiling severity and its impact on power deterioration. To ensure consistency, repeatability, and computational correctness, all image analysis, modelling, simulation, and optimization operations are carried out with MATLAB.

Collect and preprocess a collection of PV panel photos with varied soiling levels. The dataset will comprise photos taken under various lighting, weather, and environmental circumstances, as well as the related energy output statistics. This stage is critical for developing a strong image processing model.

Create a standard image processing pipeline in MATLAB to identify and quantify soiling. Use techniques like brightness analysis, histogram equalization, contrast analysis, edge detection (e.g., Sobel, Canny), local binary pattern (LBP) analysis ,and texture analysis to extract characteristics that indicate dirt buildup (Wai Kean Yap, 2015).

Define a quantitative Soiling Index (SI) using retrieved picture attributes. To indicate the level of soiling on each panel picture, create an index incorporating statistical and visual properties such as brightness levels, contrast variation, histogram distribution, and surface texture patterns (Wai Kean Yap, 2015).

Model the link between the Soiling Index and PV energy deterioration. Using MATLAB-based regression modelling (e.g., linear, polynomial, or exponential regression), connect SI values with observed energy output, predicting performance deterioration as soiling rises (Wai Kean Yap, 2015).

Simulate various cleaning intervals (e.g., every 5, 10, 30, 60, 120, and 240 days) and evaluate their energy and cost consequences. Create a MATLAB simulation environment that mimics energy recovery following cleaning activities and tracks energy losses over time. Cleaning scenarios will be assessed according to energy output recovery and cleaning expenses.

Perform economic optimization to identify the optimal cleaning frequency. Apply the cost-benefit formula: Net Benefit = (Energy Saved x Cost per kWh) - Cleaning Cost. This approach identifies the most lucrative cleaning strategy (Mounir Abraim, PVSMS: A system for quantifying soiling effects and optimizing cleaning schedule in PV solar plants, 2025).

Validate the model with accuracy and performance metrics. Performance will be judged as follows: Regression metrics: RMSE (Root Mean Square Error), R^2 (coefficient of determination), Validation will be performed on a subset of the dataset designated for testing.

2. INTEGRATED REAL IMAGE AND POWER DATA APPROACH FOR PHOTOVOLTAIC SOILING ASSESSMENT

This section introduces a modelling framework for evaluating photovoltaic (PV) panel soiling, utilizing actual pictures and power data from a functioning PV system. The proposed approach, in contrast to purely theoretical or synthetic simulations, incorporates field-acquired PV panel images, measured electrical performance data, and image-based feature extraction to simulate soiling behavior and assess its effect on energy production under realistic operating conditions. The simulation is based on actual images of photovoltaic panels taken at the rooftop installation of the Department of Electrical and Electronics Engineering at Sakarya University. The photos were analyzed using the MATLAB-based image processing framework to identify visual characteristics associated with dust deposition and surface deterioration. A Soiling Index (SI) was calculated for each photograph, indicating the extent of soiling on the photovoltaic panel surface. The image-based SI values were subsequently utilized as direct inputs for the simulation and power loss modelling phases.

2.1. REAL PV IMAGE ACQUISITION AND ORIENTATION-BASED ANALYSIS



Figure 1. PV Modules with Different Orientations Used for Soiling Analysis

The experimental photovoltaic system has twelve identical photovoltaic panels organized to examine orientation-dependent soiling effects. The panels are organized as follows: three panels connected in series orientated south, three panels mounted horizontally, three panels orientated east, and three panels orientated west. This setup facilitates a comparative examination of dust deposition and performance deterioration under uniform environmental conditions but varying exposure directions.

The real photographs are the principal input for the simulation system. Each picture was processed separately to determine the respective Soiling Index, enabling the monitoring of surface contamination changes over time and across various panel orientations as shown in Figure 1.

2.2. TWO MONTH EXPERIMENT USING CLEANING AND NO-CLEANING SCENARIOS

The study utilizes authentic operational data gathered over a two-month testing session, segmented into two separate stages. In the initial month, all photovoltaic panels underwent hand cleaning at consistent intervals of 14 days, culminating in two cleaning activities per panel. This phase emulates a regulated maintenance plan and allows the monitoring of soiling accumulation and subsequent recovery following cleaning interventions.

No cleaning was conducted on any PV panel during the second month. This phase replicates the natural collection of dust under authentic environmental conditions. The study assesses the impact of cleaning frequency on the evolution of the Soiling Index and the resultant power losses by comparing these two periods.

The image-derived SI values from actual images were utilized to depict the daily soiling condition of each panel in the simulation. This method guarantees that the simulated soiling behavior accurately represents real-world conditions instead of presumed or intentionally created soiling patterns.

2.3. POWER BASED SOILING INDEX CALCULATION AND CROSS VALIDATION

To validate the dependability of the image-based Soiling Index, the study incorporates a power-based soiling index computation generated from actual photovoltaic output measurements. Power data were acquired for each panel orientation in both clean and soiled situations, while maintaining identical environmental parameters to provide a valid comparison.

The power-based soiling index was calculated using the following equation (Deepak Yadav, 2025):

$$Soiling\ Index\ (\%) = \left(\frac{P_{Clean} - P_{dirty}}{P_{Clean}}\right) \times 100 \quad (1)$$

where P_{Clean} represents the measured power output post-cleaning, and P_{dirty} is the measured output under contaminated circumstances. The computations were conducted manually with actual measured power data to confirm the accuracy of the image-based SI values in representing genuine electrical performance decline.
The comparison between image processing-derived soiling index (SI) using MATLAB and (SI) based computations facilitates the evaluation of the correlation between apparent surface pollution and measured energy loss. The concordance between these two independent metrics validates the physical relevance of the suggested image-based soiling simulation.

2.4. REAL POWER DATA ACQUISITION USING GROWATT INVERTER SYSTEM



Figure 2. Installed Growatt inverters in the rooftop photovoltaic system at Sakarya university.

All electrical performance data utilized in the real images were sourced from a Growatt grid-connected inverter placed at the Sakarya University photovoltaic system as shown in Figure 2. The inverter persistently monitors essential operating metrics, such as immediate power output and daily energy generation.
Performance statistics were obtained using the Growatt online monitoring platform, which acquires real-time and historical information straight from the inverter. This method allows

precise daily monitoring of photovoltaic power generation and guarantees alignment between electrical data and the picture capture schedule as shown in Figure 3.

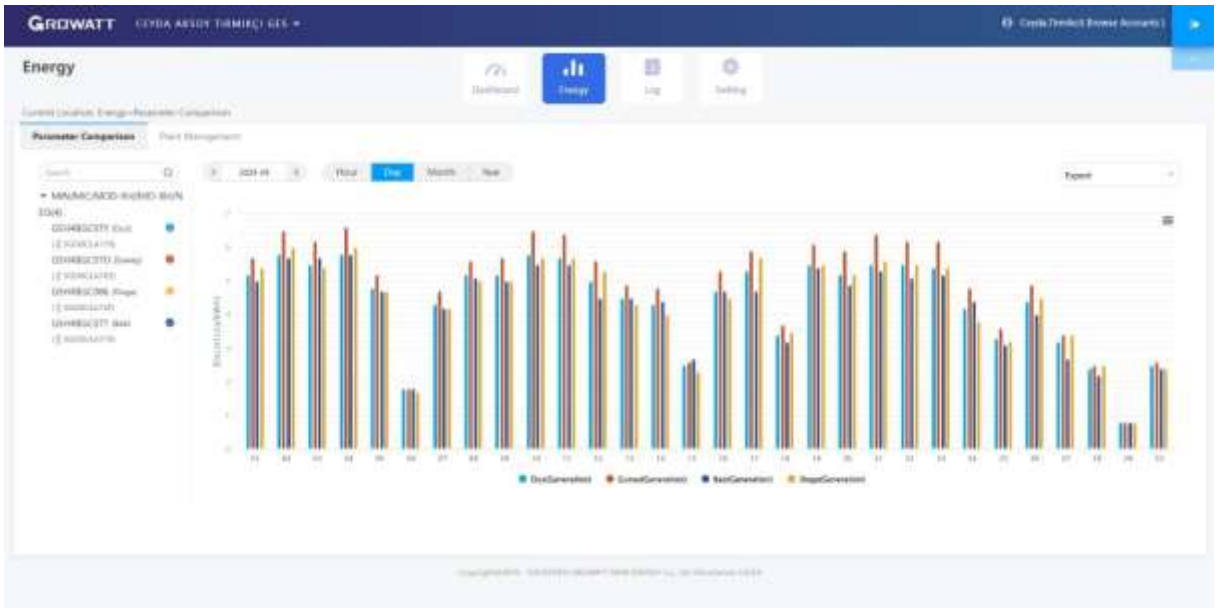


Figure 3. Daily energy generation comprasion from the Growatt monitoring platform.

The Growatt inverter offers dependable DC–AC conversion and integrated data logging, rendering it appropriate for the experimental research of photovoltaic performance decline. The monitoring feature enables the calculation framework to utilize measured field data, hence augmenting the trustworthiness of the results.

3. IMAGE PROCESSING AND SOILING INDEX COMPUTATION

The presented image processing system intends to provide a reliable, scalable, and sensor-independent technique for measuring photovoltaic (PV) panel soiling using visual surface information. The technology is designed to gradually convert raw PV panel photos into a useful numerical indicator known as the Soiling Index (SI), which represents the severity of dust collection and its potential influence on energy output. The framework is validated using real-world data from an operating PV system at Sakarya University's Department of Electrical and Electronic Engineering.

3.1. IMAGE ACQUISITION AND GRAYSCALE CONVERSION

Images of photovoltaic panels are obtained under various environmental settings, encompassing different light levels, weather conditions, and surface contamination patterns. The picture collection was generated by taking high-resolution images of an actual photovoltaic system with twelve identical panels placed at Sakarya University. The panels are configured in four

distinct orientations: three panels connected in series directed south, three panels mounted horizontally, three panels orientated east, and three panels orientated west. This configuration allows for orientation-dependent investigation of soiling behavior under equivalent environmental circumstances.

Since chromatic information is not required for detecting dust-related surface deterioration, the RGB photos are transformed into greyscale format. This approach minimizes computing complexity while preserving luminance-based information, which is directly influenced by dust deposition. The greyscale format maintains uniformity throughout the dataset and increases resistance to color distortions induced by camera sensors or ambient illumination variances.

3.2. IMAGE PREPROCESSING AND ENHANCEMENT

Image preprocessing is conducted before feature extraction to enhance the reliability and stability of the derived features. The greyscale picture is initially transformed into a normalized double-precision format to facilitate precise mathematical calculations. A Gaussian smoothing filter is subsequently employed to mitigate high-frequency noise, including sensor noise and minor light variations, which might otherwise destabilize edge and texture assessments. Histogram equalization is utilized to improve global contrast and standardize brightness distribution in photographs. This phase is crucial as photovoltaic photos are obtained at different times of the day and under diverse solar irradiance and meteorological circumstances. Histogram equalization evenly redistributes intensity values, mitigating the impact of illumination effects unrelated to soiling and enhancing the sensitivity of subsequent feature extraction to surface contamination instead of lighting artefacts.

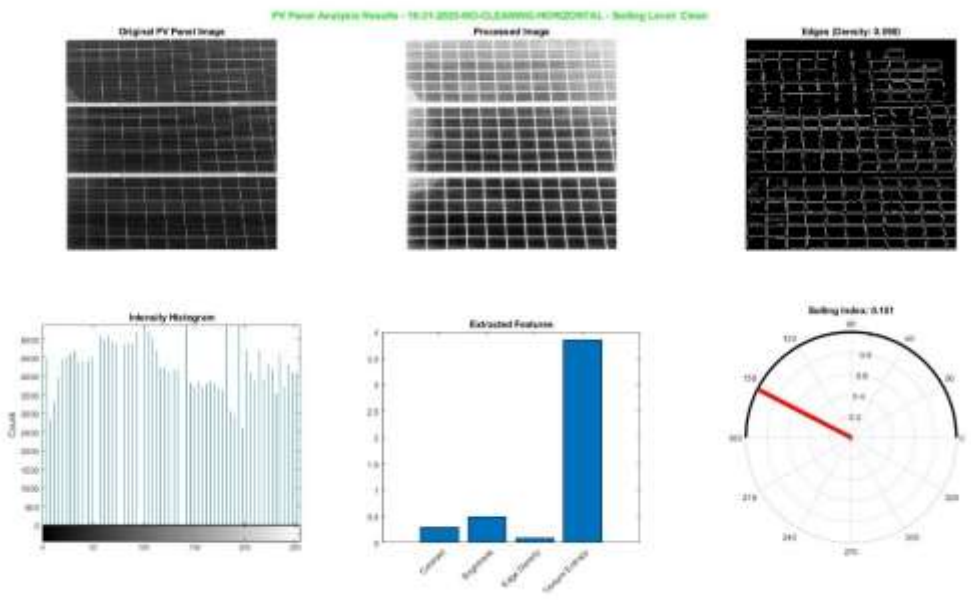


Figure 4. Soiling Analysis of a Horizontally Installed PV Panel without Cleaning.

3.3. FEATURE EXTRACTION STRATEGY

A multi-feature extraction technique is employed to thoroughly characterize the visual impact of soiling on photovoltaic panel surfaces. Each feature is a unique physical expression of dust deposition and surface deterioration shown in Figure 4.

3.4. CONTRAST ANALYSIS

The contrast of an image is measured by the root mean square (RMS) of pixel intensities. Unsoiled photovoltaic panels generally display enhanced contrast owing to reflections, grid lines, and surface roughness. As dust gathers on the panel surface, these structural variances are obscured, resulting in a more uniform look and a quantifiable decrease in contrast. Consequently, diminished contrast values are seen as a sign of heightened soiling severity.

3.5. BRİGHTNESS ANALYSIS

The mean image brightness is computed to signify the total light reflectance of the panel's surface. Dust layers diminish surface reflectivity and absorb incident light, leading to darker pictures. Thus, diminished average brightness values correlate with elevated levels of contamination. This characteristic is especially responsive to thick or evenly distributed dust layers, which were seen during the uncleaned testing phase.

3.6. EDGE DENSITY MEASUREMENT

Edge density is calculated with the Canny edge detection technique, which detects intensity discontinuities that correlate to surface characteristics like photovoltaic cell borders, grid lines, and panel texture. In pristine circumstances, these characteristics are distinctly delineated, resulting in a high edge density. As contamination escalates, dust particles obscure surface features, resulting in a marked decrease in discernible edges. The proportion of identified edge pixels to total image pixels serves as a significant predictor of surface deterioration as shown in Figure 4.

3.7. TEXTURE ENTROPY ANALYSIS

Local entropy analysis is employed to capture texture abnormalities caused by non-uniform dust deposition. Entropy is calculated within tiny neighborhoods to measure unpredictability in the distribution of pixel intensities. Elevated entropy values signify diverse surface patterns, typically found under situations of partial or uneven soiling. This function is particularly helpful for identifying early-stage or localized pollution that may not substantially impact overall brightness.

3.8. HISTOGRAM-BASED STATISTICAL FEATURES

The greyscale intensity histogram is examined to derive higher-order statistical moments, such as variance, skewness, and kurtosis. The variance of a histogram indicates the distribution of intensity values and often escalates when dust generates irregular shading patterns on the panel surface. Skewness and kurtosis elucidate the asymmetry and peak sharpness of the distribution, offering further information into the characteristics and distribution of surface pollution as shown in Figure 4.

3.9. LOCAL BINARY PATTERN (LBP) UNİFORMITY

Local Binary Pattern (LBP) analysis is utilized to delineate micro-textural alterations on the panel surface. Each pixel is stored according to the relative intensity of its adjacent pixels, creating a texture descriptor that is extremely responsive to subtle surface alterations. A homogeneity metric is obtained from the LBP map, with less uniformity indicating uneven textures caused by dust particles. This feature improves the differentiation between clean panels and panels with little soiling seen throughout the trial campaign.

3.10. SOILING INDEX FORMULATİON

The retrieved picture attributes are amalgamated into a singular Soiling Index (SI) to yield a concise and comprehensible metric of panel cleanliness. Before fusion, all characteristics are standardized to a uniform range of 0 to 1, guaranteeing equitable contribution irrespective of

magnitude. Feature normalization is structured to ensure that elevated normalized values consistently indicate greater soiling severity as shown in Figure 4.

A weighted linear combination is subsequently utilized to calculate the final SI value. Feature weights are determined by empirical sensitivity analysis and physical relevance, prioritizing contrast and edge density because of their significant link with surface pollution shown in Figure 4. Texture entropy, brightness, histogram variance, and LBP uniformity are used to encapsulate complimentary dimensions of soiling behavior. The resultant SI is limited to the interval [0, 1], facilitating clear interpretation and comparison across panels, orientations, and observation periods.

3.11. VISUALIZATION AND SOILING CLASSIFICATION

Multiple visualization outputs are produced to aid qualitative analysis and result interpretation. The components comprise the original picture, the preprocessed image, detected edges, intensity histograms, and bar charts that encapsulate the retrieved features. A gauge-style visualization represents the Soiling Index, offering a clear indicator of contamination severity. The Soiling Index is classified into clean, moderately dirty, and badly soiled environments according to established threshold values. This category classification facilitates practical maintenance choices and allows for direct comparison between cleaned and uncleaned operational periods.

3.12. BATCH PROCESSİNG, MODELING, AND VALIDATION

The framework facilitates batch processing for the effective analysis of extensive picture collections. Summary statistics, including mean, minimum, maximum, and standard deviation of SI values, are calculated to delineate overall site cleanliness trends for various panel orientations. The experimental program spanned two months, with the first month featuring biweekly cleaning, and the second month devoid of any cleaning operations. This configuration facilitated a direct comparison of SI development under both clean and unclean circumstances. Regression-based modelling is utilized to determine a quantitative correlation between the calculated Soiling Index values and the observed photovoltaic power and energy losses. Model validation utilizes ground-truth performance data, and accuracy is evaluated by common statistical measures, including RMSE, MAE, coefficient of determination (R^2), and classification accuracy. The findings illustrate the reliability and generalization potential of the proposed image-based soiling assessment approach under actual operational and environmental circumstances.

4. SIMULATION USING REAL IMAGES FOR PV SOILING AND CLEANING OPTIMIZATION

This study introduces a data-driven methodology for the analysis of photovoltaic (PV) panel soiling and the optimization of cleaning intervals using actual photos, measured power data, and economic modelling. The suggested system was designed and tested by an experimental photovoltaic installation situated on the rooftop of the Electrical and Electronics Engineering Department at Sakarya University, Türkiye. The installation comprises 12 monocrystalline photovoltaic panels, each with a capacity of 400 W, configured in four distinct orientations to examine the influence of panel direction on soiling behavior and energy loss: three panels orientated south in series, three panels mounted horizontally, three panels orientated east, and three panels orientated west.

The simulation framework was developed in MATLAB to ascertain suitable cleaning intervals for photovoltaic (PV) panels using image-derived soiling indices, power loss modelling, and economic cost analysis. The platform incorporates authentic image processing, statistical modelling, long-term soiling accumulation simulation, and optimization to provide data-driven maintenance choices.

4.1. SYSTEM INITIALIZATION AND INPUT PARAMETERS

At the beginning of the simulation, System parameters are established to delineate the economic and physical attributes of the photovoltaic system:

Electricity tariff (C_{tariff}) : cost per kilowatt-hour (USD/kWh), indicating revenue forfeited when energy production is hindered by soiling.

Cleaning costs (C_{clean}): cost for each maintenance session (USD).

Panel rating (P_{rated}): the nominal power of each photovoltaic panel (W).

Peak sun hours (H_{PSH}): the total number of full sun hours each day that contribute to energy generation.

Simulation period (N): the aggregate number of days during which soiling and cleaning methodologies are evaluated.

The simulation environment was established in MATLAB to guarantee reproducibility and numerical precision. Essential economic and technical characteristics were established to represent the true operational circumstances of the Sakarya University photovoltaic system. The power rate was established at 0.12 USD/kWh (Karadede, 2025), reflecting the economic cost of energy loss attributable to soiling. The cleaning expense was estimated at 1 USD each

session, encompassing fundamental labor and water use expenses for minor maintenance. Each photovoltaic panel was designed with a nominal power output of 400 W, and an average of 6 peak sun hours per day ((GEPA), 2025), aligning with the solar irradiation levels in northwestern Türkiye. The simulation duration was established at 365 days to provide a comprehensive evaluation of soiling buildup, cleaning methodologies, and seasonal influences. Various cleaning intervals (5, 10, 30, 60, 120, and 240 days) were assessed to determine the most economical maintenance method.

4.2. IMAGE PROCESSING WITH REAL IMAGE ACQUISITION AND SOILING INDEX EXTRACTION

This work's significant contribution is the utilization of authentic photovoltaic panel photos obtained straight from the rooftop installation at Sakarya University. Images were captured periodically under diverse environmental situations, encompassing varied degrees of dust deposition, lighting scenarios, and weather states. These photos serve as the foundation for reliable measurement of soiling.

All photos were processed with a specialized image processing pipeline developed in MATLAB. A Soiling Index (SI) was derived for each image utilizing a mix of visual characteristics responsive to dust and dirt buildup. The traits encompassed diminished brightness, reduced contrast, variability in edge density, histogram variance, LBP uniformity, and entropy of surface texture. The retrieved characteristics were merged into a singular normalized index denoting the extent of soiling on the panel surface, with elevated SI values signifying more contamination as shown in Figure 4.

The calculated Soiling Index values and related picture attributes were methodically recorded in a CSV file, establishing a structured dataset that associates each actual image with its respective soiling severity. This dataset allows transparent validation and additional statistical analysis.

4.3. POWER LOSS MODELING BASED ON SOILING INDEX

The correlation between the image-derived Soiling Index and photovoltaic power loss was modeled to evaluate the electrical impact of soiling. Power deterioration from soiling was assessed using a nonlinear model, recognizing that power loss escalates more swiftly at elevated contamination levels. Random noise was used to address inevitable measurement inaccuracies and operational unpredictability.

A linear regression model was subsequently established between the Soiling Index and the associated power loss percentage. This regression model establishes a feasible mathematical correlation enabling the direct prediction of daily power loss using image-based soiling observations. The model's correctness was assessed by statistical metrics, including the coefficient of determination (R^2) and the root mean square error (RMSE), confirming that the fitted model accurately reflects the observed trend.

4.4. SOILING ACCUMULATION AND ENVIRONMENTAL EFFECTS

The long-term soiling behaviour was modelled using a daily accumulation framework. A baseline daily soiling rate was presumed to signify the steady accumulation of dust on the photovoltaic panels. A seasonal weather element was integrated to adjust the accumulation rate over time, simulating authentic outside settings. Furthermore, random precipitation events were used to replicate natural cleansing, wherein rainfall partially eliminates deposited dust and diminishes the Soiling Index.

This methodology allows an accurate depiction of photovoltaic panel exposure to environmental conditions at Sakarya University, where both arid and wet intervals influence soiling dynamics.

4.5. CLEANING INTERVAL SIMULATION AND ENERGY LOSS ESTIMATION

For each potential cleaning interval, the simulation monitored the daily progression of the Soiling Index, anticipated power loss, and associated energy loss during the full simulation duration. Scheduled cleaning events were implemented by resetting the Soiling Index to zero at certain intervals, signifying total manual cleaning of the panels.

The daily energy loss was determined using the rated panel power and peak solar hours, adjusted for the anticipated power loss %. The overall yearly energy loss for each cleaning approach was determined by aggregating daily losses.

4.6. ECONOMIC EVALUATION AND OPTIMIZATION

An economic evaluation was conducted by aggregating the expenses associated with wasted energy and the costs of remediation efforts. The cost of energy loss was computed by multiplying the total energy lost by the electricity rate, whereas the cleaning cost was ascertained by multiplying the number of cleaning events by the cost per session. The entire operational expense for each cleaning interval was subsequently calculated.

The ideal cleaning frequency was determined to be the one that reduces the overall expense. This optimisation offers a definitive, quantitative solution for photovoltaic maintenance

planning tailored to the unique operational characteristics of the Sakarya University photovoltaic system.

4.7. VISUALIZATION AND RESULT INTERPRETATION

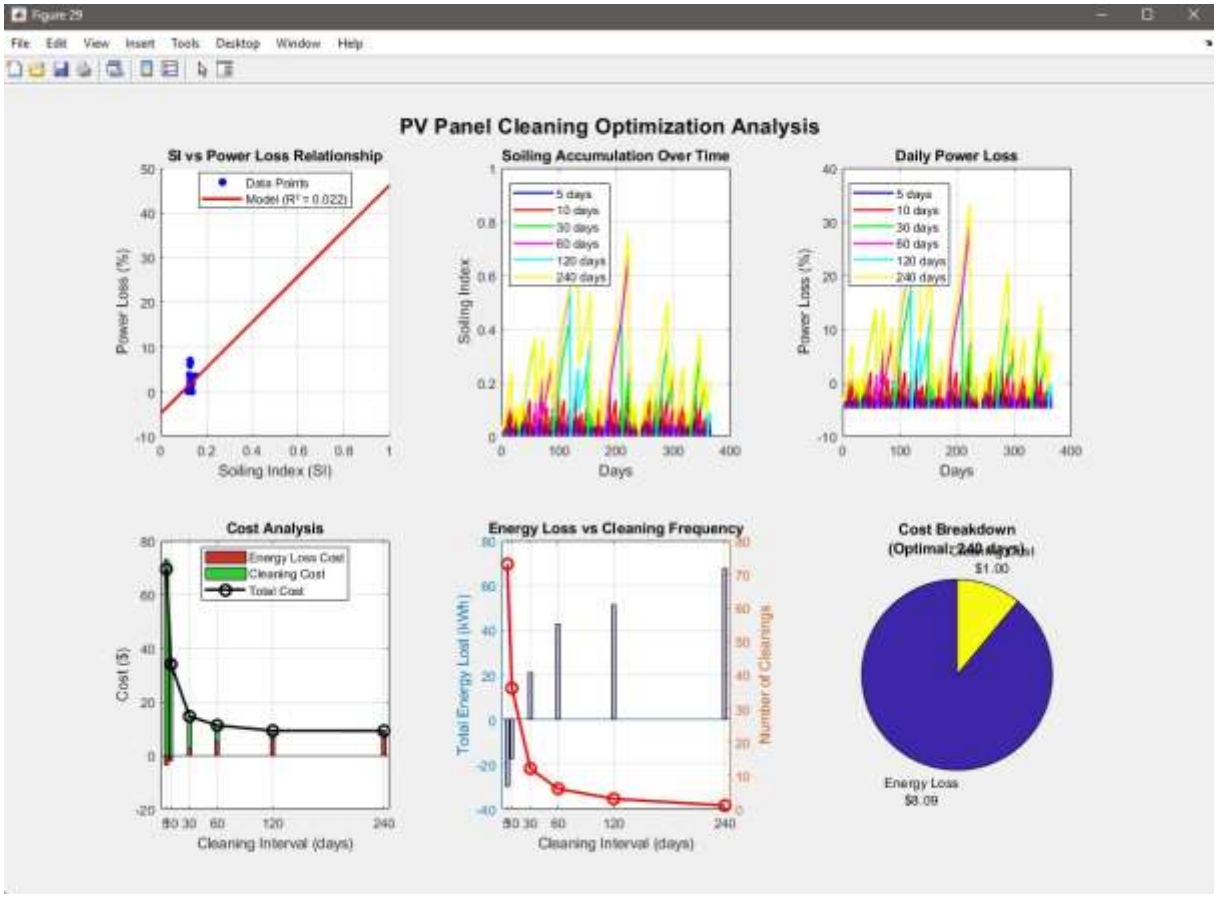


Figure 5. PV Panel Cleaning Optimization Analysis Based on Soiling, Power Loss, and Cost Evaluation.

The simulation outcomes were depicted using several graphs to enhance comprehension. The analysis encompassed the correlation between the Soiling Index and power loss, the temporal progression of soiling at various cleaning intervals, daily power loss patterns, and cost assessments of different solutions as shown in *Figure 5*. A summary table was produced, emphasising total energy loss, the count of cleaning activities, and the overall cost for each period, with the ideal approach distinctly marked.

4.8. MODEL VALIDATION

The efficacy of the power loss prediction model was ultimately assessed utilising typical statistical criteria, such as R^2, RMSE, and mean absolute error (MAE). These measurements

validate the dependability of employing image-based soiling indices as indicators of photovoltaic performance deterioration.

5. RESULTS AND DISCUSSION

This section delineates the experimental outcomes derived from the proposed image-based soiling assessment and cleaning optimization methodology implemented at a photovoltaic installation at Sakarya University. The results originate from two complementary elements:

- Image processing analysis of actual photovoltaic panel images to measure soiling via the proposed Soiling Index (SI),
- MATLAB-based simulations assessing power loss, energy loss, and economic performance across various cleaning intervals.

Collectively, our findings illustrate the practical efficacy of utilizing actual visual data alongside operational power metrics to inform condition-based photovoltaic maintenance choices.

5.1. IMAGE-BASED SOILING ANALYSIS USING REAL PV IMAGES

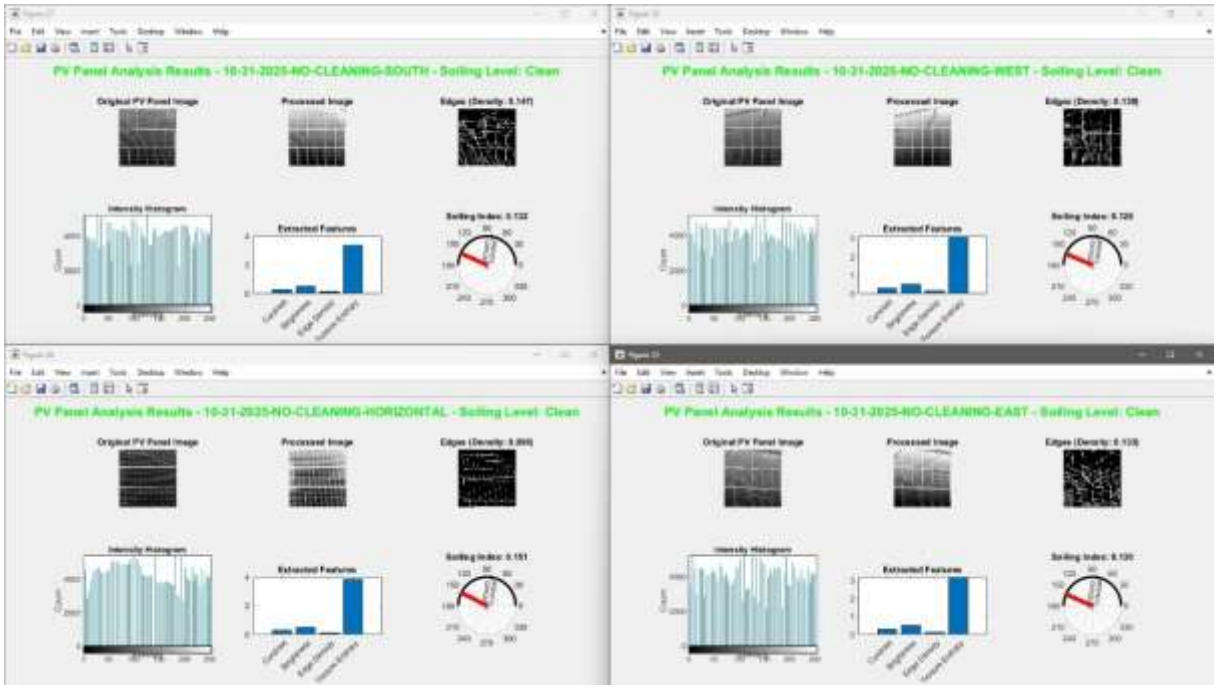


Figure 6. An Image Processing Framework for PV Panel Soiling Detection Across Different Orientations

The image processing outcomes indicate that the proposed MATLAB-based framework effectively quantifies surface cleanliness utilizing actual solar panel pictures taken under uniform climatic circumstances but varying orientations. As shown in *Figure 6* Panels orientated south, east, west, and horizontally had low Soiling Index (SI) values, indicating a

predominantly clean surface state during the analysis time. Minor discrepancies in SI were noted across orientations, with horizontally positioned panels exhibiting somewhat elevated SI values, attributable to enhanced dust accumulation resulting from less gravitational self-cleaning effects.

Extracted visual metrics, including brightness, contrast, edge density, and texture entropy, consistently indicated surface conditions, with clean panels demonstrating elevated edge density and contrast alongside reduced entropy values. The uniformity of SI values across orientations in the absence of cleaning circumstances substantiates the reliability of the image processing pipeline and verifies that the computed SI is responsive to actual surface attributes rather than lighting artefacts. These findings validate the efficacy of employing actual photos as a sensor-free method for ongoing photovoltaic soiling assessment.

5.2. SIMULATION RESULTS FOR CLEANING OPTIMIZATION USING SOILING INDEX

The simulation findings demonstrate a definitive correlation between the image-derived Soiling Index and solar power loss, affirming that heightened surface contamination results in quantifiable performance decline. Despite the heterogeneity in the relationship between SI and power loss caused by external noise and operational uncertainty, the overarching trend substantiates the physical significance of the suggested soiling model. Extended cleaning intervals led to elevated cumulative soiling, augmented daily power loss, and raised overall energy loss over time. Brief cleaning intervals decreased power loss but substantially escalated maintenance expenses owing to the necessity of frequent cleaning activities. The cost study indicated that an intermediate cleaning interval offers the ideal equilibrium between energy recovery and cleaning expenditures, hence minimizing total operating costs as shown in *Figure 5*. The integrated assessment of energy loss and cost factors verifies that data-driven, condition-based cleaning procedures exceed the efficacy of fixed-interval maintenance methods. The results indicate that combining actual image-based soiling evaluation with simulation and cost modelling offers a viable and efficient decision-support instrument for optimizing solar system maintenance.

6. CONCLUSIONS

This study introduced a thorough MATLAB-based image processing and simulation framework for identifying ideal cleaning intervals for photovoltaic (PV) solar panels under actual working circumstances. The suggested technique facilitates condition-based maintenance choices by including actual photovoltaic panel pictures, measurable electrical performance data, and economic modelling, rather of depending on predefined or heuristic cleaning schedules. A comprehensive image processing pipeline was established to assess surface soiling by analyzing visual attributes including brightness, contrast, edge density, histogram statistics, texture entropy, and Local Binary Pattern (LBP) uniformity. The characteristics were amalgamated into a standardized Soiling Index (SI), which demonstrated reliability as an indication of surface contamination. Validation using power-based soiling estimates obtained from actual inverter measurements established a significant correlation between the image-derived SI values and the real solar power loss, hence affirming the physical significance and reliability of the proposed index. The framework was assessed utilizing an actual rooftop solar system at Sakarya University, consisting of panels with varying orientations (south, east, west, and horizontal). The findings indicated that panel orientation affects soiling behavior, with horizontally mounted panels demonstrating marginally more soiling buildup due to diminished gravitational self-cleaning effects. Notwithstanding these discrepancies, the suggested image-based approach reliably identified variances in surface cleanliness across all orientations, affirming its broad applicability.

Simulation outcomes demonstrated a distinct trade-off among cleaning frequency, energy recovery, and maintenance expenses. Brief cleaning intervals reduced energy losses but elevated operational costs, whereas prolonged intervals resulted in excessive dirt accumulation and substantial power decline. The economic optimization research revealed that intermediate, data-driven cleaning intervals reduce total operational costs by balancing recovered energy with cleaning charges. These data validate that condition-based cleaning solutions surpass traditional fixed-interval maintenance methods in both cost and energy efficiency metrics.

The suggested system provides a scalable, cost-effective, and sensor-agnostic solution for the evaluation of solar soiling and the optimization of maintenance. Its dependence on conventional imaging apparatus and MATLAB-based analysis renders it appropriate for both rooftop and utility-scale photovoltaic systems. The amalgamation of authentic photos, quantified power data, and economic assessment constitutes an effective decision-support instrument for photovoltaic operators aiming to optimize energy output, minimize superfluous cleaning, and

enhance long-term system dependability. Future endeavors may enhance this framework by integrating machine learning methodologies for adaptive feature weighting, broadening the dataset across various climatic regions and seasons, and incorporating real-time camera systems or UAV-based imaging to facilitate fully automated, large-scale photovoltaic monitoring and maintenance scheduling.

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PSİKOMOTOR BECERİ ÖĞRETİMİNDE GERİ BİLDİRİM YAKLAŞIMLARI: SPOR BİLİMLERİ ALAN YAZININA DAYALI BİR DERLEME

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ÖZET

Psikomotor becerilerin öğretimi, beden eğitimi ve spor bilimleri alanında öğrenme sürecinin merkezinde yer almakta; öğrencilerin ve sporcuların motor performanslarını geliştirmelerinde temel bir işlev üstlenmektedir. Bu süreçte geri bildirim, öğrenenin yaptığı hareket hakkında bilgi edinmesini sağlayan, hataların fark edilmesine ve performansın düzenlenmesine katkıda bulunan önemli bir öğretim unsurudur. Spor becerilerinin edinimi yalnızca tekrar yoluyla değil, aynı zamanda doğru, zamanında ve amaca uygun geri bildirimlerin sunulmasıyla desteklenmektedir. Özellikle beden eğitimi derslerinde ve spor öğretimi ortamlarında geri bildirimin niteliği, öğrencilerin beceri kazanımı, motivasyonu ve öğrenmenin kalıcılığı üzerinde belirleyici bir rol oynamaktadır.

Bu çalışmanın amacı, psikomotor beceri öğretiminde kullanılan geri bildirim yaklaşımlarını spor bilimleri alan yazınına dayalı olarak incelemek ve mevcut literatürü bütüncül bir bakış açısıyla değerlendirmektir. Derleme kapsamında, ağırlıklı olarak Türkiye'de yayımlanmış kitaplar, hakemli dergi makaleleri ve lisansüstü çalışmalar ele alınmış; geri bildirim kavramı, türleri ve öğretim sürecindeki işlevi kuramsal bir çerçevede tartışılmıştır. Çalışmada herhangi bir gözlem, deneysel uygulama ya da istatistiksel analiz yapılmamış; literatürde yer alan bulgular yorumlayıcı bir yaklaşımla sentezlenmiştir.

Derleme sonucunda, psikomotor beceri öğretiminde geri bildirimin yalnızca hatayı düzeltmeye yönelik bir araç olmadığı, aynı zamanda öğreneni yönlendiren, motive eden ve öğrenme sürecini yapılandıran çok boyutlu bir öğretim stratejisi olduğu görülmektedir. Özellikle öğretmen merkezli, öğrenci merkezli, akran ve teknoloji destekli geri bildirim yaklaşımlarının beden eğitimi ve spor öğretiminde farklı amaçlara hizmet ettiği anlaşılmaktadır. Elde edilen bulguların, beden eğitimi öğretmenleri ve spor eğitmenleri için öğretim sürecinin daha etkili planlanmasına katkı sağlayacağı düşünülmektedir.

Anahtar Kelimeler: Psikomotor beceri, geri bildirim, spor öğretimi, beden eğitimi, derleme

FEEDBACK APPROACHES İN PSYCHOMOTOR SKİLL INSTRUCTİON: A LİTERATURE REVİEW BASED ON THE FİELD OF SPORTS SCİENCES

Abstract

The teaching of psychomotor skills occupies a central position in the learning process within the fields of physical education and sports sciences, playing a fundamental role in the development of students' and athletes' motor performance. In this process, feedback constitutes a crucial instructional element that enables learners to obtain information about their movements, recognize errors, and regulate performance. The acquisition of sport skills is supported not only through repetition but also through the provision of accurate, timely, and purpose-oriented feedback. Particularly in physical education classes and sport teaching environments, the quality of feedback plays a decisive role in skill acquisition, motivation, and the retention of learning.

The aim of this study is to examine feedback approaches used in psychomotor skill teaching based on the sports sciences literature and to evaluate the existing body of research from a holistic perspective. Within the scope of this review, primarily books, peer-reviewed journal articles, and postgraduate theses published in Türkiye were examined, and the concept of feedback, its types, and its functions in the instructional process were discussed within a theoretical framework. No observations, experimental interventions, or statistical analyses were conducted; instead, the findings reported in the literature were synthesized through an interpretative approach.

The results of the review indicate that feedback in psychomotor skill teaching is not merely a tool for error correction but rather a multidimensional instructional strategy that guides learners, enhances motivation, and structures the learning process. In particular, teacher-centered, learner-centered, peer-based, and technology-supported feedback approaches serve different instructional purposes in physical education and sport teaching contexts. It is considered that the findings of this study may contribute to more effective instructional planning for physical education teachers and sport instructors.

Keywords: Psychomotor skill, feedback, sport instruction, physical education, review

KRONİK SOL OMUZ AĞRISI VE ÜST EKSTREMİTE PARESTEZİSİNİN NADİR NEDENİ: SERVİKAL İNTRADURAL-EKSTRAMEDÜLLER KİTLE

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ÖZET

Menenjiomlar, dural tabanlı ve erişkinlerde sıkça rastlanan intrakraniyal tümörlerdir; bununla birlikte daha nadiren spinal kanalda da izlenebilir ve lokalizasyonlarına bağlı olarak çeşitli klinik tablolarla ortaya çıkabilirler. Bu çalışmada, kronik sol omuz ağrısı şikayetiyle başvuran bir hastada saptanan, nadir görülen servikal intradural-ekstramedüller yerleşimli menenjiom olgusunun literatür bilgileri ışığında sunulması amaçlanmıştır.

Altmış üç yaşındaki kadın hasta, üç yıldır devam eden sol omuz ağrısı ve sol üst ekstremiteye yayılan parestezi şikayetleriyle polikliniğimize başvurdu. Ağrının mekanik karakterde olduğu ve gece ağrısının bulunmadığı öğrenildi. Hastanın öyküsünde travma, zorlanma, sistemik veya nörolojik ek semptomlar (disfaji, denge kaybı vb.) mevcut değildi. Fizik muayenede servikal ve üst ekstremite eklem hareket açıklıkları tamdı. Paravertebral kaslarda spazm ve palpasyonla hassasiyet dışında nörolojik defisit saptanmadı (kas gücü 5/5, duyu normal, derin tendon refleksleri normoaktif). Servikal kompresyon ve distraksiyon testleri pozitif olarak değerlendirildi. Laboratuvar tetkiklerinde 25-OH D vitamini düşüklüğü ile CRP ve ürik asit düzeylerinde hafif yükseklik izlendi. Çekilen servikal manyetik rezonans görüntülemede (MRG) C5-C6 seviyesinde, sol paramedian alanda, medulla spinalise bası etkisi oluşturan, yaklaşık 12 mm çapında; intradural-ekstramedüller yerleşimli, T1 ve T2 ağırlıklı serilerde hipointens sinyal özelliği gösteren ve kontrastlı serilerde homojen kontrast tutan kitle lezyonu tespit edildi. Menenjiom ve schwannom ön tanılarıyla beyin cerrahisi kliniğine yönlendirilen hasta opere edildi. Patolojik inceleme sonucu WHO Grade I menenjiom olarak raporlandı.

Bu olgu, kronik omuz ağrısı ve üst ekstremite parestezisi gibi atipik kas-iskelet sistemi semptomlarıyla başvuran hastalarda, belirgin nörolojik defisit veya alarm semptomları olmasa dahi, spinal yerleşimli kitlelerin ayırıcı tanıda akılda tutulması gerektiğini vurgulamaktadır.

Anahtar Kelimeler: Omuz ağrısı, Servikal radikülopati, İntradural-ekstramedüller tümör, Menenjiom

RARE CAUSE OF CHRONIC LEFT SHOULDER PAIN AND UPPER EXTREMITY PARESTHESIA: CERVICAL INTRADURAL-EXTRAMEDULLARY MASS

ABSTRACT

Meningiomas are intracranial tumors originating from the dura mater and are frequently encountered in adults; however, they can also be observed more rarely in the spinal canal and can present with various clinical pictures depending on their localization. In this study, it was

aimed to present a rare case of cervical intradural-extramedullary meningioma detected in a patient presenting with chronic left shoulder pain, in the light of literature information. A sixty-three-year-old female patient applied to our outpatient clinic with complaints of left shoulder pain and paresthesia radiating to the left upper extremity that had been ongoing for three years. It was learned that the pain was mechanical in character and there was no night pain. There were no trauma, strain, systemic or additional neurological symptoms (dysphagia, loss of balance, etc.) in the patient's history. In the physical examination, cervical and upper extremity joint ranges of motion were full. No neurological deficit was detected except for spasm and tenderness on palpation in the paravertebral muscles (muscle strength 5/5, sensation normal, deep tendon reflexes normoactive). Cervical compression and distraction tests were evaluated as positive. In laboratory tests, low 25-OH vitamin D levels and slight elevation in CRP and uric acid levels were observed. In the cervical magnetic resonance imaging (MRI), a mass lesion with a diameter of approximately 12 mm, intradural-extramedullary localization, showing hypointense signal characteristics in T1 and T2 weighted series and homogeneously enhancing contrast in contrast series, causing compression on the spinal cord, was detected in the left paramedian area at the C5-C6 level. The patient, who was referred to the neurosurgery clinic with preliminary diagnoses of meningioma and schwannoma, was operated on. The pathological examination result was reported as WHO Grade I meningioma.

This case emphasizes that spinal masses should be kept in mind in the differential diagnosis in patients presenting with atypical musculoskeletal symptoms such as chronic shoulder pain and upper extremity paresthesia, even if there is no significant neurological deficit or alarm symptoms.

Keywords: Shoulder pain, Cervical radiculopathy, Intradural-extramedullary tumor, Meningioma

ADÖLESANLARIN BEDEN ALGILARININ ÇEŞİTLİ DEĞİŞKENLER AÇISINDAN İNCELENMESİ

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ÖZET

Bu çalışmada adölesanların beden algılarının; yaş, cinsiyet, sigara kullanımı ve ekonomik durum değişkenleri açısından incelenmesi amaçlanmıştır. Çalışma tarama modellerinden nicel tarama modeline göre gerçekleştirilmiştir ve aynı zamanda kesitsel tarama yöntemi kullanılmıştır. Çalışma, Gaziantep İl Milli Eğitim Müdürlüğü'ne bağlı Şehit Cuma Akıl Erkek Anadolu İmam Hatip Lisesi ve Sevinç Bahattin Teymur Kız Anadolu İmam Hatip Lisesi'nde öğrenim gören, adölesan dönemde olup, fizyolojik veya psikolojik herhangi bir engeli bulunmayan 175 kız ve 193 erkek olmak üzere toplam 368 Öğrenci üzerinde yapılmıştır. Çalışmaya katılacan adolesanların; demografik bilgileri (yaş, cinsiyet, , ailenin ortalama aylık gelir durumu, sigara kullanımı) alındıktan sonra, beden imajının tespiti için; Orijinal adı Body-Cathexis Scale (BCS) olan ölçek, 1953 yılında Secard ve Jurard tarafından geliştirilmiş, Kişinin 40 ayrı vücut bölümünden ya da işlevinden memnuniyetini belirleyen ölçek kullanılmıştır. Adölesanların Beden Algıları ile Tespit Edilen Değişkenler bakımından değerlendirilmesinde Çokboyutlu Ölçeklendirme (Multidimensional Scaling) analiz tekniğinden yararlanılmıştır. Yapılan Çokboyutlu Ölçeklendirme Analizi sonucunda Stres katsayısı 0.089 ve açıklanabilen varyasyon düzeyi de %77.8 olarak belirlenmiştir. Adölesanlar tespit edilen özellikler bakımından genel olarak dört gruba ayrıldığı görülmüştür. Adölesanların birbirlerinden farklılaşmasında yani algılarının farklılaşmasında Yaş'ın önemli bir faktör olduğu görülmüştür. Dikkat edileceği Cinsiyet ve Sigara kullanma durumu, daha ziyade bireylerin ekonomik durum, burun, VK, iştah durumu, idrar/dışkı düzeni, sağlık ve duygu keskinliği ile ilişkili olduğu tespit edilmiştir. Dolayısıyla bireylerin cinsiyetleri ve sigara kullanıp kullanmamaları, bu grupta verilen algılarını önemli düzeyde etkilediği tespit edilmiştir. Diğer taraftan söz konusu bireylerin fiziksel güç, kas kuvveti, enerji düzeyi, yüz rengi, saç, el, bel, kulak değişkenlerinin de birbirleriyle ilişkili olduğu tespit edilmiştir.

Anahtar Kelimeler: Adölesan, beden algısı, cinsiyet, yaş, ekonomik durum

EXAMINATION OF ADOLESCENTS' BODY PERCEPTIONS IN TERMS OF VARIOUS VARIABLES

ABSTRACT

This study aimed to examine adolescents' body image perceptions in terms of age, gender, smoking habits, and economic status. The study was conducted using a quantitative survey model and a cross-sectional survey method. The study involved a total of 368 students (175 girls and 193 boys) attending Şehit Cuma Akıl Boys' Anatolian Imam Hatip High School and Sevinç Bahattin Teymur Girls' Anatolian Imam Hatip High School, both affiliated with the Gaziantep Provincial Directorate of National Education, who were adolescents and had no physiological or psychological disabilities. After collecting demographic information (age, gender, average monthly family income, smoking habits) from the adolescents participating in the study, the Body-Cathexis Scale (BCS), originally developed by Secard and Jurard in 1953, was used to determine body image. This scale assesses a person's satisfaction with 40 separate body parts or functions. Multidimensional scaling analysis technique was used to evaluate adolescents' body image perceptions and the variables identified. The stress coefficient was determined as 0.089 and the explainable variation level as 77.8%. Adolescents were generally divided into four groups based on the identified characteristics. Age was found to be a significant factor in differentiating adolescents from each other, i.e., in the differentiation of their perceptions. It was noted that gender and smoking status were found to be more closely related to individuals' economic status, nose, BMI, appetite, urinary/bowel regularity, health, and emotional sharpness. Therefore, it was determined that individuals' gender and smoking status significantly influenced their perceptions within this group. On the other hand, it was also found that the variables of physical strength, muscle power, energy level, facial color, hair, hands, waist, and ears were related to each other.

Key words : adolescent, body perception, gender, age, economic situation

SPOR İŞLETMELERİNİN HUKUKİ SÜREÇLERİ ÜZERİNE BİR ARAŞTIRMA

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ÖZET

Spor endüstrisi, küresel ölçekte ekonomik ve sosyal açıdan büyük bir etkiye sahip dinamik bir sektördür. Bu sektördeki hukuki süreçler, işletmelerin faaliyetlerini doğrudan etkileyen önemli bir rol oynamaktadır. Bu çalışmada, spor işletmelerinin hukuki yapısı ve karşılaştıkları hukuki sorunlar ele alınmış, özellikle spor hukuku, ticaret hukuku, sözleşme hukuku, fikri mülkiyet hukuku ve vergi hukuku gibi alanlarda düzenlemeler incelenmiştir. Ayrıca, spor işletmelerinin karşılaştığı hukuki sorunlar arasında sponsorluk ve yayın hakları anlaşmazlıkları, sporcularla yapılan sözleşmeler, doping ve disiplin süreçleri ile ticari uyuşmazlıklar gibi konular yer almaktadır. Uluslararası düzeyde ise Spor Tahkim Mahkemesi (CAS) ve büyük spor organizasyonları (FIFA, UEFA, IOC) gibi kurumlar, spor hukuku ve tahkim süreçlerinin şekillenmesinde önemli bir rol oynamaktadır. Bu bağlamda, spor işletmelerinin hukuki süreçlerini etkili bir şekilde yönetebilmeleri için hukuki riskleri minimize etme, sözleşme yönetimi, güncel düzenlemeleri takip etme ve uluslararası tahkim süreçlerine hâkim olma gibi stratejiler önerilmektedir.

Anahtar Kelimeler: Spor hukuku, spor işletmeciliği, sponsorluk anlaşmazlıkları

A RESEARCH ON THE LEGAL PROCESSES OF SPORTS ENTERPRİSES

ABSTRACT

The sports industry is a dynamic sector with a significant global economic and social impact. Legal processes within this sector play a crucial role in influencing the operations of businesses. This study discusses the legal framework of sports enterprises and the legal challenges they face, examining regulations in areas such as sports law, commerecial law, contract law, intellectual property law, and tax law. Legal issues encountered by sports enterprises include disputes over sponsorship and broadcasting rights, contracts with athletes, doping and disciplinary processes, and commercial disputes. At the international level, institutions such as the Court of Arbitration for Sport (CAS) and major sports organizations (FIFA, UEFA, IOC) play a pivotal role in shaping sports law and arbitration processes. In this context, strategies such as minimizing legal risks, contract management, staying updated with current regulations,

and mastering international arbitration processes are recommended for effective management of legal processes in sports enterprises.

Keywords: Sports law, sports business, sponsorship disputes

GİRİŞ

Spor endüstrisi, küresel ölçekte ekonomik, sosyal ve kültürel etkileri bulunan çok boyutlu bir sektördür. Spor kulüpleri, federasyonlar, spor organizasyonları ve ticari paydaşlar, yalnızca sportif faaliyetler yürütmekle kalmayıp aynı zamanda önemli ekonomik ve hukuki ilişkiler ağı içerisinde faaliyet göstermektedir. Bu durum, sporun giderek artan biçimde ticarileşmesine ve profesyonelleşmesine paralel olarak hukuki düzenlemelerin önemini artırmaktadır (Gardiner vd., 2019; Weatherill, 2017).

Spor işletmelerinin faaliyetleri; spor hukuku, sözleşme hukuku, ticaret hukuku, fikri mülkiyet hukuku ve vergi hukuku gibi farklı hukuk disiplinlerinin kesişiminde yer almaktadır. Özellikle profesyonel spor kulüplerinin şirketleşmesi, sponsorluk ve yayın hakları sözleşmelerinin artması ve uluslararası transferlerin yaygınlaşması, hukuki süreçlerin karmaşık bir yapı kazanmasına neden olmuştur (Parrish, 2022).

Uluslararası düzeyde spor hukuku, FIFA, UEFA ve Uluslararası Olimpiyat Komitesi (IOC) gibi kuruluşların düzenlemeleri ile şekillenmekte; ortaya çıkan uyuşmazlıklar çoğunlukla Spor Tahkim Mahkemesi (Court of Arbitration for Sport – CAS) tarafından çözümlenmektedir. CAS kararları, spor hukukunda içtihat niteliği taşıyarak hem ulusal hem de uluslararası uygulamaları etkilemektedir (Gardiner vd., 2019).

Avrupa Birliği bağlamında spor, uzun süre özel bir düzenleme alanı olarak değerlendirilmiş olsa da, özellikle rekabet hukuku ve serbest dolaşım ilkeleri çerçevesinde Avrupa Birliği hukukunun denetimine tabi olmuştur. Avrupa Birliği Adalet Divanı'nın (CJEU) kararları ve akademik tartışmalar, sporun ekonomik yönü ağır bastığı ölçüde AB hukukunun kapsamına girdiğini ortaya koymaktadır (Weatherill, 2017; Parrish, 2022).

Türkiye'de ise spor işletmelerinin hukuki yapısı ve faaliyetleri, başta 7405 sayılı Spor Kulüpleri ve Spor Federasyonları Kanunu olmak üzere ilgili mevzuat çerçevesinde düzenlenmektedir. Bu kanun, spor kulüplerinin tüzel kişiliği, mali yapısı, denetimi ve faaliyet alanlarına ilişkin önemli hükümler içermekte; spor işletmelerinin hukuki sorumluluklarını belirgin hâle getirmektedir (Mevzuat Bilgi Sistemi, 2022).

Bu çalışma, spor işletmelerinin karşılaştığı hukuki süreçleri ulusal ve uluslararası düzenlemeler ışığında ele alarak, sektördeki hukuki risk alanlarını ortaya koymayı ve bu risklerin yönetimine yönelik bir çerçeve sunmayı amaçlamaktadır.

YÖNTEM

Bu araştırmada, spor işletmelerinin hukuki süreçlerini incelemek amacıyla nitel araştırma yöntemlerinden doküman analizi kullanılmıştır. Doküman analizi, ilgili konuda üretilmiş yazılı materyallerin sistematik biçimde incelenmesini içeren bir yöntem olup, Bowen (2009) ve Creswell (2013) tarafından tanımlanan doküman inceleme adımlarına uygun şekilde yürütülmüştür.

Araştırmanın veri kaynağını;

- Türkiye'de spor hukukunu düzenleyen ulusal mevzuatlar (7405 Sayılı Spor Kulüpleri ve Spor Federasyonları Kanunu, Türk Ticaret Kanunu, 6769 Sayılı Sınai Mülkiyet Kanunu, vergi mevzuatı) (Mevzuat Bilgi Sistemi, 2022),
- Uluslararası spor hukuku düzenlemeleri (WADA Dünya Dopingle Mücadele Kodu, FIFA ve UEFA düzenlemeleri, IOC Olimpiyat Tüzüğü),
- CAS (Court of Arbitration for Sport) kararları,
- Alan yazında spor hukuku ve spor işletmeciliği konularında yayımlanmış hakemli makaleler, kitaplar ve raporlar oluşturmaktadır.

Dokümanlar, araştırma sorusuyla ilişkili olacak şekilde sistematik biçimde taranmış; spor işletmelerinin hukuki süreçlerine ilişkin bilgiler karşılaştırmalı olarak değerlendirilmiştir. Analiz sürecinde dokümanlardan elde edilen bilgiler sınıflandırılmış, kavramsal bütünlük sağlanmış ve literatürdeki mevcut hukuki yaklaşımlarla tutarlılığı kontrol edilmiştir.

Bu yöntem, spor hukuku alanında yapılan benzer çalışmalarda (Gardiner vd., 2019; Weatherill, 2017; Parrish, 2022) yaygın olarak kullanılan bir yaklaşım olup, spor işletmelerinin hukuki yapısını incelemek için uygun bir çerçeve sunmaktadır.

BULGULAR

Spor İşletmelerinin Hukuki Çerçevesi

Spor işletmeleri, faaliyet alanları ve örgütlenme biçimlerine bağlı olarak çok sayıda hukuki düzenlemeye tabi olmaktadır. Profesyonelleşme ve ticarileşmenin artmasıyla birlikte spor kulüpleri ve spor işletmeleri, yalnızca spor hukuku kapsamında değil; ticaret hukuku, sözleşme hukuku, fikri mülkiyet hukuku ve vergi hukuku gibi farklı hukuk disiplinlerinin kesişiminde faaliyet göstermektedir (Gardiner vd., 2019; Üzeltürk, 2022).

Spor Hukuku

Spor hukuku, spor faaliyetlerinin ulusal ve uluslararası düzeyde düzenlenmesini sağlayan kurallar bütününü ifade etmektedir. Ulusal mevzuatlar, spor kulüplerinin, federasyonların ve sporcuların hak ve yükümlülüklerini belirlerken; uluslararası düzenlemeler, özellikle doping,

disiplin ve transfer süreçlerinde belirleyici olmaktadır. Dünya Dopingle Mücadele Ajansı (WADA) tarafından yayımlanan Dünya Dopingle Mücadele Kodu, sporcular ve spor işletmeleri açısından bağlayıcı nitelik taşımaktadır (World Anti-Doping Agency [WADA], 2021).

Türkiye'de spor hukuku alanındaki temel düzenlemelerden biri 7405 sayılı Spor Kulüpleri ve Spor Federasyonları Kanunudur. Bu kanun, spor kulüplerinin tüzel kişiliğini, mali yapısını, denetim mekanizmalarını ve faaliyet alanlarını düzenleyerek spor işletmelerinin hukuki sorumluluklarını açık biçimde ortaya koymaktadır (Çolakoğlu vd., 2022).

Ticaret Hukuku

Profesyonel spor kulüpleri ve spor işletmeleri, ekonomik faaliyetleri nedeniyle ticaret hukukunun düzenleme alanı içerisinde yer almaktadır. Sponsorluk anlaşmaları, lisans sözleşmeleri, yayın hakları ve ticari faaliyetlerden elde edilen gelirler, ticaret hukukunun temel konuları arasında bulunmaktadır. Spor kulüplerinin şirketleşmesiyle birlikte, ticari faaliyetler daha kurumsal bir yapıya kavuşmuş ve hukuki sorumluluklar artmıştır (Gardiner vd., 2019; Soyer & Can, 2010).

Türkiye'de spor işletmelerinin ticari faaliyetleri, genel olarak Türk Ticaret Kanunu hükümleri çerçevesinde yürütülmekte; özellikle profesyonel liglerde faaliyet gösteren kulüpler açısından ticari şeffaflık ve mali denetim ön plana çıkmaktadır.

Sözleşme Hukuku

Spor işletmelerinin hukuki ilişkilerinin önemli bir bölümü sözleşmelere dayanmaktadır. Sporcularla yapılan sözleşmeler, transfer anlaşmaları, sponsorluk ve yayın hakları sözleşmeleri bu kapsamda değerlendirilmektedir. Sözleşme hukukuna ilişkin uyuşmazlıklar, spor işletmeleri açısından önemli hukuki riskler doğurabilmektedir. Uluslararası düzeyde ortaya çıkan sözleşme ihtilafları çoğunlukla Spor Tahkim Mahkemesi (CAS) tarafından çözümlenmektedir (Court of Arbitration for Sport [CAS], 2020; Kayapınar, 2021).

Fikri Mülkiyet Hukuku

Spor işletmelerinin marka değeri, ticari gelirlerinin önemli bir kısmını oluşturmaktadır. Kulüp isimleri, logolar, amblemler ve lisanslı ürünler fikri mülkiyet hukuku kapsamında korunmaktadır. Fikri mülkiyet haklarının etkin biçimde korunması, spor işletmelerinin marka değerinin sürdürülebilirliği açısından kritik öneme sahiptir (Suluk vd., 2024). Türkiye'de fikri mülkiyet hakları, 6769 sayılı Sınai Mülkiyet Kanunu çerçevesinde düzenlenmekte olup, spor işletmelerinin marka ve lisans haklarının korunmasını güvence altına almaktadır.

Vergi Hukuku

Spor işletmeleri ve sporcular, elde ettikleri gelirler üzerinden çeşitli vergi yükümlülüklerine tabidir. Sponsorluk gelirleri, yayın hakları, bilet satışları ve reklam gelirleri vergi hukuku kapsamında değerlendirilmektedir. Vergi mevzuatının doğru uygulanmaması, spor işletmeleri açısından ciddi mali ve hukuki yaptırımlar doğurabilmektedir. Bu nedenle profesyonel spor işletmelerinde vergi planlaması ve mali denetim önemli bir yönetim alanı olarak öne çıkmaktadır (Çamcı, 2009; Suluk vd., 2024).

Spor İşletmelerinin Karşılaştığı Hukuki Sorunlar

Spor işletmeleri, faaliyetlerini sürdürürken çeşitli hukuki uyuşmazlıklarla karşılaşmaktadır. Bu uyuşmazlıklar çoğunlukla sponsorluk ve yayın hakları anlaşmaları, sporcularla yapılan sözleşmeler, disiplin ve doping süreçleri ile ticari faaliyetlerden kaynaklanan ihtilaflar etrafında yoğunlaşmaktadır (Gardiner vd., 2019; Gül & Onay, 2021).

Sponsorluk ve Yayın Hakları Anlaşmazlıkları

Sponsorluk ve yayın hakları, spor işletmelerinin en önemli gelir kaynakları arasında yer almaktadır. Bu alanda yaşanan hukuki sorunlar genellikle sözleşme hükümlerinin ihlali, tarafların yükümlülüklerini yerine getirmemesi veya sözleşmelerin yorumlanmasına ilişkin uyuşmazlıklardan kaynaklanmaktadır. Yayın haklarına ilişkin anlaşmazlıklar ise özellikle ulusal ve uluslararası organizasyonlarda yetki paylaşımı ve gelir dağılımı konularında ortaya çıkmaktadır (Weatherill, 2017; Soyer & Can, 2010).

Bu tür uyuşmazlıklar, spor işletmelerinin mali yapısını doğrudan etkileyebilmekte ve uzun süren hukuki süreçler nedeniyle ciddi ekonomik kayıplara yol açabilmektedir. Bu nedenle sponsorluk ve yayın hakları sözleşmelerinin açık, öngörülebilir ve hukuki açıdan sağlam bir şekilde hazırlanması büyük önem taşımaktadır (Gül & Onay, 2021).

Sporcularla Yapılan Sözleşmeler

Spor işletmeleri ile sporcular arasındaki ilişkiler büyük ölçüde sözleşmelere dayanmaktadır. Transfer sözleşmeleri, hizmet sözleşmeleri ve performansa dayalı anlaşmalar, taraflar arasında en sık uyuşmazlık yaşanan alanlar arasında yer almaktadır. Özellikle sözleşmenin feshi, tazminat talepleri ve sözleşmeye aykırılık iddiaları, spor işletmeleri açısından önemli hukuki riskler doğurmaktadır (Gardiner vd., 2019; Kayapınar, 2021).

Uluslararası sporcu transferlerinde ortaya çıkan sözleşme uyuşmazlıkları, çoğunlukla Spor Tahkim Mahkemesi (CAS) tarafından karara bağlanmakta; CAS kararları, spor hukuku uygulamalarında yol gösterici bir nitelik taşımaktadır (Court of Arbitration for Sport [CAS], 2020).

Doping ve Disiplin Süreçleri

Doping ve disiplin süreçleri, spor işletmelerini doğrudan etkileyen önemli hukuki sorun alanlarından biridir. Sporculara uygulanan doping yaptırımları, yalnızca bireysel sonuçlar doğurmakla kalmamakta; kulüpler ve spor işletmeleri açısından da sportif ve mali yaptırımlara neden olabilmektedir. Dünya Dopingle Mücadele Kodu, disiplin süreçlerinin yürütülmesinde temel uluslararası belge niteliğindedir (World Anti-Doping Agency [WADA], 2021).

Disiplin süreçlerinde usul güvencelerine uyulmaması, sporcular ve kulüpler açısından hukuki ihtilaflara yol açabilmekte ve bu ihtilaflar çoğunlukla CAS nezdinde çözüme kavuşturulmaktadır.

Ticari Uyuşmazlıklar

Spor işletmeleri, bilet satışları, lisanslama faaliyetleri, ürün satışları ve reklam anlaşmaları gibi ticari faaliyetlerinden kaynaklanan çeşitli uyuşmazlıklarla karşılaşabilmektedir. Bu uyuşmazlıklar genellikle sözleşmeye aykırılık, ödeme yükümlülüklerinin yerine getirilmemesi ve ticari hakların ihlali gibi nedenlerden doğmaktadır. Ticari uyuşmazlıkların etkin bir şekilde yönetilememesi, spor işletmelerinin sürdürülebilirliğini olumsuz yönde etkileyebilmektedir (Parrish, 2022).

Uluslararası Boyutta Spor Hukuku ve Tahkim Süreçleri

Uluslararası spor hukuku, büyük ölçüde uluslararası spor kuruluşlarının düzenlemeleri ve tahkim mekanizmaları aracılığıyla şekillenmektedir. FIFA, UEFA ve Uluslararası Olimpiyat Komitesi (IOC) gibi kuruluşlar, sporun uluslararası düzeyde yönetilmesinde ve hukuki standartların belirlenmesinde önemli bir rol oynamaktadır.

Spor Tahkim Mahkemesi (CAS), spor hukukunda ortaya çıkan uyuşmazlıkların çözümünde en yetkili uluslararası merci olarak kabul edilmektedir. CAS'ın verdiği kararlar, spor hukuku alanında içtihat niteliği taşımakta ve ulusal hukuk sistemleri üzerinde dolaylı etkiler yaratmaktadır (Gardiner vd., 2019; Court of Arbitration for Sport [CAS], 2020).

Avrupa Birliği bağlamında ise spor, ekonomik faaliyet yönü ağır bastığı ölçüde AB hukukunun denetimine tabi olmakta; rekabet hukuku ve serbest dolaşım ilkeleri çerçevesinde değerlendirilmektedir. Bu durum, spor işletmelerinin uluslararası faaliyetlerinde hukuki uyum gerekliliğini artırmaktadır (Weatherill, 2017; Parrish, 2022).

SONUÇ ve ÖNERİLER

Bu araştırmada, spor işletmelerinin hukuki süreçleri ulusal ve uluslararası düzenlemeler çerçevesinde incelenmiştir. Elde edilen bulgular, spor işletmelerinin yalnızca sportif faaliyetler yürüten yapılar olmadığını; aynı zamanda çok boyutlu hukuki ilişkiler ağı içerisinde faaliyet

gösteren ekonomik aktörler olduğunu ortaya koymaktadır. Spor hukuku, ticaret hukuku, sözleşme hukuku, fikri mülkiyet hukuku ve vergi hukuku gibi farklı hukuk disiplinlerinin spor işletmelerinin faaliyet alanlarını doğrudan etkilediği tespit edilmiştir.

Araştırma bulguları, spor işletmelerinin en sık karşılaştıkları hukuki sorunların sponsorluk ve yayın hakları anlaşmazlıkları, sporcularla yapılan sözleşmelerden doğan ihtilaflar, doping ve disiplin süreçleri ile ticari faaliyetlerden kaynaklanan uyuşmazlıklar olduğunu göstermektedir. Bu sorunların büyük bir bölümünün, sözleşme yönetimindeki yetersizlikler, mevzuat takibinin düzenli yapılmaması ve uluslararası düzenlemelere uyum konusundaki eksikliklerden kaynaklandığı görülmektedir.

Uluslararası boyutta spor hukuku uygulamaları incelendiğinde, Spor Tahkim Mahkemesi'nin (CAS) spor hukukunda merkezi bir rol üstlendiği ve verdiği kararlarla uygulamaya yön verdiği anlaşılmaktadır. FIFA, UEFA ve Uluslararası Olimpiyat Komitesi gibi kuruluşların düzenlemeleri ise spor işletmelerinin faaliyet alanlarını belirleyen temel normatif çerçeveyi oluşturmaktadır. Avrupa Birliği bağlamında sporun ekonomik yönünün ön plana çıkması, spor işletmelerinin rekabet hukuku ve serbest dolaşım ilkeleri çerçevesinde daha sık denetime tabi tutulmasına yol açmaktadır.

Türkiye özelinde değerlendirildiğinde, 7405 sayılı Spor Kulüpleri ve Spor Federasyonları Kanunu'nun spor işletmelerinin hukuki yapısını daha belirgin hâle getirdiği; mali denetim, şeffaflık ve yönetsel sorumluluklar açısından önemli düzenlemeler getirdiği görülmektedir. Ancak uygulamada, spor işletmelerinin bu düzenlemelere uyum sürecinde çeşitli yapısal ve yönetsel sorunlarla karşılaştığı söylenebilir.

Öneriler

Araştırma bulgularına dayanarak, spor işletmelerinin hukuki süreçlerini daha etkin ve sürdürülebilir bir şekilde yönetebilmeleri için aşağıdaki öneriler geliştirilebilir:

Hukuki risk yönetimi güçlendirilmelidir; Spor işletmeleri, faaliyet alanlarına ilişkin hukuki riskleri önceden tespit edebilecek bir risk yönetimi yaklaşımı benimsemeli ve bu süreçte alanında uzman hukukçularla sürekli iş birliği içerisinde olmalıdır.

Sözleşme yönetimi profesyonelleştirilmelidir: Sporcu sözleşmeleri, sponsorluk anlaşmaları ve yayın hakları sözleşmeleri açık, öngörülebilir ve güncel mevzuata uygun şekilde hazırlanmalı; sözleşmelerin uygulanması düzenli olarak denetlenmelidir.

Ulusal ve uluslararası mevzuat takibi sistematik hâle getirilmelidir: Spor işletmeleri, başta 7405 sayılı Kanun olmak üzere ulusal düzenlemeleri ve FIFA, UEFA, WADA gibi uluslararası kuruluşların güncel kurallarını yakından takip etmelidir.

Uluslararası tahkim süreçlerine hazırlık artırılmalıdır: Spor işletmeleri, CAS nezdinde ortaya çıkabilecek uyuşmazlıklara karşı kurumsal bilgi ve deneyim geliştirmeli; uluslararası tahkim süreçlerine hâkim bir yapı oluşturmalıdır.

Sonuç olarak, spor işletmelerinin hukuki süreçleri etkin bir şekilde yönetebilmesi, yalnızca hukuki uyum açısından değil; aynı zamanda ekonomik sürdürülebilirlik ve kurumsal istikrar açısından da büyük önem taşımaktadır. Bu çalışma, spor işletmelerinin hukuki yapısını bütüncül bir bakış açısıyla ele alarak alandaki literatüre katkı sunmakta ve gelecekte yapılacak çalışmalara zemin hazırlamaktadır.

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SPOR KULÜPLERİNDE SPONSORLUK YASALARININ ROLÜ: HUKUKİ VE FİNANSAL BİR ANALİZ

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ÖZET

Bu çalışma, sponsorluk yasalarının spor kulüpleri açısından taşıdığı hukuki ve finansal önemi incelemektedir. Spor kulüplerinin gelir kaynaklarını artırmak ve sürdürülebilir bir yapıya kavuşmalarını sağlamak amacıyla sponsorluk anlaşmaları kritik bir rol oynamaktadır. Çalışmada, Türkiye'deki ilgili mevzuatlar, akademik literatür ve hukuki çerçeve detaylı bir şekilde ele alınmıştır. Nitel araştırma yöntemi kullanılarak gerçekleştirilen bu çalışmada, sponsorluk yasalarının spor kulüplerinin mali sürdürülebilirliği üzerindeki etkileri analiz edilmiştir. Elde edilen bulgular, sponsorluk düzenlemelerinin kulüpler için finansal avantajlar sunduğunu ve hukuki çerçevenin bu sürecin güvenliğini sağladığını göstermektedir. Sonuç olarak, kulüplerin sponsorluk süreçlerini daha etkin yönetebilmesi için hukuki bilinçlenme ve finansal planlamaya önem vermeleri önerilmektedir.

Anahtar Kelimeler: Sponsorluk, spor kulüpleri, hukuki çerçeve, finansal sürdürülebilirlik

THE ROLE OF SPONSORSHİP LAWS İN SPORTS CLUBS: A LEGAL AND FİNANCİAL ANALYSİS

ABSTRACT

This study examines the legal and financial significance of sponsorship laws for sports clubs. Sponsorship agreements play a crucial role in increasing the revenue streams of sports clubs and ensuring their sustainable structure. The study extensively analyzes the relevant legislation in Turkey, academic literature, and the legal framework. Utilizing a qualitative research method, this study evaluates the impact of sponsorship laws on the financial sustainability of sports clubs. The findings indicate that sponsorship regulations provide financial benefits to clubs and that the legal framework ensures the security of this process. In conclusion, it is recommended that clubs prioritize legal awareness and financial planning to manage their sponsorship processes more effectively.

Keywords: Sponsorship, sports clubs, legal framework, financial sustainability.

GİRİŞ

Sponsorluk, tarihsel süreçte kültür ve sanat etkinliklerinin desteklenmesinden günümüz spor kulüplerine kadar uzanan bir gelişim göstermiştir. Roma döneminde “mesenlik” olarak adlandırılan sponsorluk uygulamaları, günümüzde özellikle olimpiyatlar ve profesyonel spor

kulüplerinde önemli bir finansal ve hukuki araç hâline gelmiştir. Bennet (1999), sponsorluk kavramını, işletmelerin belirlenmiş hedef kitlelere marka veya ürün tanıtımı yaparak olumlu bir imaj oluşturmasını sağlayan bir pazarlama iletişim aracı olarak tanımlamıştır. Çamcı (2009) ise sponsorluk faaliyetlerini, marka adının etkinlikler sırasında tanıtılması karşılığında, giderlerin kısmen veya tamamen sponsor tarafından karşılanması olarak açıklamıştır.

Günümüzde sponsorluk, markaların toplumsal hafızada yer edinmesinde önemli bir iletişim stratejisi olarak kullanılmaktadır. Markalar, sponsorluk faaliyetleri aracılığıyla isim, ekipman, mekân, promosyon ve finansal destek unsurlarıyla spor etkinliklerinde yer almakta ve tüketici algısında değer yaratmayı hedeflemektedir (Gül & Onay, 2021). Türkiye'de sponsorluk faaliyetlerinin kurumsal iletişim açısından incelendiği bir araştırmada, markaların spor kulüplerine yönelerek hem toplumsal imajlarını güçlendirdikleri hem de pazarlama stratejilerini spor üzerinden gerçekleştirdikleri görülmüştür.

Spor kulüplerinin mali yapısında sponsor gelirleri, yalnızca işletme maliyetlerini dengelemekle kalmamakta, aynı zamanda borç yönetimi ve uzun vadeli yatırım stratejilerinin temel bir bileşeni hâline gelmektedir.

2022 yılında yürürlüğe giren 7405 sayılı Spor Kulüpleri ve Spor Federasyonları Kanunu, kulüplerin mali disiplinine ve şeffaflığa vurgu yaparak sponsorluk geliri yönetimini hukuki bir zemine oturtmuştur (Mevzuat Bilgi Sistemi, 2022). Çolakoğlu, Özbey ve Doğan (2022) tarafından yapılan kamu politikası analizi, bu yasanın yapısal değişimlerle Türk spor yönetimini yeniden şekillendirme potansiyeli taşıdığını ortaya koymaktadır. Kanunla getirilen finansal yükümlülükler ve denetim mekanizmaları, kulüplerin sponsor gelirlerini sağlıklı bir şekilde yönetmesine ve uzun vadeli mali sürdürülebilirliğini güvence altına almasına olanak tanımaktadır.

Bu noktada, sponsorluk yasalarının spor kulüpleri açısından önemi yalnızca finansal değil, aynı zamanda kurumsal güven, marka değeri ve hukuki istikrar açısından da değerlidir. Bu çalışmada, Türkiye özelinde mevzuat, akademik literatür ve uygulama örnekleri üzerinden sponsorluk yasalarının kulüplerin sürdürülebilir gelir yapısına katkıları hukuki ve finansal boyutlarıyla analiz edilecektir.

YÖNTEM

Bu çalışmada, Türkiye'de spor kulüplerinde sponsorluk yasalarının hukuki ve finansal etkilerini incelemek amacıyla nitel araştırma yaklaşımı benimsenmiş ve doküman analizi yöntemi kullanılmıştır (Bowen, 2009). Doküman analizi, mevcut belgelerin sistematik bir şekilde incelenerek içeriklerinin anlamlı bir biçimde yorumlanmasını sağlayan bir nitel araştırma

yöntemidir. Bu yöntem, yazılı yasal düzenlemeler, akademik makaleler ve resmi raporlar gibi birincil ve ikincil kaynakların detaylı şekilde değerlendirilmesine imkân tanır.

Veri Kaynakları

Araştırmada kullanılan veri kaynakları şunlardır:

Mevzuat ve yasal düzenlemeler: Türkiye'de spor kulüplerinin sponsorluk gelirlerini ve sözleşme süreçlerini düzenleyen temel kanunlar incelenmiştir. Bunlar arasında 3289 sayılı Gençlik ve Spor Genel Müdürlüğü'nün Teşkilat ve Görevleri Hakkında Kanun, 3813 sayılı Türkiye Futbol Federasyonu Kuruluş ve Görevleri Hakkında Kanun, 193 sayılı Gelir Vergisi Kanunu, 5520 sayılı Kurumlar Vergisi Kanunu ve 7405 sayılı Spor Kulüpleri ve Spor Federasyonları Kanunu bulunmaktadır (Mevzuat Bilgi Sistemi, 2022).

Akademik literatür: Sponsorluk sözleşmeleri, finansal sürdürülebilirlik ve hukuki düzenlemelerle ilgili Türkiye ve uluslararası literatürde yayınlanmış makaleler, tezler ve kitaplar incelenmiştir (Bennet, 1999; Çamcı, 2009; Gül & Onay, 2021).

Resmî rapor ve diğer dokümanlar: Türkiye'deki spor kulüplerinin sponsorluk uygulamalarını yansıtan raporlar ve politika belgeleri değerlendirilmiştir (Çolakoğlu vd., 2022).

Veri Analizi Süreci

Doküman analizi sürecinde izlenen adımlar şunlardır:

Veri toplama: Yukarıda belirtilen yasal düzenlemeler, akademik çalışmalar ve raporlar sistematik olarak derlenmiştir.

Veri sınıflandırma: Belgeler, hukuki düzenlemeler, finansal etkiler, sponsorluk sözleşmeleri ve vergi avantajları gibi temalar altında sınıflandırılmıştır.

İçerik analizi: Her belge ve literatür parçası tematik olarak incelenmiş; sponsorluk yasalarının kulüplerin mali sürdürülebilirliği ve hukuki güvenliği üzerindeki etkileri analiz edilmiştir (Bowen, 2009; Creswell, 2013).

Sentez ve yorumlama: Elde edilen bulgular, kulüplerin sponsorluk süreçlerini hukuki ve finansal açıdan nasıl yönettiklerini ortaya koyacak biçimde sentezlenmiş ve yorumlanmıştır.

Bu yöntem, hem Türkiye'de hem de uluslararası literatürde spor kulüplerinin sponsorluk uygulamalarına dair hukuki ve finansal boyutları sistematik şekilde değerlendirme imkânı sunmaktadır. Böylece, çalışmanın bulguları, literatürdeki benzer çalışmalarla karşılaştırılabilir ve sponsorluk yasalarının kulüpler üzerindeki etkileri daha kapsamlı şekilde ortaya konabilir.

BULGULAR

Sponsorluk Yasasının Spor Kulüpleri Açısından Önemi

Sponsorluk yasaları, spor kulüplerinin finansal kaynaklarını artırmak ve sürdürülebilirliklerini sağlamak açısından büyük önem taşımaktadır. Türkiye'deki yasal düzenlemeler, sponsorluk gelirlerinin kulüpler için bir kaynak olarak kullanılmasına olanak tanırken, aynı zamanda vergi avantajları da sağlar. Türkiye'deki 3289 sayılı Gençlik ve Spor Genel Müdürlüğü'nün Teşkilat ve Görevleri Hakkında Kanun ve 3813 sayılı Türkiye Futbol Federasyonu Kuruluş ve Görevleri Hakkında Kanun, sponsorluk harcamalarının belirli bir kısmının vergi matrahından indirilmesine izin verir. Bu düzenleme, kulüplerin finansal yüklerini hafifletmeyi amaçlarken, sponsorluk faaliyetlerini teşvik etmektedir (Soyer & Can, 2010).

Ayrıca, 193 sayılı Gelir Vergisi Kanunu'nun 89. maddesi ve 5520 sayılı Kurumlar Vergisi Kanunu'nun 10/b maddesi de sponsorluk harcamalarına vergi avantajları sağlar. Bu düzenlemeler sayesinde, sponsorluk harcamaları vergi matrahından indirilebilir ve kulüplerin finansal kaynakları artırılabilir. Bu yasal düzenlemeler, kulüplerin mali sürdürülebilirliğini güçlendirirken, sporun yaygınlaşmasına ve kalitesinin artırılmasına da katkı sağlar.

Finansal Açıdan Etkileri

Sponsorluk, spor kulüpleri için finansal açıdan büyük önem taşıyan bir gelir kaynağıdır. Sponsorluk anlaşmaları, kulüplerin faaliyetlerini sürdürebilmeleri, altyapılarını geliştirebilmeleri ve uluslararası platformda tanınmalarını sağlamaları için kritik bir rol oynamaktadır (Weatherill, 2017). Bu bağlamda, sponsorluk sözleşmelerinin hukuki boyutları ve geçerliliği, kulüplerin stratejik hedeflerine ulaşmalarında etkili olabilir.

Sponsorluk anlaşmaları, kulüplerin gelir modellerini çeşitlendirmelerine olanak tanırken, aynı zamanda önemli hukuki düzenlemelere de tabidir. Spor kulüpleri ve sponsorlar arasında yapılan sözleşmelerde dikkat edilmesi gereken noktalar arasında tarafların hak ve yükümlülükleri, ödeme şartları, sürecin denetimi ve anlaşmazlık çözüm mekanizmaları yer almaktadır. Bu nedenle, sponsorluk sözleşmelerinin hukuki altyapısının doğru şekilde oluşturulması, kulüplerin finansal güvenliği için oldukça önemlidir (Weatherill, 2017).

Sponsorluk gelirleri, spor kulüplerinin ekonomik istikrarını sağlamalarında kritik bir rol oynar. Sponsorluk anlaşmaları, kulüplere şu finansal avantajları sağlar:

- **Gelir Artışı:** Sponsorluk, kulüplerin temel gelir kaynaklarından biri olup, maç gelirleri ve yayın haklarının dışında alternatif bir finansman sağlar (Bennett, 1999).
- **Vergi Avantajları:** Sponsorluk harcamalarının vergi avantajları sayesinde, kulüplerin finansal yükünü hafifletir (Çamcı, 2009).

- **Marka Değeri Artışı:** Sponsorluk anlaşmaları sayesinde kulüpler, ulusal ve uluslararası alanda daha fazla tanınır hale gelir (Gül & Onay, 2021).
- **Altyapı ve Yatırım Olanakları:** Sponsorluk gelirleri, spor tesisleri, altyapı projeleri ve sporcu gelişim programları için kullanılabilir (Foster, 2003).

Sponsorluk Sözleşmelerinin Hukuki Çerçevesi

Sponsorluk sözleşmelerinin hukuki çerçevesi, taraflar arasındaki ilişkiyi düzenleyen ve tarafların haklarını, yükümlülüklerini belirleyen önemli bir sözleşme türüdür. Sponsorluk sözleşmeleri, hem ticari ilişkileri hem de spor kulüpleri ile sponsorlar arasındaki bağları düzenleyen yasal bir çerçeveye sahiptir. Bu sözleşmeler, genel olarak tarafların birbirlerine sağladığı hizmetlerin ve faydaların kapsamını, süresini, mali yükümlülükleri ve diğer şartları belirler.

Türk hukukunda sponsorluk sözleşmeleri, Borçlar Kanunu'na (6098 sayılı Türk Borçlar Kanunu, 2011) ve Ticaret Kanunu'na (6102 sayılı Türk Ticaret Kanunu, 2011) dayalı olarak düzenlenir. Sponsorluk sözleşmesi, esasen bir "hizmet sözleşmesi" olarak kabul edilebilir ve taraflar arasında belirli bir hizmetin sunulması ve karşılığında maddi bir çıkar sağlanması söz konusu olur (Kayapınar, 2021).

Sponsorluk sözleşmeleri, taraflar arasında yapılan müzakereler sonucu belirli bir protokole dayanarak imzalanır ve tarafların birbirlerine karşı sorumluluklarını açıkça belirler. Sözleşmede, sponsorun sağladığı mali destek, sponsorluk karşılığında kulüp tarafından yapılacak reklam ve tanıtım faaliyetleri, sponsorluk süresi ve diğer belirleyici unsurlar yer alır (Soyer & Can, 2010). Bu tür sözleşmeler, ayrıca, fikri mülkiyet haklarının kullanımı, reklam hakları ve marka ile ilgili unsurları da kapsar.

Sponsorluk sözleşmesinin hukuki çerçevesinde dikkat edilmesi gereken bir diğer önemli unsur da sözleşmeye taraf olanların haklarının korunmasıdır. Sözleşmelerin düzgün bir şekilde hazırlanması ve yasal zemine oturtulması hem kulüplerin hem de sponsorların çıkarlarını güvence altına alır. Bu noktada, sözleşme hükümleri ne kadar açık ve detaylı olursa, taraflar arasındaki anlaşmazlıkların çözülmesi de o kadar kolay olur (Canöz vd., 2021).

Vergilendirme ve Sponsorluk

Sponsorluk gelirleri, vergi mevzuatına tabi olup, kulüplerin finansal yönetimini etkileyen önemli bir unsurdur. Spor kulüpleri, sponsorluk gelirlerinden elde ettikleri gelirleri vergilendirirken, ilgili vergi düzenlemeleri doğrultusunda hesaplama yapmalıdırlar. Bu süreçte, kulüplerin vergi yükümlülüklerini doğru şekilde yerine getirebilmeleri için uzman vergi danışmanlarından yardım alması gereklidir (Parrish, 2022). Sponsorluk gelirlerinin doğru bir

şekilde beyan edilmesi ve vergi düzenlemelerine uygun hareket edilmesi, kulüplerin yasal sorunlarla karşılaşmaması açısından kritik bir öneme sahiptir.

SONUÇ VE ÖNERİLER

Bu çalışma, Türkiye'de spor kulüplerinde sponsorluk yasalarının hukuki ve finansal etkilerini incelemiştir. Bulgular, sponsorluk yasalarının kulüplerin mali sürdürülebilirliği açısından kritik bir rol oynadığını göstermektedir. Sponsorluk gelirleri, kulüplerin faaliyetlerini sürdürmelerine, altyapı yatırımlarını gerçekleştirmelerine ve marka değerlerini artırmalarına olanak tanırken, yasal çerçevenin sağlamlığı, bu sürecin güvenli ve düzenli biçimde yürütülmesini sağlamaktadır.

Araştırma, hukuki boyut açısından sponsorluk sözleşmelerinin doğru şekilde hazırlanmasının, taraflar arasındaki hak ve yükümlülüklerin net olarak belirlenmesinin ve vergi avantajlarının etkin kullanılmasının kulüpler için büyük önem taşıdığını ortaya koymaktadır. Mevzuata uygun yönetilen sponsorluk anlaşmaları, olası hukuki anlaşmazlıkların önlenmesine yardımcı olurken, kulüplerin finansal risklerini de azaltmaktadır.

Finansal açıdan incelendiğinde, sponsorluk gelirlerinin kulüplerin toplam gelirleri içerisindeki payının kayda değer olduğu ve bu gelirlerin altyapı, sporcu gelişimi ve marka bilinirliği gibi alanlarda etkin şekilde kullanıldığı görülmektedir. Ayrıca, sponsorluk anlaşmalarının ulusal ve uluslararası görünürlük üzerinde olumlu bir etkisi olduğu ve kulüplerin tanınırlığını artırdığı saptanmıştır.

Sonuç olarak, spor kulüplerinin sponsorluk süreçlerini daha etkin yönetebilmeleri için öneriler şunlardır:

1. **Hukuki Bilinçlenme:** Kulüpler, sponsorluk sözleşmelerinin hukuki boyutlarını iyi anlamalı ve profesyonel hukuki danışmanlık almalıdır.
2. **Finansal Planlama:** Sponsorluk gelirleri, kulüplerin mali hedeflerine uygun şekilde planlanmalı ve önceliklendirilmelidir.
3. **Vergi Teşviklerinden Yararlanma:** Mevcut yasal düzenlemeler çerçevesinde sponsorluk harcamalarının vergi avantajlarından maksimum düzeyde faydalanılmalıdır.
4. **Uluslararası Sponsorluk Stratejileri:** Kulüpler, yurt dışı sponsorlarla anlaşmalar yaparak gelir kaynaklarını çeşitlendirmeli ve marka değerlerini küresel ölçekte artırmalıdır.

Bu çalışma, sponsorluk yasalarının spor kulüplerinin hukuki ve finansal sürdürülebilirliği üzerindeki etkilerini ortaya koyarak, kulüplerin sponsorluk süreçlerini daha bilinçli ve stratejik bir şekilde yönetmelerine rehberlik etmeyi amaçlamaktadır. Gelecek araştırmalarda, farklı spor

branşlarında sponsorluk uygulamalarının karşılaştırılması ve uzun dönemli finansal etkilerinin analiz edilmesi önerilmektedir.

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TÜRKİYE'DE YAŞLI DOSTU KENTLER KONUSUNDA YAZILMIŞ LİSANSÜSTÜ TEZLERİN VE TR DİZİN MAKALELERİN İNCELENMESİ

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ÖZET

Bu çalışma, Türkiye'de "yaşlı dostu kent" konusu üzerine hazırlanmış lisansüstü tezler ile TR Dizin kapsamında yayımlanan akademik makaleleri incelemeyi amaçlamaktadır. Araştırma kapsamında, Yükseköğretim Kurulu Ulusal Tez Merkezi'nde yer alan lisansüstü tezler ve TR Dizin'de indekslenen makaleler doküman analizi yöntemiyle ele alınmıştır. İncelenen çalışmalar; türlerine, yayımlandıkları yıllara, üniversitelere, enstitülere, bilim dallarına ve kullanılan araştırma yöntemlerine göre sınıflandırılmıştır. Elde edilen veriler betimsel istatistikler kullanılarak analiz edilmiştir. Araştırma bulguları, Türkiye'de yaşlı dostu kent temalı akademik çalışmaların 2010 yılından itibaren yapılmaya başlandığını, ancak çalışmaların büyük ölçüde 2016–2025 yılları arasında yoğunlaştığını ve toplamda sınırlı sayıda araştırmanın gerçekleştirildiğini göstermektedir. İncelenen çalışmaların çoğunlukla sosyal olarak aktif yaşlı bireyler üzerine odaklandığı, buna karşın yoksul, yalnız yaşayan, eve bağımlı ya da bakım gereksinimi yüksek yaşlı grupların deneyimlerinin yeterince ele alınmadığı belirlenmiştir. Ayrıca yaşlı kadınlar, engelli bireye sahip yaşlılar ve düşük sosyoekonomik düzeydeki yaşlılar gibi dezavantajlı gruplara yönelik çalışmaların sınırlı olduğu dikkat çekmektedir. Bunun yanı sıra yaşlı dostu kent politikalarının genellikle sosyal katılım, ücretsiz ulaşım ve rekreasyonel faaliyetler gibi üst düzey hedeflere odaklandığı; kaldırım düzenlemeleri, erişilebilirlik ve kentsel güvenlik gibi temel fiziksel altyapı unsurlarının ise yeterince ele alınmadığı görülmektedir. Sonuç olarak, yaşlı dostu kent yaklaşımının daha kapsayıcı bir biçimde ele alınabilmesi için, farklı sosyoekonomik ve yaşam koşullarına sahip yaşlı grupları merkeze alan araştırmaların artırılmasının ve bu doğrultuda politika ve uygulamaların geliştirilmesinin gerekli olduğu değerlendirilmektedir.

Anahtar Kelimeler: Yaşlı dostu kent, yaşlanma, doküman analizi, lisansüstü tezler

AN EXAMINATION OF GRADUATE THESES AND TR DİZİN ARTICLES WRITTEN ON AGED-FRIENDLY CITIES IN TURKEY

ABSTRACT

This study aims to examine postgraduate theses and academic articles published in the TR Dizin database on the subject of "age-friendly cities" in Turkey. Within the scope of the

research, postgraduate theses in the Higher Education Council National Thesis Center and articles indexed in the TR Dizin database were analyzed using document analysis. The studies examined were classified according to their types, publication years, universities, institutes, disciplines, and research methods used. The data obtained were analyzed using descriptive statistics. The research findings show that academic studies on the theme of age friendly cities in Turkey began in 2010, but the studies were largely concentrated between 2016 and 2025, with a limited number of studies conducted in total. It was determined that most of the studies examined focused on socially active elderly individuals, while the experiences of poor, lonely, homebound, or elderly groups with high care needs were not adequately addressed. It is also noteworthy that studies focusing on disadvantaged groups such as elderly women, elderly individuals with disabilities, and those with low socioeconomic status are limited. Furthermore, it is observed that age-friendly city policies generally focus on high-level goals such as social participation, free transportation, and recreational activities; while fundamental physical infrastructure elements such as sidewalk improvements, accessibility, and urban safety are not adequately addressed. In conclusion, it is considered necessary to increase research focusing on elderly groups with diverse socioeconomic and living conditions and to develop policies and practices accordingly, in order to address the age-friendly city approach in a more inclusive manner.

Keywords: Age-friendly city, aging, document analysis, postgraduate theses.

1. GİRİŞ

"Yaşlı dostu kent" kavramı, Birleşmiş Milletler ve Dünya Sağlık Örgütü'nün (DSÖ) öncülüğünde, yaşlanmanın yalnızca bireysel değil aynı zamanda mekânsal ve toplumsal bir süreç olduğu anlayışıyla literatüre girmiştir. DSÖ, aktif yaşlanma ve yerinde yaşlanma yaklaşımlarını temel alarak yaşlı bireylerin sağlık, katılım ve güvenlik olanaklarını destekleyen; kentsel yapı ve hizmetleri erişilebilir kılmayı amaçlayan yaşlı dostu kent ilkelerini tanımlamıştır (Becerikli ve Bayram, 2024).

Dünya genelinde artan yaşam süresi ve hızlı kentleşme, yaşlı nüfusun kentlerde yoğunlaşmasına yol açmaktadır. DSÖ verilerine göre dünya nüfusunun %55'inden fazlası kentlerde yaşamakta olup bu oranın 2050 yılında %68'e ulaşması beklenmektedir (World Health Organization [WHO], 2024). Bu demografik dönüşüm, kentsel mekânların yaşlanma deneyimi üzerindeki belirleyici rolünü daha görünür hâle getirmektedir. Yaşlanma, yalnızca biyolojik bir süreç değil; bireylerin çevreleriyle kurdukları ilişkiler, mekânsal düzenlemeler ve sosyal katılım olanaklarıyla yakından ilişkili çok boyutlu bir olgudur (Caner vd., 2013).

Türkiye'de de düşen doğurganlık hızları, artan yaşam süresi ve kentleşme süreci nüfusun hızla yaşlanmasına neden olmaktadır. TÜİK verilerine göre yaşlı nüfus oranı 2024 yılında %10,6'ya ulaşmış; bu oranın 2050 yılında %19,5'e çıkması öngörülmektedir (Türkiye İstatistik Kurumu [TÜİK], 2025). Bu durum, yaşlı dostu kent yaklaşımlarının sosyal politika ve kent planlaması açısından önemini artırmaktadır. DSÖ'nün "Yaşlı Dostu Kentler ve Topluluklar" girişimi kapsamında tanımlanan açık alanlar ve binalar, ulaşım, konut, toplumsal katılım, iletişim ve bilgiye erişim, saygı ve kapsayıcılık, toplum desteği ve sağlık hizmetleri gibi bileşenler, yaşlı bireylerin kent yaşamına eşit ve bağımsız katılımını desteklemeyi amaçlamaktadır.

Yaşlı dostu kent yaklaşımı, yalnızca fiziksel çevre düzenlemeleriyle sınırlı olmayıp sosyal katılımı, toplumsal saygıyı ve karar alma süreçlerine katılımı da içeren bütüncül bir perspektife sahiptir. Ancak literatürde, özellikle dezavantajlı yaşlı grupların deneyimlerini merkeze alan çalışmaların sınırlı olduğu görülmektedir.

Bu çalışma, Türkiye'de yaşlı dostu kent konusuna ilişkin akademik üretimi ortaya koymak amacıyla, Yükseköğretim Kurulu Ulusal Tez Merkezi'nde yer alan lisansüstü tezler ile TR Dizin kapsamında yayımlanan akademik makaleleri doküman analizi yöntemiyle incelemeyi amaçlamaktadır. Çalışma, Türkiye'deki akademik eğilimleri, yoğunlaşma alanlarını ve araştırma boşluklarını belirleyerek literatüre katkı sunmayı hedeflemektedir.

2. YÖNTEM

Bu araştırmada, Yükseköğretim Kurulu Ulusal Tez Merkezi veri tabanında yer alan lisansüstü tezler ile TR Dizin kapsamında yayımlanan akademik makaleler incelenmiştir. Veriler, "yaşlı dostu kent/şehir/il", "yaşlılık" ve "aktif yaşlanma" anahtar kavramları kullanılarak yapılan taramalar sonucunda elde edilmiştir. Belirlenen ölçütler doğrultusunda toplam 19 çalışmaya ulaşılmıştır.

Araştırma, 2010–2025 yılları arasında yayımlanmış ve çevrim içi ortamda tam metnine erişilebilen çalışmalar ile sınırlıdır. İncelenen tez ve makaleler doküman analizi yöntemiyle ele alınmış; elde edilen veriler betimsel istatistikler kullanılarak analiz edilmiştir. Verilerin analizinde SPSS ve Excel programlarından yararlanılmış; bulgular tablo ve grafikler aracılığıyla sunulmuştur.

Araştırmaya dâhil edilen çalışmalar yedi ana değişken çerçevesinde sınıflandırılmıştır. Bu değişkenler; çalışmaların düzeyi (yüksek lisans, doktora, tıpta uzmanlık ve makale), ele aldıkları konu alanları, hazırlandıkları bölümler, üniversiteler, enstitüler, yayımlandıkları yıllar ve genel dağılımlarıdır.

Araştırmaya Dâhil Edilme Kriterleri

- Türkiye'de gerçekleştirilmiş olması
- Araştırma makalesi veya lisansüstü tez niteliğinde olması
- Nitel ve/veya nicel yöntemlerle yürütülmüş olması
- Çevrim içi ortamda tam metnine erişilebilir olması

Araştırmaya Dâhil Edilmeme Kriterleri

- Türkiye dışında yayımlanmış olması
- Derleme çalışması niteliğinde olması
- Tam metnine çevrim içi ortamda erişilememesi
- Kongre veya sempozyum bildirisi olması
- Proje, rapor veya yalnızca basılı kitap formatında yayımlanmış olması

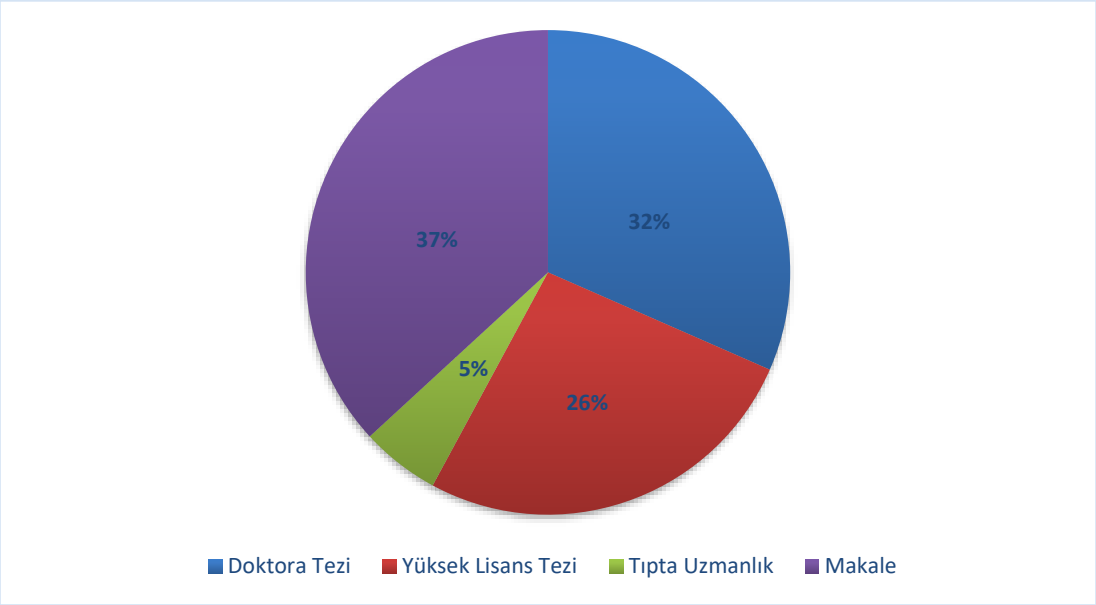
3. ARAŞTIRMA VE BULGULAR

Bu bölümde, Yükseköğretim Kurulu Ulusal Tez Merkezi Veri Tabanı ve TR Dizin üzerinden "yaşlı dostu kent/şehir/il" ve "yaşlanma" anahtar kavramları kullanılarak yapılan tarama sonucunda ulaşılan toplam 19 lisansüstü tez ve akademik makaleye ilişkin bulgular sunulmaktadır. Çalışmalar; türlerine, yıllara göre dağılımlarına, disiplinlere ve üniversitelere göre incelenmiştir.

Tablo 1. Çalışmaların Türlerine Göre Dağılımı

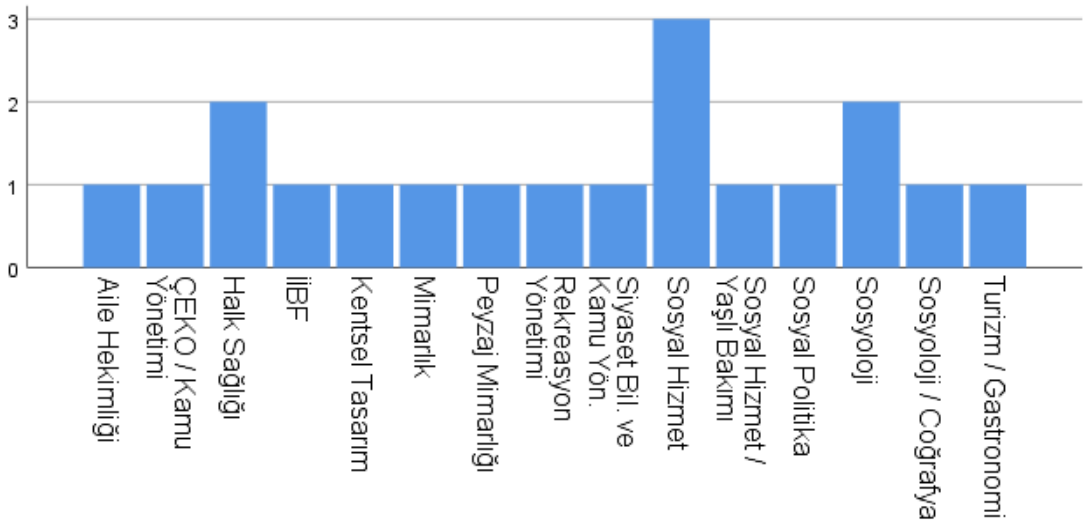
Çalışma Türü	Sayı
Yüksek Lisans Tezi	5
Doktora Tezi	6
Tıpta Uzmanlık Tezi	1
Makale	7
Toplam	19

Araştırma kapsamında incelenen çalışmaların türlerine göre dağılımı Tablo 1'de sunulmuştur. Buna göre, 19 çalışmanın 5'i yüksek lisans tezi, 6'sı doktora tezi, 1'i tıpta uzmanlık tezi ve 7'si akademik makale niteliğindedir. Bu bulgu, yaşlı dostu kent konusunun Türkiye'de ağırlıklı olarak lisansüstü düzeyde ele alındığını, makale sayısının ise kısıtlı olmakla birlikte son yıllarda azda olsa artış kazandığı ortaya koymaktadır. Çalışmaların önemli bir kısmı lisansüstü tezlerden oluşmaktadır. Bu durum, yaşlı dostu kent konusunun Türkiye'de ağırlıklı olarak akademik tez çalışmaları kapsamında ele alındığını göstermektedir.



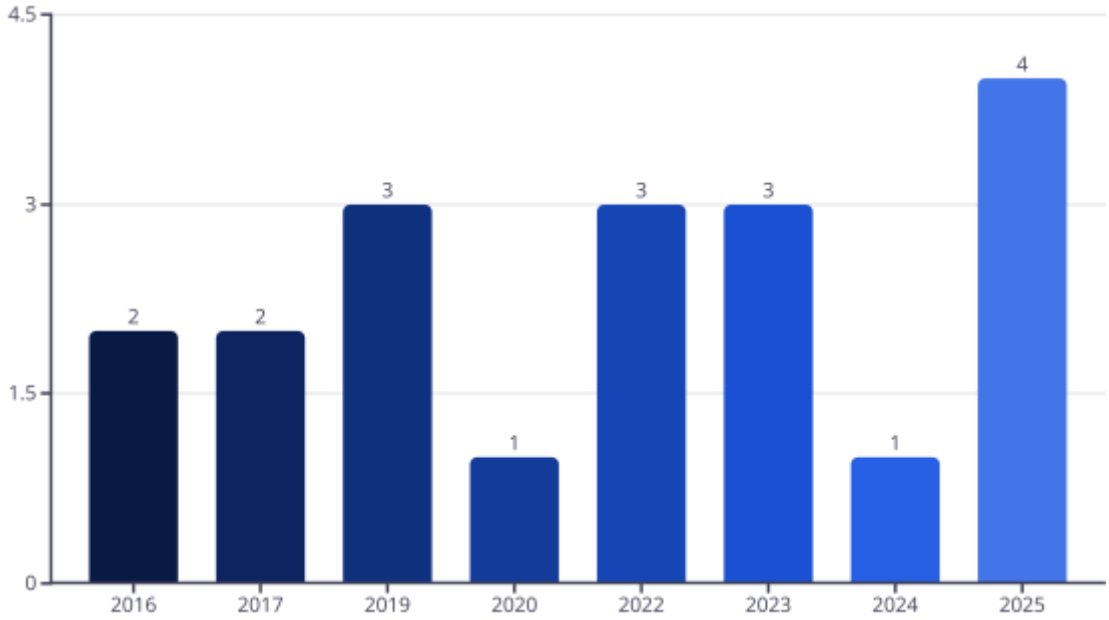
Şekil 1. Çalışmaların Türlerine Göre Yüzdelik Dağılımı

Çalışmaların türlerine göre yüzdelik dağılımı incelendiğinde, makalelerin %37 ile en yüksek oranı oluşturduğu; bunu %32 ile doktora tezleri, %26 ile yüksek lisans tezleri ve %5 ile tıpta uzmanlık tezlerinin izlediği görülmektedir (Şekil 1).



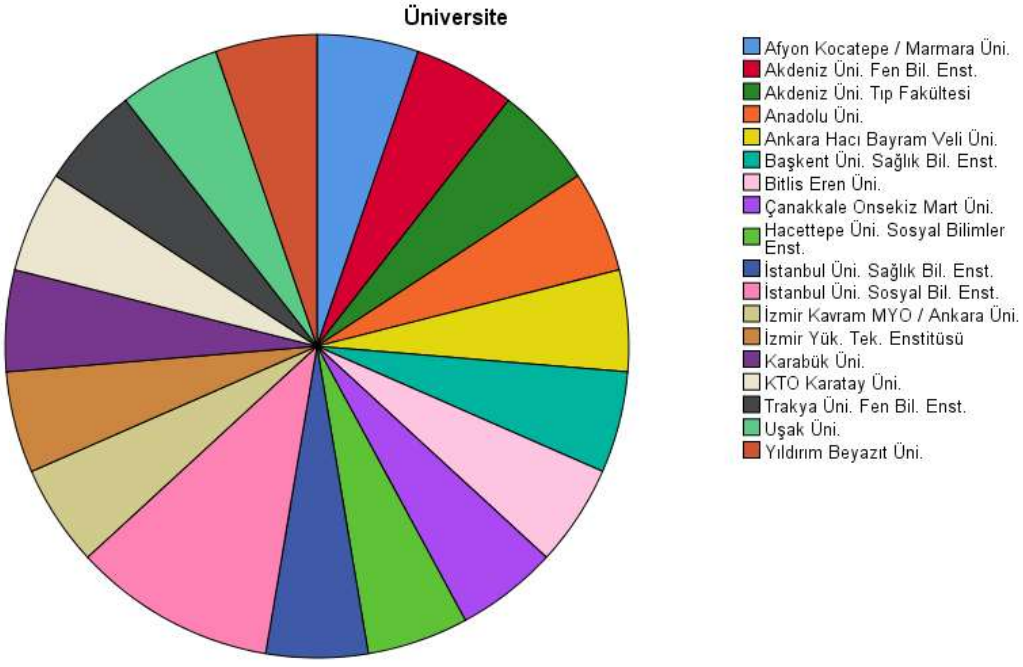
Şekil 2. Çalışmaların Bölümlere Göre Dağılımı

Çalışmaların bölümlere göre dağılımı incelendiğinde (Şekil 2), sosyal hizmet, halk sağlığı ve sosyoloji bölümlerinin öne çıktığı; mimarlık, kentsel tasarım, peyzaj mimarlığı, kamu yönetimi ve turizm gibi diğer disiplinlerde ise sınırlı sayıda çalışma bulunduğu görülmektedir.



Şekil 3. Çalışmaların Yıllara Göre Dağılımı

Çalışmaların yıllara göre dağılımı incelendiğinde, yaşlı dostu kent konulu akademik üretimin 2016 yılından itibaren başladığı ve 2022–2025 döneminde görece bir artış gösterdiği görülmektedir (Şekil 3).



Şekil 4. Çalışmaların Üniversitelere Göre Dağılımı

Üniversitelere göre dağılım incelendiğinde, çalışmaların belirli üniversitelerde yoğunlaştığı ve özellikle İstanbul Üniversitesi başta olmak üzere büyük ve köklü üniversitelerde daha fazla sayıda çalışma yapıldığı görülmektedir (Şekil 4).

Genel olarak bulgular, Türkiye'de yaşlı dostu kent konusundaki akademik çalışmaların sayısal olarak sınırlı, zamansal olarak geç başlamış ve belirli disiplinler ile üniversitelerde yoğunlaşmış

olduğunu ortaya koymaktadır. Ayrıca çalışmaların büyük bölümünün yaşlı dostu kent yaklaşımını daha çok kavramsal, mekânsal veya politika düzeyinde ele aldığı; kırılgan yaşlı gruplar, yerel uygulamaların etkililiği ve saha temelli değerlendirmelerin ise sınırlı kaldığı görülmektedir. Bu bulgular, yaşlı dostu kent yaklaşımının Türkiye'de henüz bütüncül ve kapsayıcı bir akademik çerçeveye kavuşamadığını göstermekte ve tartışma bölümünde ele alınacak olan yapısal eksikliklere işaret etmektedir.

3.TARTIŞMA VE SONUÇ

Dünya genelinde ve Türkiye'de kentsel nüfusun hızla artması ve bu nüfusun giderek yaşlanması, kentlerin 65 yaş üstü bireylerin beklenti ve ihtiyaçları doğrultusunda yeniden planlanmasını zorunlu kılmaktadır (Kesgin, 2023). Küresel ölçekte 65 yaş ve üzeri bireylerin önemli bir bölümünün kentlerde yaşamasına karşın, mevcut kentsel yapıların bu nüfusa yeterince uyumlu olmadığı; bu durumun yaşlıların yaşam kalitesini olumsuz etkilediği görülmektedir. Türkiye'de ise Türkiye İstatistik Kurumu ([TÜİK], 2025) verilerine göre 65 yaş ve üzeri nüfusun oranı 2024 yılı itibarıyla %10,6'ya ulaşmış olup yaşlı nüfusun önümüzdeki yıllarda artmaya devam edeceği öngörülmektedir. Buna rağmen kentsel planlama ve uygulamalarda yaşlılara yönelik düzenlemelerin sınırlı kaldığı dikkat çekmektedir.

Dünya Sağlık Örgütü tarafından geliştirilen "Yaşlı Dostu Kent" yaklaşımı, yaşlı bireylerin fiziksel, sosyal ve psikolojik gereksinimlerini bütüncül biçimde ele almayı amaçlayan önemli bir çerçeve sunmaktadır. Türkiye'de yaşlı nüfus oranının artması, bu yaklaşımın kentsel planlama, sosyal politika ve yerel yönetim uygulamaları açısından taşıdığı önemi daha da artırmaktadır. Yaşlı dostu kentler; barınma, ulaşım, sosyal katılım, sağlık hizmetleri ve yönetişim gibi çok boyutlu alanları kapsayan bir rehber niteliği taşımaktadır.

Bu çalışma kapsamında incelenen tez ve makaleler, Türkiye'de yaşlı dostu kentler konusundaki akademik üretimin niceliksel olarak sınırlı olduğunu ve belirli disiplinlerde yoğunlaştığını göstermektedir. Demografik dönüşümün hızına karşın, gerek akademik çalışmaların gerekse sahadaki uygulamaların bu sürece yeterince eşlik edemediği görülmektedir. Literatürdeki bulgular, yaşlı dostu kent yaklaşımının yalnızca fiziksel erişilebilirlik düzenlemeleriyle sınırlanamayacağını; sosyal katılım, barınma, sağlık ve yönetişim boyutlarını içeren bütüncül bir anlayış gerektirdiğini ortaya koymaktadır.

Bulgular daha ayrıntılı incelendiğinde, yaşlı dostu kent konusundaki akademik üretimin tür, disiplin, yıl ve üniversite dağılımları açısından dengesiz bir görünüm sergilediği anlaşılmaktadır. Çalışmaların önemli bir bölümünün makale ve doktora tezlerinden oluşması, konunun akademik olarak henüz sınırlı bir literatüre sahip olduğunu; buna karşın doktora

düzeyinde derinlemesine ele alınmaya başlandığını düşündürmektedir. Disiplinler arası potansiyele rağmen çalışmaların ağırlıklı olarak sosyal hizmet, halk sağlığı ve sosyoloji alanlarında yoğunlaşması, mimarlık ve kentsel tasarım gibi alanlarda görece sınırlı kalması dikkat çekicidir. Ayrıca akademik üretimin belirli yıllarda ve köklü üniversitelerde yoğunlaşması, yaşlı dostu kent yaklaşımına yönelik akademik ilginin mekânsal ve kurumsal olarak eşitsiz dağıldığını göstermektedir.

Yerel yönetimlerin yaşlılara yönelik farkındalığının arttığı gözlenmekle birlikte, uygulamaların çoğu zaman parçacıl kaldığı ve stratejik bir bütünlük içinde sürdürülemediği anlaşılmaktadır. Dünya Sağlık Örgütü'nün yaşlı dostu kentler ağına katılan belediyelerde olumlu adımlar atılsa da kurumlar arası koordinasyon eksikliği ve uygulamaların sürekliliği önemli bir sorun alanı olarak öne çıkmaktadır. Bu durum, yaşlılara yönelik hizmetlerin yardım temelli yaklaşımlardan uzaklaşıp hak temelli ve aktif yaşlanmayı destekleyen bir yapıya kavuşturulması gerekliliğini ortaya koymaktadır.

Sonuç olarak, Türkiye'de yaşlı dostu kentleşme sürecinin henüz gelişim aşamasında olduğu söylenebilir. Fiziksel düzenlemeler önemli olmakla birlikte, sosyal destek mekanizmaları ve katılımcı yönetişim anlayışıyla bütünleşmediği sürece yeterli olmayacaktır. Yaşlı nüfusun homojen bir grup olmadığı; cinsiyet, gelir düzeyi ve bölgesel farklılıklar gibi değişkenlerin yaşlılık deneyimini doğrudan etkilediği göz önünde bulundurulmalıdır.

Bu bağlamda, gelecekte geliştirilecek politikaların; yaşlıların yerinde ve aktif yaşlanmasını destekleyen, kuşaklararası etkileşimi güçlendiren ve yerel ihtiyaçlara duyarlı bir perspektifle ele alınması önerilmektedir. Akademik çalışmaların artırılması ve yerel uygulamalarla daha güçlü biçimde ilişkilendirilmesi, Türkiye'de sürdürülebilir ve kapsayıcı yaşlı dostu kentlerin geliştirilmesine önemli katkı sağlayacaktır.

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TÜRKİYE'DE ENGELLİLERDE SOSYAL DESTEK KONUSUNDA YAZILMIŞ LİSANSÜSTÜ TEZLERİN İNCELENMESİ

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ÖZET

Engelli bireylerin toplumla bütünleşme süreçlerinde karşılaştıkları güçlüklerin aşılmasında sosyal destek önemli bir koruyucu faktör olarak öne çıkmaktadır. Sosyal destek; bireylerin kaygı ve stres düzeylerini azaltarak baş etme becerilerini güçlendirmekte, toplumsal rollerini yerine getirmelerini ve yaşam değişikliklerine uyumlarını kolaylaştırmaktadır. Bu bağlamda, engelli bireylerin toplumsal yaşama katılımında sosyal desteğin nasıl ele alındığını ve bu desteğin hangi boyutlarda incelendiğini ortaya koymak önem kazanmaktadır. Bu çalışmanın amacı, Türkiye'de 2010–2025 yılları arasında YÖK Ulusal Tez Merkezi'nde yayımlanan ve "sosyal destek" ile "engellilik" anahtar kelimeleriyle ilişkili lisansüstü tezleri sistematik biçimde inceleyerek alanın güncel görünümünü ortaya koymaktır. Bu kapsamda 32 lisansüstü tez doküman analizi yöntemiyle incelenmiş; araştırma yöntemleri, örneklem grupları, engel türleri, veri toplama araçları ve tematik odaklar açısından değerlendirilmiştir. Bulgular, çalışmaların ağırlıklı olarak nicel yöntemleri tercih ettiğini; nitel desenlerin sınırlı kaldığını ve karma yöntemin kullanılmadığını göstermektedir. Engel türleri açısından zihinsel engellilik ve karma/genel engellilik kategorilerinin ağırlık kazandığı görülmektedir. Sosyal destek ise en sık aileden algılanan destek biçiminde ele alınmış; kurumsal destek boyutunun görece daha az çalışıldığı belirlenmiştir. Sonuç olarak, sosyal destek ve engellilik alanındaki lisansüstü tezlerin önemli bir akademik birikim sunduğu, ancak kurum temelli destek sistemleri, sosyal hizmet müdahale modelleri ve farklı engel gruplarının temsili açısından geliştirilmesi gerektiği değerlendirilmektedir. Bu doğrultuda, nitel ve karma yöntem araştırmalarının artırılması ile farklı engel gruplarının temsil edildiği çalışmaların yaygınlaştırılması önerilmektedir.

Anahtar Kelimeler: Sosyal destek, engellilik, lisansüstü tezler, doküman analizi, Türkiye.

AN ANALYSIS OF POSTGRADUATE THESES WRITTEN ON SOCIAL SUPPORT FOR PEOPLE WITH DISABILITIES IN TURKIYE

ABSTRACT

Social support emerges as an important protective factor in overcoming the difficulties encountered by individuals with disabilities in their integration into society. Social support strengthens coping skills by reducing individuals' anxiety and stress levels, facilitating their

fulfilment of social roles and their adaptation to life changes. In this context, it is important to reveal how social support is addressed in the participation of disabled individuals in social life and in which dimensions this support is examined. The aim of this study is to reveal the current state of the field by systematically reviewing postgraduate theses published in the YÖK National Thesis Centre in Türkiye between 2010 and 2025 that are related to the keywords 'social support' and 'disability'. Within this scope, 32 postgraduate theses were examined using document analysis methods; they were evaluated in terms of research methods, sample groups, types of disability, data collection tools, and thematic focuses. The findings show that the studies predominantly favoured quantitative methods; qualitative designs were limited and mixed methods were not used. In terms of disability types, mental disability and mixed/general disability categories were predominant. Social support was most frequently addressed in the form of perceived support from the family; it was determined that the institutional support dimension was relatively less studied. In conclusion, postgraduate theses in the field of social support and disability offer significant academic accumulation, but it is assessed that they need to be developed in terms of institution-based support systems, social service intervention models, and the representation of different disability groups. In this regard, it is recommended that qualitative and mixed-method research be increased and that studies representing different disability groups be disseminated.

Keywords: Social support, disability, postgraduate theses, document analysis, Türkiye.

1. GİRİŞ

Birleşmiş Milletler Engelli Hakları Sözleşmesi'nde (United Nations, 2006), engelli kavramı; diğer bireylerle eşit koşullar altında topluma tam ve etkin katılımın önünde engel oluşturan uzun süreli fiziksel, zihinsel, düşünsel ya da algısal bozuklukları bulunan bireyleri kapsayacak şekilde tanımlanmaktadır. Dünya Sağlık Örgütü'nün Dünya Engellilik Raporu'nda (WHO, 2011) ise engellilik, bireylerin sağlık durumları ile çevresel ve toplumsal faktörler arasındaki olumsuz etkileşim sonucu ortaya çıkan bir durum olarak tanımlanmaktadır. Türkiye'de Ulusal Engelli Veri Sisteminde kayıtlı engelli sayısı Aralık 2023 itibariyle 2.511.950'dir (Engelli ve Yaşlı Hizmetleri Genel Müdürlüğü [EYHGM], 2023).

Özel gereksinimli bir çocuğa sahip olmak, aileler için kaygı yaratmakla birlikte çocuğun bakım ve eğitimine ilişkin çok yönlü gereksinimleri karşılamada zorlanmaya neden olabilmektedir (Ersoy ve Çürük, 2009). Bu süreçte aile içi ve çevreden alınan sosyal desteğin önemi literatürde vurgulanmaktadır. Sosyal destek, bireyin iyilik halini güçlendirmenin yanı sıra stresli durumlarla başa çıkma sürecini kolaylaştırmaktadır (Lehman ve Irvin, 1996). Engelli çocuğa

sahip ailelerde sosyal destek; kabullenme, çözüm yolları arama ve günlük yaşama uyum sağlama açısından işlevseldir.

Bu çalışmada, Türkiye'de engellilerde sosyal destek konusunda yazılmış lisansüstü tezlerin sistematik biçimde incelenerek alanın güncel görünümünün ortaya konması amaçlanmaktadır. Bu kapsamda aşağıdaki araştırma sorularına cevap aranmaktadır:

1. Türkiye'de engellilerde sosyal destek konusunda yazılmış lisansüstü tezlerin araştırma yöntemine göre dağılımı nasıldır?
2. Türkiye'de engellilerde sosyal destek konusunda yazılmış lisansüstü tezlerin örnekleme göre dağılımı nasıldır?
3. Türkiye'de engellilerde sosyal destek konusunda yazılmış lisansüstü tezlerin engellilik türlerine göre dağılımı nasıldır?
4. Türkiye'de engellilerde sosyal destek konusunda yazılmış lisansüstü tezlerin veri toplama aracına göre dağılımı nasıldır?
5. Türkiye'de engellilerde sosyal destek konusunda yazılmış lisansüstü tezlerin temalarına göre dağılımı nasıldır?

2. YÖNTEM

2.1. Araştırma Deseni

Bu çalışma, Türkiye'de engellilik ve sosyal destek konusunda yazılmış lisansüstü tezlerin sistematik analizi amacıyla doküman incelemesi yöntemiyle gerçekleştirilmiştir. Doküman analizi, araştırılan olgu veya olgulara dair yazılı materyallerin analizidir (Yıldırım ve Şimşek, 2013).

2.2. Veri Kaynağı ve Örneklem

Çalışma verileri, Yüksek Öğretim Kurumu Ulusal Tez Merkezi'nden "sosyal destek" ve "engellilik" anahtar kelimeleri kullanılarak taranmıştır. Araştırmaya 2010-2025 yılları arasında Türkçe dilinde yayınlanmış, erişime açık 32 lisansüstü tez dahil edilmiştir.

2.3. Dahil Etme Kriterleri

- YÖK Ulusal Tez Merkezi'nde yayınlanmış olması
- 2010-2025 yılları arasında yayınlanmış olması
- Türkçe dilinde yazılmış olması
- Engellilik ve sosyal destek konularını birlikte ele alması
- Erişime açık tam metin olması

2.4. Veri Analizi

İncelenen tezler; araştırma yöntemleri, örneklem grupları, engel türleri, kullanılan veri toplama araçları ve tematik odaklar açısından kategorize edilmiş ve betimsel analiz yöntemiyle sunulmuştur.

3. BULGULAR

3.1. Tezlerin Engellilik Türlerine Göre Dağılımı

Tablo 1. Tezlerin Engellilik Türlerine Göre Dağılımı

Engellilik Türü	**Tez Sayısı**
Zihinsel Engellilik	11
Karma/Genel Engellilik	12
İşitme Engeli	3
Fiziksel Engellilik	2
Ortopedik Engellilik	2
Görme Engeli	2
TOPLAM	**32**

İncelenen tezlerin %37.5'i (n=12) karma/genel engellilik, %34.4'ü (n=11) zihinsel engellilik kategorisinde yer almaktadır (Tablo 1). Zihinsel engellilik kategorisindeki yoğunluk, bu ailelerin sosyal destek ihtiyacının daha fazla olduğunu gösteren literatür bulgularıyla uyumludur (Kay, 2002; Toprak, 2018).

3.2. Tezlerin Örneklem Gruplarına Göre Dağılımı

Tablo 2. Tezlerin Örneklem Gruplarına Göre Dağılımı

Örneklem Grubu	**Tez Sayısı**
Anne ve Baba (Birlikte)	12
Sadece Anne	10
Sadece Baba	2
Bakım Elemanları/Öğretmenler	3
Engelli Birey (Yetişkin)	5
TOPLAM	**32**

Tablo 2'de görüldüğü gibi tezlerin %37.5'inde (n=12) anne ve baba birlikte örnekleme dahil edilmiştir. Bu durum, sosyal yaşamdaki değişimler ve babaların bakıma artan katılımıyla bakım

sorumluluğunun yalnızca annelere atfedilmekten çıkmasının bir yansıması olarak değerlendirilebilir (Aşkın Ceran vd., 2021).

3.3. Tezlerin Araştırma Yöntemine Göre Dağılımı

Tablo 3. Tezlerin Araştırma Yöntemine Göre Dağılımı

Araştırma Yöntemi	**Tez Sayısı**
Nicel Araştırma	30
Nitel Araştırma	2
Karma Yöntem	0
TOPLAM	**32**

Tezlerin %93.8'i (n=30) nicel araştırma yöntemleri kullanılarak gerçekleştirilmiştir. Nitel araştırmaların sınırlı sayıda kalması, alandaki derinlemesine analiz ihtiyacının henüz yeterince karşılanamadığını göstermektedir (Tablo 3).

Tablo 4. Tezlerde Kullanılan Veri Toplama Araçları

Ölçek İsmi	**Kullanım Sayısı**
Çok Boyutlu Algılanan Sosyal Destek Ölçeği (ÇBASDÖ)	23
Maslach Tükenmişlik Ölçeği	4
Yenilenmiş Anne-Baba Sosyal Destek Ölçeği (YASDÖ)	4
Yaşam Doyum Ölçeği (YDÖ)	4
Beck Depresyon Envanteri (BDE)	3
Kısa Semptom Envanteri (KSE)	2
Stresle Başa Çıkma Tutumları Envanteri (SBTE)	2
Algılanan Sosyal Destek Ölçeği	2
Sürekli-Durumluk Kaygı Ölçeği	2
Beck Umutsuzluk Ölçeği	2
Beach Center Aile Yaşam Kalitesi Ölçeği	2
Psikolojik İyi Oluş Ölçeği	2
UCLA Yalnızlık Envanteri	1
İş Tatmin Ölçeği (MSQ)	1
Aile Destek Ölçeği	1
Aile Yılmazlık Ölçeği (AYÖ)	1
Yakın İlişkilerde Yaşantılar Envanteri-II	1
Stresle Başa Çıkma Tarzları Ölçeği	1
İntihar Olasılığı Ölçeği	1
Bakım Verme Yükü Ölçeği	1
Liebowitz Sosyal Kaygı Ölçeği (LSKÖ)	1
Sağlık İnanç Modeli Ölçeği Engel Algısı Alt Boyutu	1
Zarit Bakım Yükü Ölçeği (ZBYÖ)	1
Dünya Sağlık Örgütü Yaşam Kalitesi Ölçeği Kısa Formu (WHOQOL-BREF)	1
Stresle Baş Etme Tutumları Ölçeği	1
Genel Öz Yeterlilik Ölçeği	1
Evlilik Uyum Ölçeği	1
Olumlu Gelecek Beklentisi Ölçeği	1
PERMA Ölçeği	1
Yetişkinler İçin Sosyal ve Duygusal Yalnızlık Ölçeği	1
Spiritüel İyi Oluş Ölçeği	1
Bilinçli Farkındalık Ölçeği (BİFÖ)	1
Aile Gereksinimleri Belirleme Aracı	1

Hogan Yas Tepkileri Tarama Listesi (HYTL)	1
Ölüm Algısı Ölçeği (ÖAÖ)	1

Tablo 4'te görüldüğü gibi incelenen tezlerde en sık kullanılan ölçek Çok Boyutlu Algılanan Sosyal Destek Ölçeği'dir (ÇBASDÖ) (n=23). Bunu Maslach Tükenmişlik Ölçeği (n=4), Yenilenmiş Anne-Baba Sosyal Destek Ölçeği (n=4) ve Yaşam Doyum Ölçeği (n=4) takip etmektedir. ÇBASDÖ, aile, arkadaş ve özel kişi olmak üzere üç farklı kaynaktan algılanan sosyal desteği değerlendirmesi açısından tercih edilmektedir (Zimet vd., 1988).

3.5. Tezlerin Tematik Dağılımı

Bu anlamda çalışmaya dahil edilen 32 tez incelendiğinde aşağıdaki dokuz ana tema ön plana çıkmaktadır:

1. Algılanan Sosyal Destek: Aile, arkadaş ve özel kişilerden algılanan destek düzeyleri (ÇBASDÖ).

2. Psikolojik İyi Oluş ve Ruh Sağlığı: Depresyon, kaygı, umutsuzluk ve psikolojik iyilik hali (BDE, Psikolojik İyi Oluş Ölçeği, KSE).

3. Bakım Yükü, Tükenmişlik ve Stres: Bakım yükü, tükenmişlik sendromu ve stresle başa çıkma (Maslach Tükenmişlik Ölçeği, ZBYÖ, SBTE).

4. Aile İşlevselliği ve Evlilik Uyumu: Evlilik doyumu ve aile içi işlevsellik (Evlilik Uyum Ölçeği, Beach Center Ölçeği).

5. Yaşam Kalitesi, Yaşam Doyumu ve İyi Oluş: Genel yaşam kalitesi ve doyum düzeyleri (YDÖ, WHOQOL-BREF, PERMA).

6. Yalnızlık ve Sosyal İzolasyon: Sosyal ve duygusal yalnızlık (UCLA Yalnızlık Envanteri).

7. Başa Çıkma, Uyum ve Psikososyal Süreçler: Stresle başa çıkma stratejileri, aile yılmazlığı ve öz yeterlilik (SBTE, Aile Yılmazlık Ölçeği).

8. Özel Gruplar ve Karşılaştırmalı Yaklaşımlar: Farklı engel grupları ve örneklem grupları arası karşılaştırmalar.

9. Sosyal Hizmet ve Müdahale Boyutu: Sosyal hizmet müdahaleleri, aile gereksinimleri ve kurumsal destek sistemleri.

Bu tematik çeşitlilik, engelli bireylere sahip ailelerde sosyal desteğin çok boyutlu bir işlev gördüğünü ve farklı psikososyal değişkenlerle ilişkili olduğunu göstermektedir.

4. SONUÇ VE ÖNERİLER

2010-2025 yılları arasında Türkiye'de engellilik ve sosyal destek konusunda yayınlanan 32 lisansüstü tezin analizi, sosyal desteğin engelli bireylere sahip ailelerde kabullenme, çözüm

üretme ve günlük yaşama uyum sağlama açısından önemli bir biyopsikososyal kaynak olduğunu ortaya koymaktadır.

Bulgular, çalışmaların ağırlıklı olarak Psikoloji ve Sosyal Hizmet alanlarında yoğunlaştığını; zihinsel engellilik kategorisinin diğer engel gruplarına göre daha fazla çalışıldığını göstermektedir. Örneklem açısından anne ve babaların birlikte dahil edildiği çalışmaların artması olumlu bir gelişme olmakla birlikte, babaların ve kardeşlerin örneklem olarak ele alındığı çalışmalar hâlâ yetersizdir. Yöntemsel açıdan tezlerin %93.8'inin nicel araştırma deseninde olması, nitel ve karma yöntem araştırmalarının sınırlılığına işaret etmektedir.

Sonuç olarak, engelli bireylere sahip ailelerde sosyal destek konusunda yapılan lisansüstü tezler önemli bir akademik birikim sunmakla birlikte, nitel ve karma yöntem araştırmalarının artırılması, farklı engel gruplarının ve aile bireylerinin (özellikle babalar ve kardeşler) temsil edildiği çalışmaların yaygınlaştırılması önerilmektedir.

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NÜFUSUN YAŞLANMASININ SOSYAL GÜVENLİK SİSTEMLERİNİN SÜRDÜRÜLEBİLİRLİĞİ AÇISINDAN DEĞERLENDİRİLMESİ

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ÖZET

Sanayi Devrimi ile birlikte üretim şekli değişmiş ve yeni üretim şekli temelinde işgücü piyasası şekillenmiştir. İşgücü piyasasında ise birtakım sosyal riskler gittikçe belirginleşmiş ve sosyal güvenlik ihtiyacı hissedilmiştir. Başka bir ifadeyle sosyal güvenlik ihtiyacı endüstrileşen toplumlarda ortaya çıkmıştır. Sosyal güvenlik en temel insan hakları arasında yer almakta olup insan yaşamı boyunca sosyal güvence sağlayan en temel sosyal koruma mekanizmalarındandır. Çeşitli nedenlerden dolayı sosyal güvenlik ihtiyacı gün geçtikçe artmaktadır. Bu nedenlerden bazıları arasında; küreselleşmenin etkisiyle birlikte artan sosyal sorunlar, esnek ve güvencesiz işlerin yaygınlaşması, ücretlerin düşük düzeylerde gerçekleşmesi, nüfusun yaşlanması vb. yer almaktadır. Bir taraftan sosyal güvenlik ihtiyacı artmakta diğer taraftan ise sosyal güvenlik sistemlerinin sürdürülebilirliğinin sağlanması gittikçe zorlaşmaktadır. Kayıt dışı istihdam, nüfusun yaşlanması, nüfusun yaşlanması ile birlikte çalışma çağındaki nüfusun azalması, aylık ve gelirlerden faydalanan kişi sayısının artması ve faydalanma süresinin uzaması gibi çeşitli nedenlerden dolayı sosyal güvenlik sistemlerinin aktif-pasif dengesi bozulabilmekte ve bu durum sistemlerin finansal sürdürülebilirliklerini olumsuz etkileyebilmektedir. Nüfus dünya genelinde yaşlanma eğilimini sürdürmektedir. Bu durum ise sosyal güvenlik sistemlerinin üzerinde önemli bir mali baskı oluşturabilmektedir. Dolayısıyla merkeze nüfus ve nüfusla ilgili tahminleri koyarak sosyal güvenlik sistemlerinin planlanması ve finansal sürdürülebilirliğinin sağlanması büyük öneme sahiptir.

Anahtar Kelimeler: Sosyal güvenlik, sosyal güvenlik sistemleri, nüfusun yaşlanması, aktif-pasif oranı.

ASSESSING POPULATION AGING IN TERMS OF THE SUSTAINABILITY OF SOCIAL SECURITY SYSTEMS

ABSTRACT

With the Industrial Revolution, the mode of production changed and the labour market was shaped on the basis of the new mode of production. In the labour market, certain social risks have become increasingly apparent and the need for social security has been felt. In other words, the need for social security has emerged in industrialised societies. Social security is among the most fundamental human rights and is one of the most basic social protection mechanisms that provides social security throughout a person's life. For various reasons, the need for social

security is increasing day by day. Some of these reasons include: increasing social problems due to globalization, the spread of flexible and precarious jobs, low wage levels, an aging population, etc. On the one hand, the need for social security is increasing, while on the other hand, ensuring the sustainability of social security systems is becoming increasingly difficult. Due to various factors such as informal employment, population aging, the decrease in the working-age population due to population aging, the increase in the number of people benefiting from benefits and pensions, and the lengthening of the benefit period, the active-passive balance of social security systems can be disrupted, and this situation can negatively affect the financial sustainability of the systems. Populations worldwide continue to age. This situation can place significant financial pressure on social security systems. Therefore, placing population and population-related projections at the centre is of great importance for the planning of social security systems and ensuring their financial sustainability.

Keywords: Social security, social security systems, aging population, active-passive ratio.

1.GİRİŞ

Dünya genelinde nüfusun gittikçe yaşlanması, yeni yüzyılın en önemli demografik olguları arasında yer almaktadır (Hablemitoğlu ve Özmete, 2010: 15). Nüfusun yaşlanması toplumlarda çeşitli sosyal ve ekonomik sorunlara neden olabilmektedir. Aynı zamanda yaşlanan nüfus ülkelerin sosyal güvenlik sistemlerini etkilemekte ve sosyal güvenliğin en temel araçlarından biri olan sosyal sigortalar alanında finansman sorunlarına yol açmaktadır (Yılmaztürk, 2023: 314).

Sosyal güvenlik sistemleri, demografik değişimlerden etkilenen dinamik bir yapıya sahiptir (Çalışır, 2023: 337). Doğum oranlarının azalması ve yaşam süresinin uzaması ile birlikte gerçekleşen nüfusun yaşlanmasının sosyal güvenlik sistemleri üzerinde önemli etkileri bulunmaktadır. Nüfus yaşlandıkça, sosyal güvenlik sistemlerinin bir yandan sosyal sigorta prim gelirleri azalmakta diğer yandan ise yaşlılık aylığından ve sağlık sigortasından faydalanan kişi sayısı artmaktadır. Böylelikle, sosyal sigorta sitemlerinin aktüeryal dengesi bozulmakta ve finansal sürdürülebilirlik ile ilgili sorunlar ortaya çıkmaktadır. Ülkeler, demografik değişim bağlamında sosyal sigorta sistemlerinin aktüeryal dengesini sağlayabilmek için sosyal güvenlik reformları gerçekleştirmektedir. Örneğin, sosyal güvenlik reformları genel itibariyle sosyal sigorta sistemlerinden yaşlılık aylığına hak kazanma koşulları temelinde şekillenebilmekte olup, yaşlılık aylığına hak kazanma yaşı yükseltilebilmektedir.

Dünya genelinde nüfus yaşlanmaktadır. Nüfusun yaşlanmasının sosyal güvenlik sistemleri üzerindeki etkilerinin incelenmesi geliştirilecek sosyal güvenlik politikaları bakımından önem arz etmektedir.

2.NÜFUSUN YAŞLANMASI, SOSYAL GÜVENLİK VE SOSYAL GÜVENLİK SİSTEMLERİ

Yaşlanma kavramı "*insanın doğumuyla başlayıp ölümüne kadar devam eden, bireylerin bedensel, psikolojik, zihinsel, sosyal alanda giderek durağanlaşmaya başladığı ve zamanla çöküşe geçtiği bir dönem*" olarak tanımlanmaktadır (İçli, 2016: 41). Yani yaşlanma insanın doğumundan itibaren başlayan ve ölümüne kadar devam eden bir süreci kapsamakta olup, sadece biyolojik boyutları olmayan aynı zamanda toplumsal boyutları da olan bir süreçtir (Uyanık, 2017: 70).

Dünyada 20.yüzyılda nüfus artış hızı yavaş ve 65 yaş üstü nüfusun toplam nüfus içindeki payı az iken 20.yüzyılın ilk yarısında nüfus artış hızı artarak yaşamdan beklenen süre uzamış ve doğurganlık ve ölüm oranlarında önemli düşüşler yaşanmıştır. Dolayısıyla aynı yüzyılın ikinci yarısından itibaren de yeni bir demografik dönüşüm süreci başlamıştır (Gürsoy Çuhadar ve Lordoğlu, 2016: 64). Nüfusun yaşlanmasının temel belirleyicileri arasında; doğum oranlarının azalması, yaşamdan beklenen sürenin uzaması ve göçler yer almaktadır (Yumurtacı, 2013: 12). Türkiye'de yaşlı nüfusun toplam nüfus içindeki oranı yıllar itibariyle artmış olup bu oran, 1935 yılında %3.9, 1950 yılında %3.3, 1975 yılında %4.6, 2000 yılında %5.7, 2010 yılında %7.2, 2020 yılında %9.5, 2024 yılında %10.6 olarak gerçekleşmiştir. Yaşlı nüfus oranının 2050 yılında %23.1, 2080 yılında %33.4, 2100 yılında ise %33.6 olacağı tahmin edilmektedir (TÜİK, 2025).

Sosyal güvenlik, sosyal risklere karşı bireye asgari güvence sağlayan, muhtaçlığa ve yoksulluğa karşı da bireyi koruyan ve toplumsal huzuru sağlayan en önemli sosyal politika araçlarından biridir (Kırmızı ve Hüseyinli, 2019: 1204). Sosyal güvenlik esasında bir gelir transferidir ve prim ödeyen yurttaşlar ve devletin ilgili kurumları bakımından oldukça da masraflı bir sistemdir. Dolayısıyla toplumun tamamını kapsayan bir sosyal güvenlik mekanizmasının kurulabilmesi ve bu sistemin sürdürülebilirliğinin sağlanabilmesi için verimli bir işgücü piyasasına yahut katma değeri yüksek mal ve hizmet üretimine gereksinim bulunmaktadır (Kılıç, 2013: 88).

Sosyal güvenlik sistemlerinin oluşturulmasında; toplumsal refah ihtiyacının artması, Sanayi Devrimi ile birlikte ortaya çıkan işçi sınıfının yeni korunma ihtiyaçları, refah devleti anlayışının yaygınlaşması, ekonomik krizler vb. etkili olmuştur (Dağ, 2019: 369). Sosyal güvenlik

sistemlerine gereksinim bilhassa Sanayi Devrimi ile birlikte ortaya çıkmıştır. Üretimin fabrika çatısı altında gerçekleştirilmesi, işçi sınıfının çalışma koşulları temelinde yaşadığı sorunlar ve sosyal güvencesiz çalışma, aile yapısının değişmesi, işsizlik, yoksulluk, iş kazaları ve meslek hastalıkları gibi birçok sorun sanayileşme sonrası yaygın karşılaşılan sorunlar arasında yer almıştır. Söz konusu bu sorunlar, küreselleşme, teknolojik gelişmeler ve neoliberal politikaların yaygınlık kazanmasıyla birlikte küresel bir nitelik kazanmış ve sosyal güvenliğe ve sosyal güvenlik sistemlerine olan gereksinim daha da artmıştır.

Ülkelerin sosyal güvenlik sistemlerinin yeterliliğinin değerlendirilmesinde bazı göstergelerden faydalanılabilmektedir. Bu göstergeler arasında; ödenen aylık ve gelirlerin yeterli düzeyde olması, sistemin aktüeryal dengesinin ve finansal sürdürülebilirliğinin sağlanması, sosyal sigorta primlerinin ödenebilir bir düzeyde olması, yoksullukla mücadele etmesi ve sosyal güvenlik kapsamında olan nüfusun toplam nüfus içindeki payının yüksek olması vb. yer alabilmektedir (Gümüş, 2010: 5).

Sosyal güvenlik sistemlerinde gelir-gider dengesinin sağlanamaması halinde sosyal güvenlik bütçe açıklarının kapatılmasına yönelik merkezi bütçeden transferler yapılmaktadır. Söz konusu transferler ise ülkelerin mali yapısını doğrudan etkilemekte ve aynı zamanda bir gelir transferi etkisi de oluşturmaktadır (Bulut, 2023: 58). Bununla birlikte sosyal güvenlik sistemlerinin aktüeryal dengesinin sağlanması sistemlerin finansal sürdürülebilirliğinin sağlanabilmesi açısından önem arz etmektedir. Kamu bütçesinden sosyal güvenlik açıklarının kapatılmasına yönelik yapılan bütçe transferleri ise kamu bütçesi üzerinde mali bir baskı oluşturabilmektedir. Örneğin, nüfus yaşlandıkça sosyal güvenlik sistemlerinin sigorta prim gelirleri azalacak ve yaşlılık aylığından faydalanan kişi sayısı artacaktır. Dolayısıyla nüfusun yaşlanması ile birlikte sosyal güvenlik sistemlerinin aktif/pasif dengesi bozulacak ve sosyal güvenlik açıkları ortaya çıkacaktır. Bu açıkların kapatılması için kamu bütçesinden daha fazla bütçe transferi edilecek ve böylelikle nüfusun yaşlanması kamu bütçesi üzerinde mali bir baskıya neden olabilecektir.

Literatürde sosyal güvenlik sistemlerinin temel sorunları ve sosyal güvenlik açıklarına yönelik yapılan çalışmalar bulunmaktadır. Demir ve Canbay (2013: 458) yaptıkları çalışmada Türk sosyal güvenlik sisteminin finansman sorunlarını demografik dönüşüm, erken emeklilik, kayıt dışı istihdam, sağlık harcamalarındaki artış, ekonomik nedenler, devlet katkısının yetersizliği, devlet politikasındaki tutarsızlık, prim tahsilatının düşük olması, prim karşılığı olmayan ödemeler olarak vurgulamıştır. Balcı İzgi (2008: 104) yaptığı çalışmada Türk Sosyal Güvenlik Sisteminin sorunlarını demografik unsurlar, düşük kapsam ve prim tahsilatının gerçekleşmesi, kayıt dışı istihdam ve politik müdahaleler olmak üzere dört bağlamda değerlendirmiştir. Canbay

ve Demir (2013) yaptıkları çalışmada Türk Sosyal Güvenlik Sisteminin açıklarının nedenlerini; kayıt dışılık, erken emeklilik, aktif/pasif dengesinin bozulması, fonların etkin değerlendirilememesi, primlerin tahsil edilememesi olarak vurgulamıştır. Bulut (2023) yaptığı çalışmada sosyal güvenlik sisteminin finansman açığına neden en temel unsurlar arasında; düşük aktif/pasif sigortalı oranı, kayıt dışı istihdam, primlerin tahsil edilmesinde başarısızlıklar, sosyal güvenlik ahlakının ve bilincinin yetersizliği, süreklilik arz eden yapılandırma uygulamaları belirtilmiştir.

3.NÜFUSUN YAŞLANMASININ SOSYAL GÜVENLİK SİSTEMLERİNE ETKİLERİ

Doğum oranlarının azalması ve yaşamdan beklenen sürenin uzaması yaşlı nüfusun toplam nüfus içindeki payının artmasına ve dolayısıyla sosyal güvenlik sistemlerinin işlevselliği üzerinde önemli düzeyde baskılara neden olmuştur (Asilzâde, 2025: 8). Nüfusun yaşlanmasıyla birlikte çalışma çağındaki aktif nüfusun azalması ekonomik büyümeyi yavaşlatmakta ve bu durum da mali dengeyi olumsuz etkileyerek mali sürdürülebilirliği zorlaştırmaktadır (Kalınkara, 2016: 26).

Nüfusun yaşlanması ile birlikte ekonomik büyümenin yavaşlaması, tasarrufların azalması, işgücü üretkenliğinin azalması ve sosyal güvenlik sistemlerinin finansal sürdürülebilirliğini sağlamaya yönelik kamu harcamalarının artması vb. sorunlar ortaya çıkabilmektedir (Yılmaz Akın, 2009: 30). Yaşlı nüfusun toplam nüfus içindeki oranının artması, sosyal güvenlik harcamalarını arttıracak ve sistemi finanse eden sigortalılarının sayısını azaltarak şiddetli finansman krizlerinin yaşanmasına zemin hazırlayacaktır (Gümüş, 2010: 11). Başka bir ifadeyle doğum oranlarının azalması, zamanla istihdama katılan kişi sayısını azaltarak sosyal sigorta sistemlerine aktarılacak prim katkılarının da azalmasına neden olacaktır (Çalışır, 2023: 338).

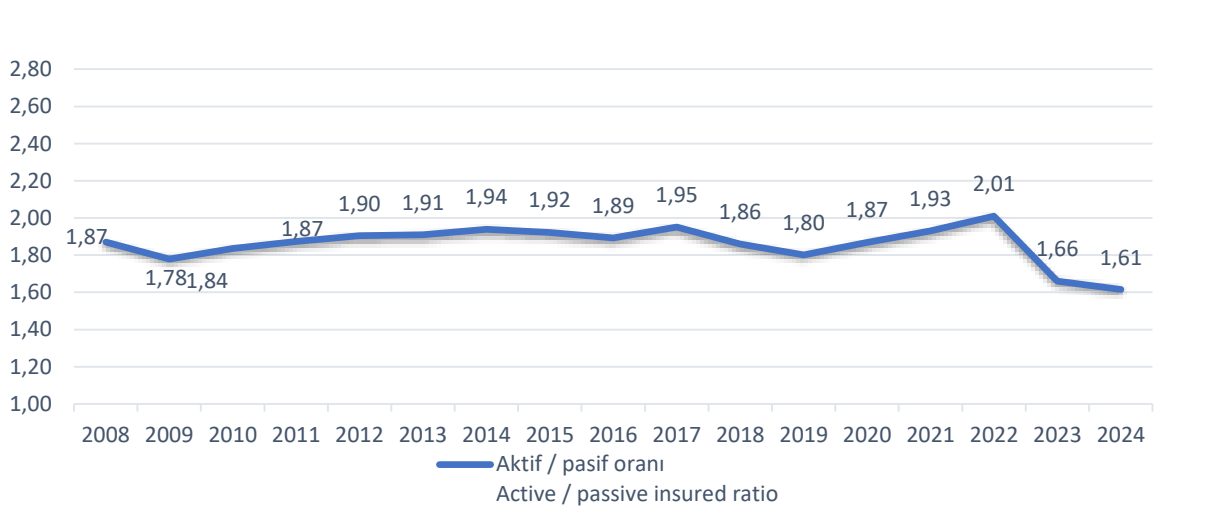
Dünyada çoğu ülkede yaşlılık döneminde gelir güvenliğini sağlayan en önemli sosyal koruma mekanizması kamusal emeklilik sistemleridir (Kul Parlak, 2016: 120). 1980-2010 yılları aralığında bazı ülkelerde emeklilik sistemlerinin özelleştirildiği ve sonrasında ise özelleştirme uygulamalarının tersine çevrildiği görülse de gelişmiş ülkeler özelleştirme yoluna gitmemiştir. Bu ülkelerde, nesiller arası dayanışma yaklaşımına ve yeniden dağıtım anlayışına bağlı kalınarak sosyal sözleşmeden kaçınılmadan emeklilik yaşının yükseltilmesi, emekli aylıklarının planlanması gibi reformlara odaklanılmıştır (Çalışır, 2023: 336). Bu bağlamda yaşam süresinin artması ve doğum oranlarının azalmasının bir sonucu olarak sosyal güvenlik sistemlerinin finansal sürdürülebilirliğinin sağlanabilmesi için ülkelerde genel olarak emeklilik yaşının yükseltilmesi yönünde düzenlemeler yapılmaktadır (Yasım, 2025: 263).

Nüfusun yaşlanmasının yanı sıra küreselleşme, artan rekabet ve teknolojik gelişmelerle birlikte işgücü piyasalarında ve aile yapısında dönüşümler yaşanmakta ve emeklilik sistemleri üzerinde çeşitli sorunlara yol açmaktadır (Kul Parlak, 2016: 120). Bunların yanı sıra COVİD-19 pandemisi de ülkelerdeki sosyal güvenlik sistemlerinin finansal sorunlarını daha da derinleştirmiş ve ülkelerin sosyal güvenlik sistemleri üzerindeki mali baskıyı artırmıştır (Sevim vd., 2022: 787).

Nüfus yaşlandıkça yaşlı bağımlılık oranları da artmaktadır. Yaşlı bağımlılık oranları da sosyal güvenlik sistemlerinin finansal sürdürülebilirliği hususunda göz önünde bulundurulmalıdır. Türkiye'de yaşlı bağımlılık oranı yıllar itibariyle artmıştır. 1950 yılında %5.7, 1975 yılında %8.4, 2000 yılında %10.5, 2024 yılında %15.5 olarak gerçekleşmiştir. Yaşlı bağımlılık oranının 2030 yılında %19.5, 2050 yılında %37.2, 2080 yılında %61.9 ve 2100 yılında %61.6 olacağı tahmin edilmektedir (TÜİK, 2025).

Sosyal güvenlik sistemlerinin aktif/pasif dengesini etkileyen birçok unsurdan bahsedilebilir. Bu unsurların başında, kayıt dışı istihdam, işsizlik, doğum oranlarının azalması, yaşam süresinin uzaması, sosyal sorunlar, esnek ve güvencesiz işler, ekonomik krizler, erken emeklilik vb. gelmektedir. Türkiye'de aktif/pasif oranı yıllar itibariyle aşağıdaki grafikte verilmiştir.

Grafik 1. Sosyal Güvenlik Kurumu Aktif/Pasif Oranı, 2008-2024



Kaynak: SGK, 2025

Grafik 1'e göre Türkiye'de yıllar itibariyle aktif/pasif oranı ağırlıklı olarak 2'nin altında gerçekleşmiştir. Veriler incelendiğinde 2023 yılında aktif/pasif oranının 2.01'den 1.66'ya düştüğü, bu önemli düşüşün temel sebebi olarak ise 2023 yılındaki Emeklilikte Yaşa Takılanlar (EYT) düzenlemesinden kaynaklandığı söylenebilir. Acar ve Kitapcı (2008: 80) yaptıkları çalışmada, sosyal sigorta sistemlerinde aktif/pasif oranının gelişmiş ülkelerde dört düzeyinde

olmakla birlikte bu oranın en az iki olmasının hedeflendiğini, iki düzeyinin sinyal düzey olarak kabul edildiğinden ikinin altına düşülmesinin, sosyal güvenlik sistemlerinin finansal sorun yaşadığına işaret ettiğini belirtmiştir. Buna göre, yukarıda yer alan grafikteki veriler değerlendirildiğinde Türkiye'deki sosyal güvenlik sisteminin finansal sorun yaşadığı ifade edilebilir.

SONUÇ

Uzun ömürlülük sosyal güvenlik sistemleri bakımından önemli bir risk oluşturmaktadır (Güner, 2016: 63). Yaşam süresinin artmasıyla birlikte doğum oranlarının azalması, çalışma çağındaki işgücünün de azalmasına neden olmaktadır. Dolayısıyla doğum oranlarının azalması ve yaşam süresinin uzaması, sosyal sigorta sistemlerinin gelirlerini ve giderlerini etkileyerek giderlerin artmasına neden olabilmektedir. Demografik değişimin mevcut ve gelecekte gerçekleşmesi muhtemel etkileri bağlamında yakından takip edilmesi ülkelerin sosyal güvenlik sistemlerinin sürdürülebilirliği açısından önemlidir.

Ülkeler, nüfusun yaşlanmasının beraberinde getirdiği kamusal maliyetlerin azaltılması, sağlık hizmeti kalitesinin arttırılması ve sosyal güvenlik finansal dengesinin sağlanabilmesi için politikalarını geliştirmesi gerekmektedir (Gökbunar vd., 2016: 120). Sosyal güvenlik sistemlerinin aktüeryal dengesinin sağlanabilmesi için hem sosyal sigorta sistemlerinin gelirlerini arttıran ve hem de giderlerini azaltan çift yönlü alınacak tedbirlerin eş zamanlı uygulanmasıyla ancak mümkün olabilecektir (Yasım, 2020: 56).

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SOSYAL BİR SORUN OLARAK YAŞLILIK

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ÖZET

Toplumlar tarih boyunca çeşitli sosyal sorunlarla karşılaşmıştır. Bu sosyal sorunlar arasında, yoksulluk, göç, işsizlik, suç, bağımlılık, salgın hastalıklar, yaşlılık, vb. yer alabilmektedir. Sanayi Devrimi ve küreselleşme, sosyal sorunların derinleşmesinde ve çeşitli sosyal sorunların ortaya çıkmasında yaşanan önemli gelişmelerdir. Sanayi Devrimi ile birlikte üretim şekli değişmiş, istihdam düşük ücret düzeyinde gerçekleşmiş, kırdan kente doğru göç artmış, aile yapısı küçülmüş, sosyal ve ekonomik eşitsizlikler artmıştır. Yaşlılığın da sosyal bir sorun haline gelmesinde söz konusu bu gelişmelerin önemli bir rolü bulunmaktadır. Sanayi Devrimi öncesinde geniş aile yapısında yaşlılar yaşlılık döneminde aile üyelerinin desteğini alabiliyorken sanayileşme sonrasında aile yapısının küçülmesiyle birlikte aile üyelerinin desteğini yeterince alamamışlardır. Başka bir ifadeyle yaşlılar sanayileşmeyle birlikte yaşlılık dönemi özellikleri bağlamında sağlık ve bakım ihtiyaçları, günlük yaşam pratikleri, barınma, vb. ihtiyaçlarının karşılanmasında artık aile üyelerinin yeterince desteğini alamamış ve bu ihtiyaçları karşılama hususunda çoğunlukla tek başlarına kalmıştır. Böylelikle yaşlılar sanayileşme süreciyle birlikte sosyal bir sorun olarak değerlendirilmeye başlanmış ve yaşlılara yönelik sosyal politikalara gereksinim ortaya çıkmıştır. Yaşlılığın sosyal bir sorun olarak değerlendirilmesinden hareketle yaşlılık döneminde sağlık ve bakım ihtiyaçlarının karşılanması, gelir güvenliğinin ve sosyal güvencenin sağlanabilmesi için sosyal sigorta ve sosyal yardım uygulamaları, evde ve kurumsal bakım modellerinin geliştirilmesi gibi yaşlılık döneminde ortaya çıkan sorunlar ve ihtiyaçlar bağlamında çeşitli politikalar geliştirilmiştir. Sanayi Devrimi ile başlayan ve küreselleşme ile daha da derinleşen sosyal sorunlar temelinde yaşlılık, günümüzde sosyal bir sorun olarak varlığını sürdürmektedir.

Anahtar Kelimeler: Sosyal Sorun, Yaşlı, Yaşlılık, Sanayi Devrimi.

OLD AGE AS A SOCIAL PROBLEM

ABSTRACT

Societies have faced various social problems throughout history. These social problems may include poverty, migration, unemployment, crime, addiction, epidemics, old age, etc.Sanayi Devrimi ve küreselleşme, sosyal sorunların derinleşmesinde ve çeşitli sosyal sorunların ortaya çıkmasında yaşanan önemli gelişmelerdir. The Industrial Revolution and globalisation are

significant developments that have led to the deepening of social problems and the emergence of various social issues. With the Industrial Revolution, production methods changed, employment occurred at low wage levels, migration from rural to urban areas increased, family structures became smaller, and social and economic inequalities grew. These developments have played a significant role in making old age a social problem. Before the Industrial Revolution, elderly people living in extended families were able to receive support from family members during their old age, but after industrialisation, with the shrinking of the family structure, they were unable to receive sufficient support from family members. In other words, with industrialisation, older people can no longer rely on sufficient support from family members to meet their health and care needs, daily living practices, housing, etc., within the context of the characteristics of old age, and are mostly left to meet these needs on their own. Thus, with the industrialisation process, the elderly began to be regarded as a social problem, and the need for social policies targeting the elderly emerged. Based on the assessment of ageing as a social issue, various policies have been developed in the context of problems and needs arising during old age, such as meeting health and care needs, ensuring income security and social security through social insurance and social assistance programmes, and developing home and institutional care models. Beginning with the Industrial Revolution and deepened by globalization, aging remains a significant social problem today.

Keywords: Social Problem, Elderly, Old Age, Industrial Revolution.

EVLİLİK İLİŞKİLERİNDE ÇATIŞMA, GÜÇ VE ŞİDDETİN DİNAMİKLERİ

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ÖZET

Çatışma, iki ya da daha fazla kişi arasında ortaya çıkan anlaşmazlık ve çekişme durumunu ifade etmektedir. Bireylerin beklenti ve ihtiyaçlarının karşılanmaması, çatışma sürecini tetikleyerek psikolojik açıdan zorlayıcı bir deneyime dönüşmektedir. Evlilik ilişkisinde çatışma, diğer ilişki biçimlerine kıyasla daha karmaşık ve süreklilik arz eden bir nitelik kazanmaktadır. Bu süreçte çiftler, yoğun psikolojik yıpranmaya rağmen evliliğin sürdürülmesi ve boşanmanın önlenmesi amacıyla çatışmalı ilişkiyi devam ettirme yönünde direnç gösterebilmektedir.

Evlilikte yaşanan krizlerin sağlıklı biçimde çözümlenememesi ve çatışmanın işlevsel olmayan yollarla ele alınması, tarafların karşılıklı olarak örselenmesine yol açmaktadır. Özellikle evliliğin erken dönemlerinden itibaren karşılaşılan sorunların yıkıcı tutumlarla ele alınması, zamanla çatışmanın kronikleşmesine neden olmaktadır. Bu bağlamda, çiftlerin çatışma çözüm süreçlerinde olumlu ya da olumsuz baş etme stillerini benimsedikleri görülmektedir. Literatürde, evlilik çatışmalarında saldırgan davranışlarının belirleyici bir rol oynadığı, aynı zamanda çiftlerin, bu çatışmalar sırasında ortaya çıkan öfke duygusunu, sıklıkla şiddet yoluyla ifade ettiği görülmektedir. Bu süreçte, çoğunlukla kadınların mağduriyet yaşadığı eşlerin işlevsiz tutumlarının saldırgan davranışları artırdığı ve çatışma sürecinin eşler arası şiddetle iç içe geçtiği görülmektedir. Çatışmalı evliliklerde krizlerin çözüme kavuşturulamaması, kadınları çok boyutlu biçimde güçsüzleştiren bir sürece dönüşmektedir. Araştırmalar, bu sürecin kadınları çaresizleştirdiğini, fiziksel ve psikolojik olarak örselediğini ve şiddet döngüsünü pekiştirdiğini göstermektedir. Ayrıca, kadına yönelik şiddet vakalarına ve eş şiddeti sonucunda yaşamını yitiren kadınlara ilişkin haberlerin basın ve yayın organlarında giderek daha görünür hale geldiği dikkat çekmektedir.

Bu çalışmanın amacı, alanyazın taramasına dayalı olarak evliliklerde çeşitli nedenlerle ortaya çıkan çatışmaların ele alınış biçimlerini incelemektir. Çalışmada, evlilikte çatışma çözüm süreçlerinde saldırganlık ve şiddetin rolü vurgulanarak, evlilik çatışması ve şiddet döngüsüne ilişkin eleştirel bir perspektif sunulması hedeflenmektedir.

Anahtar Kelime: Evlilikte Çatışma, Öfke, Saldırganlık, Şiddet Döngüsü, Şiddet.

THE DYNAMİCS OF CONFLİCT, POWER, AND VİOLENCE İN MARİTAL RELATİONSHİPS

ABSTRACT

Conflict refers to a situation of disagreement and contention that arises between two or more people. When individuals' expectations and needs are not met, it triggers a conflict process that becomes a psychologically challenging experience. In marital relationships, conflict takes on a more complex and persistent nature compared to other types of relationships. During this process, despite intense psychological strain, couples may resist ending the conflictual relationship in order to maintain the marriage and prevent divorce.

The failure to resolve crises in marriage in a healthy manner and dealing with conflict in dysfunctional ways leads to mutual harm between the parties. In particular, dealing with problems encountered from the early stages of marriage with destructive attitudes causes the conflict to become chronic over time. In this context, it is seen that couples adopt positive or negative coping styles in conflict resolution processes. The literature shows that aggressive behavior plays a decisive role in marital conflicts and that couples often express the anger that arises during these conflicts through violence. In this process, it is observed that women are mostly victimized, that the dysfunctional attitudes of spouses increase aggressive behavior, and that the conflict process is intertwined with spousal violence. In conflictual marriages, the failure to resolve crises turns into a process that disempowers women in multiple ways. Research shows that this process leaves women helpless, physically and psychologically traumatized, and reinforces the cycle of violence. Furthermore, it is noteworthy that news reports on cases of violence against women and women who have lost their lives as a result of spousal violence are becoming increasingly visible in the press and media.

The aim of this study is to examine the ways in which conflicts arising in marriages for various reasons are addressed, based on a review of the literature. The study aims to present a critical perspective on marital conflict and the cycle of violence, emphasizing the role of aggression and violence in conflict resolution processes within marriage.

Keywords: Marital Conflict, Anger, Aggression, Cycle of Violence, Violence.

1. GİRİŞ

Aile kavramı, uzun yıllardır sosyoloji, antropoloji, psikoloji ve tarih gibi farklı disiplinler tarafından ele alınan toplumsal yapı içerisindeki yeri, işlevi ve dönüşümü üzerine çok sayıda araştırma ve incelemeye konu olan bir olgudur (Murdock, 1949; Parsons, 1955). Ailenin neyi ifade ettiği, hangi değerler ve ilişkiler bütünü üzerinden tanımlandığı ve insanlık tarihindeki konumu, özellikle modern sosyal bilimlerin gelişimiyle birlikte sistematik biçimde tartışılmaya

başlanmıştır (Engels, 2019; Goode, 1963). Aile kavramına ilişkin bilimsel çalışmaların kökeni 19. yüzyıla kadar uzanır. Bu dönemde ailenin tarihsel, kültürel ve toplumsal temelleri eleştirel bir bakışla sorgulanmaya başlanmaktadır (Engels, 2019; Morgan, 1877). Yaygın kabul gören görüşlerden biri, ailenin insanlık tarihinin erken dönemlerinde yalnızca biyolojik bir birliktelik değil, aynı zamanda var olma mücadelesi, birlikte yaşama ve bu birlikteliği sürdürme gereksinimine dayalı bir yapı olarak ortaya çıktığı yönündedir (Morgan, 1877; Murdock, 1949). Bu bağlamda, mülkiyet ve aidiyet ilişkilerinin henüz belirginleşmediği dönemlerde bireylerin karşılıklı sorumluluk, dayanışma ve paylaşım bilinciyle bir arada yaşamlarını sürdürdükleri, ailenin bu süreçte temel bir toplumsal örgütlenme biçimi işlevi gördüğü ifade edilmektedir (Engels, 2019).

Türk Dil Kurumu'na göre aile, "evlilik ve kan bağına dayanan; karı, koca, çocuklar ve kardeşler arasındaki ilişkilerden oluşan, toplum içindeki en küçük birlik" olarak tanımlanmaktadır. Ailenin oluşum sürecinde evlilik ve eş seçimi, bireylerin yaşamlarında belirleyici bir döneme karşılık gelmektedir. Kadınlar ve erkekler, eş seçimi sürecinde bağımsız karar verebilme olanağına sahip olduklarında, kendi ihtiyaçlarını ve beklentilerini karşılayacağını düşündükleri bireyleri tercih etme eğiliminde olmaktadırlar (Özgüven, 2009: 31). Eşlerin birbirlerini tanıma fırsatına sahip olmaları, evliliğin gerçekleşmesi durumunda olası risklerin ve koruyucu faktörlerin değerlendirilmesine olanak tanırken bu süreç, ilerleyen evlilik ilişkilerinin nasıl algılandığını ve tanımlandığını önemli ölçüde etkilemektedir.

Bir evliliğin gönüllülük temelinde ya da zorunlulukla kurulmuş olması, evlilikten alınan doyumu, ilişkinin niteliğini ve eşler arasındaki uyum düzeyini belirleyen temel etkenler arasında yer almaktadır. Evliliğin zorunluluk üzerinden anlamlandırılması, duygusal bağın gelişimini zayıflatabilmekte ve ilişkide güç dengesizliklerinin ortaya çıkmasına zemin hazırlayabilmektedir. Evliliğin ilerleyen aşamalarında aile içindeki gücün paylaşımı ve güç dengesinin kurulabilmesi, kriz durumlarının daha sağlıklı biçimde yönetilmesini mümkün kılarken bu durum, eşlerin birbirlerine psikolojik ve fiziksel zarar verme olasılığını azaltıcı ya da önleyici bir işlev görmektedir.

Bireyler yaşamları boyunca ikili ilişkilerinde çeşitli sorunlar ve çatışma durumlarıyla karşılaşabilmektedir. Ev, işyeri ve okul gibi farklı sosyal alanlarda yaşanan çatışmalar, ilişkilerin süresi ve niteliğine bağlı olarak farklı biçimlerde çözümlenebilmektedir (Arslan, 2005: 76). Görece kısa süreli ya da yüzeysel ilişkilerde çatışmalar daha kolay çözülebilirken, evlilik gibi yakın ve süreklilik arz eden ilişkilerde çatışma süreci daha kritik bir önem kazanmaktadır. Evlilikte iki farklı bireyin aynı yaşam alanını paylaşması, ortak karar alma

süreçlerinde işbirliği yapmasını ve çatışma çözme becerilerini etkin biçimde kullanmasını gerektirmektedir. Ancak çiftler bu becerileri her zaman yeterince geliştiremeyebilir.

Özgüven'e (2010) göre evlilikte çatışmanın ortaya çıkmasını güçlendiren temel unsurlar arasında eşlerin hangi kurallara uyacakları, tutarsız kuralların yürürlüğe konulması ve kuralların kim tarafından belirleneceğine ilişkin anlaşmazlıklar yer almaktadır. Çatışma, iki ya da daha fazla gereksinimin aynı anda karşılanamadığı durumlarda ortaya çıkan temel bir problem alanı olarak değerlendirilmektedir. Bu nedenle, çiftlerin çatışma çözümüne yönelik yaklaşımları, probleme nasıl yaklaştıkları ve hangi baş etme stratejilerini benimsedikleriyle yakından ilişkilidir. Bazı kişiler çatışmayı çözmeye yönelik iletişim kurmayı tercih ederken, bazıları çatışmadan kaçınmakta ya da yüzleşmekten çekinmekte, bazıları ise saldırganlık ve öfke içeren davranışlar sergileyebilmektedir (Arslan, 2005: 77).

Şiddetin temelinde yer alan saldırganlık, farklı biçimlerde ortaya çıkabilen bir davranış örüntüsüdür (Koçacık ve Çağlayandereli, 2009:27). Saldırganlığın insan doğasına içkin olduğu ya da öğrenme süreçleriyle kazanıldığı yönündeki görüşler, biyolojik, psikanalitik ve sosyal öğrenme kuramları başta olmak üzere çeşitli kuramsal yaklaşımlar çerçevesinde tartışılmıştır (Freud, 1920; Lorenz, 1966; Bandura, 1973). Güncel yaklaşımlar ise saldırgan davranışların yalnızca bireysel özelliklerden değil, aynı zamanda bireyin içinde bulunduğu toplumsal, kültürel ve yapısal bağlamdan da etkilendiğini ortaya koymaktadır (Heise, 1998; World Health Organization, 2002). Araştırma sonuçları aile içi çatışmaların, büyük ölçüde saldırganlık ve öfke içeren davranışlar yoluyla çözümlenmeye çalışıldığını bu süreçte erkeklerin çoğunlukla aktif fail, kadınların ise şiddete maruz kalan konumda yer aldığını göstermektedir (Dobash & Dobash, 1979; Johnson, 2006; Türkiye Kadına Yönelik Aile İçi Şiddet Araştırması, 2015). Aile içi çatışmalarda kadınların maruz kaldığı ağır şiddet, birçok durumda kadınların yaşamdan kopmasına kadar varan ciddi sonuçlar doğurmaktadır.

2. EVLİLİKTE ÇATIŞMA

Evlilik ilişkilerinde çatışma, insan ilişkilerinin doğasında yer alan kaçınılmaz bir olgu olmakla birlikte, çatışmanın nasıl ele alındığı ve yönetildiği evlilik bağlamında belirleyici bir öneme sahiptir. Doğan'a (2010) göre çatışmanın varlığından ziyade, çatışmanın kontrol edilme biçimi ve çiftlerin bu süreci nasıl yönlendirdiği evlilik ilişkilerinin niteliğini belirlemektedir. Bu bağlamda evlilik çatışması, yalnızca bireysel uyumsuzlukların değil, aynı zamanda ilişkisel ve yapısal dinamiklerin bir sonucu olarak ele alınmaktadır.

Aileyi bir sistem olarak ele alan kuramsal yaklaşımlar, evlilik çatışmasını kaçınılmaz bir süreç olarak değerlendirmektedir. Sprey'in (1979) aile sistemleri yaklaşımına göre her aile, kendi

içinde karşılıklı etkileşimlere dayalı bir yapı oluşturmaktadır. Bu yapı içerisinde her birey farklı beklenti, ihtiyaç ve hedeflere sahiptir. Bu farklılıklar, evlilikte çatışmanın ortaya çıkmasını kaçınılmaz kılar. Dolayısıyla evlilik çatışması, çoğunlukla işlevsel olmayan ya da yetersiz biçimde yönetilen çatışma süreçleri olarak tanımlanmaktadır. Çatışmayı tanımlayan kuramsal yaklaşımlar, çatışmanın temelinde engellenmişlik ve güç ilişkilerinin yer aldığına işaret etmektedir. Tezer'e (1986) göre çatışma, taraflardan birinin kendi istek ve beklentilerinin diğer taraf tarafından engellendiği ya da engellenme tehdidi altında olduğu durumlarda ortaya çıkan bir örüntüdür. Benzer biçimde, eşler arasındaki çatışmaların çiftlerin sorun çözme becerilerindeki yetersizlikler ve karşılıklı farklılıkları kabul etmede yaşanan güçlüklerle yakından ilişkili olduğu belirtilmektedir (Öner, 2013). Özen (2006) ise çatışmayı, mevcut çözüm yollarının taraflar açısından doyurucu bulunmadığı durumlarda ortaya çıkan bir süreç olarak ele almaktadır. Evlilik çatışmalarının değerlendirilmesinde bilişsel ve öğrenilmiş davranış örüntülerinin de önemli bir rolü bulunmaktadır. Polat'a (2012) göre bireyler çatışma sürecinde kendi istekleri ile eşlerinin isteklerini değerlendirirken, bu değerlendirme her zaman bilinçli olarak gerçekleşmemekte, geçmiş deneyimler ve öğrenilmiş davranışlar çatışmaya verilen tepkileri şekillendirmektedir. Çatışmanın sıklığı, yoğunluğu ve yarattığı gerginlik düzeyi ile evlilikten alınan doyum arasında güçlü bir ilişki bulunduğu, çatışmanın evlilik ilişkisinde duygusal ve psikolojik açıdan zorlayıcı bir etki yarattığı vurgulanmaktadır (Günay, 2007; Doğan, 2010).

Alanyazın, evlilik çatışmalarının nedenlerinin çok boyutlu olduğunu ortaya koymaktadır. İletişim eksikliği, karşılanmamış gereksinimler, ekonomik sorunlar, cinsel doyumsuzluk, aile içi rol ve otorite paylaşımına ilişkin belirsizlikler, eşlerin köken aileleriyle yaşadıkları sorunlar ve madde kullanımı gibi etkenler, evlilik çatışmasını besleyen temel faktörler arasında yer almaktadır (Tezer, 1986; Özgüven, 2009). Bu faktörler, evlilikte çatışmanın yalnızca bireysel uyumsuzluklardan değil, aynı zamanda ilişkisel ve toplumsal bağlamdan etkilendiğini göstermektedir. Evlilikte çatışmaların kronikleşmesi, eşler arasında duygusal kopuşa ve yabancılaşmaya yol açabilmektedir. Özgüven'e (2010) göre aile içinde duygu ve düşüncelerini açıkça ifade edemeyen eşler zamanla birbirlerinden uzaklaşırken ilişki duygusal bağdan yoksun, zorunlu ve bağımlı bir yapıya dönüşebilmektedir. Bu durum, çatışmanın çözümlenmesini zorlaştırmakta ve evliliği yıpratan bir döngü yaratmaktadır.

Evlilik çatışmalarının süreçsel boyutunu ele alan yaklaşımlar, çatışmanın belirli aşamalar üzerinden ilerlediğini ortaya koymaktadır. Eraslanlı ve Kalkan'a (2008) göre evlilik sorunları yaşayan çiftlerin ilişkileri üç aşamalı bir süreç izlemektedir. İlk aşamada öfke, incinme ve hayal

kırıklığı duyguları ön plana çıkarken, ikinci aşamada evliliği sürdürme ve ayrılma arasında kararsızlık yaşanmaktadır. Son aşamada ise evliliğe ilişkin umutlar tükenmekte ve sorun çözme çabaları belirgin biçimde azalmaktadır. Bu süreç, özellikle yıpranmış evliliklerde daha öngörülebilir ve kontrol edilmesi güç bir hâl almaktadır (Şengül Öner, 2013). Yakın ilişkilerde çatışmayı kaçınılmaz bir olgu olarak ele alan Hendrick (2009), çatışmanın karşılıklı etkileşime dayalı ilişkilerin doğal bir parçası olabileceğini belirtmektedir. Ancak çatışmanın yapıcı ya da yıkıcı sonuçlar doğurması, çiftlerin çatışmayı ele alış biçimlerine bağlıdır (Basım ve ark., 2009). Bu bağlamda çatışma çözme becerileri, evlilik doyumu ve uyumunun temel belirleyicileri arasında yer almaktadır.

Çatışma çözme stillerine ilişkin kuramsal yaklaşımlar, çiftlerin farklı baş etme stratejileri kullandığını göstermektedir. Gürüz ve Eğinli (2008), çatışma çözüm yaklaşımlarını olumlu ve olumsuz olmak üzere iki temel grupta ele almaktadır: Uzlaşma, problem çözme ve aktif dinleme gibi yaklaşımları olumlu; baskı kurma, güç kullanma ve kaçınmayı ise olumsuz yaklaşımlar olarak tanımlamaktadır. Öner ve Koruklu (2010) ise çatışma çözme davranışlarını saldırganlık, kaçınma ve problem çözme başlıkları altında incelemektedir. Özellikle saldırganlık, evlilik çatışmalarında yıkıcı bir baş etme stratejisi olarak öne çıkmaktadır. Guerrero (1994), yakın ilişkilerde öfkenin ifade ediliş biçimlerini olumlu/bütünleyici ifade, yaygın saldırganlık, edilgen saldırganlık ve kaçınma davranışı olarak sınıflandırmıştır. Öfkenin ifade edilme biçimi, çatışmanın seyrini ve ilişkinin geleceğini belirleyen temel bir unsur olarak değerlendirilmektedir. Bu süreçte ortaya çıkan öfke, hayal kırıklığı ve suçluluk gibi duygularla birlikte gelişen davranış örüntüleri, evlilik ilişkisini derinden etkilemekte ve çatışmanın yapıcı ya da yıkıcı bir yönde ilerlemesini belirlemektedir (Kaynak, 2014).

3. Öfkenin İfade Ediliş Biçimi "Saldırganlık"

Öfke duygusu söz konusu olduğunda, bireylerin zihninde en sık çağrışım yapan davranış biçimlerinden birinin saldırganlık olduğu görülmektedir (Berkowitz, 1993; Spielberger, 1999). Shaver ve arkadaşlarının (1987) yürüttüğü çalışmalarda, katılımcıların öfkeyle en çok ilişkilendirdikleri davranışların saldırganlık ve şiddet içerikli tepkiler olduğu ortaya konulmuştur. Bu bulgular, öfkenin toplumsal algıda çoğunlukla saldırgan davranışlarla özdeşleştirildiğini göstermektedir. Literatürde saldırganlık ve şiddet kavramları zaman zaman birbirine yakın anlamlarda kullanılmakla birlikte, kavramsal olarak farklı boyutlara işaret etmektedir (Anderson ve Bushman, 2002). Türk Dil Kurumu'na göre saldırganlık, bireyin kendi düşünce ve davranışlarını dışsal direnmelere karşı zor kullanarak kabul ettirme çabası olarak tanımlanırken; şiddet, kaba güç ve kuvvet kullanımı ile duygu ve davranışlarda aşırılığı ifade

etmektedir (Türk Dil Kurumu, 2024). İnsan ilişkilerinde şiddet, bir yandan bireyin düşünce ve duygularını nezaket sınırlarını aşan biçimde ifade etmesini, diğer yandan başkalarına fiziksel ya da psikolojik zarar verme eylemini içeren iki temel boyut taşımaktadır (WHO, 2002). Saldırganlık ise şiddetin ortaya çıkmasında fiziksel ve sözel davranışlar aracılığıyla görünür hâle gelen bir eğilim ve davranış biçimi olarak değerlendirilmektedir (Berkowitz, 1993; Anderson ve Bushman, 2002).

Saldırganlığın kökenine ilişkin kuramsal yaklaşımlar, bu davranışın insan doğasına içkin mi yoksa öğrenilmiş bir sosyal davranış mı olduğu sorusu etrafında şekillenmiştir. Bu bağlamda saldırganlık, genel olarak bireysel (içsel) ve çevresel (dışsal) faktörler temelinde açıklanmaktadır (Eroğlu, 2009). Bireysel faktörlere odaklanan kuramlar saldırganlığı biyolojik, içgüdüsel ya da psikodinamik temellere dayandırırken, çevresel faktörleri esas alan yaklaşımlar, saldırgan davranışların sosyal ve kültürel öğrenme süreçleri içerisinde şekillendiğini ileri sürmektedir. İçgüdüsel açıklamalar bağlamında, psikanalitik kuramın öncüsü Freud'un saldırganlığa ilişkin görüşleri önem taşımaktadır. Freud'a göre insan davranışlarının temelinde yaşam içgüdüsü (Eros) ve ölüm içgüdüsü (Thanatos) yer almaktadır. Ölüm içgüdüsünün dışa yönelmesi, saldırganlık ve yıkıcılık dürtülerini ortaya çıkarmaktadır (Burger, 2006). Freud, saldırganlığı doğuştan gelen içgüdüsel bir eğilim olarak ele alırken bu dürtünün içe yönelmesi durumunda bireyin kendisine, dışa yönelmesi hâlinde ise başkalarına zarar verme eğilimi gösterdiğini ileri sürmektedir (Atkinson ve ark., 1995).

Ancak saldırganlığın içgüdüsel bir özellik olarak ele alınması, özellikle yakın ilişkilerde ve aile içi şiddet bağlamında eleştirilmiştir. Sosyal öğrenme kuramcıları, saldırgan davranışların biyolojik kader olarak sunulmasının, şiddeti normalleştirme ve meşrulaştırma riski taşıdığına dikkat çekmektedir. Bu yaklaşım, özellikle erkek şiddetinin "doğal" ya da "kontrol edilemez" bir dürtü olarak açıklanmasının, toplumsal cinsiyet temelli eşitsizlikleri görünmez kılabileceğini vurgulamaktadır (Johnson, 2006). Davranışçı ve sosyal öğrenme kuramlarına göre saldırganlık, model alma, taklit, pekiştirme ve öğrenme süreçleriyle kazanılan bir davranış örüntüsüdür (Eroğlu, 2009). Özellikle aile içi şiddetin çoğu zaman gizli tutulması ve yaptırımsız kalması, saldırgan davranışların pekişmesine ve süreklilik kazanmasına neden olmaktadır (Gök, 2009). Bu durum, şiddetin kuşaklar arası aktarımını kolaylaştırırken aynı zamanda erkeklerin güç ve kontrol sahibi, kadınların ise mağdur konumda kalmasına zemin hazırlamaktadır. Engellenme kuramı ise saldırganlığın temelinde, bireyin hedeflerine ulaşmasının engellenmesi sonucu ortaya çıkan gerginlik ve dürtülerin yer aldığını savunmaktadır. Özgüven'e (2010) göre engellenme, saldırganlık dürtüsünü tetikleyen temel faktörlerden biridir. Engellenme

sonucunda ortaya çıkan gerginliği azaltma ve boşaltma ihtiyacı, bireyi saldırgan davranışlara yöneltebilmektedir (Tok, 2001). Bu bağlamda saldırganlık, bireyin yaşadığı içsel gerilimi azaltmaya yönelik ilkel bir baş etme biçimi olarak değerlendirilmektedir.

Saldırganlık davranışlarının öğrenilmesinde toplumsal cinsiyet rolleri belirleyici bir rol oynamaktadır. Sosyal kuramcılar, saldırganlığın cinsiyete göre farklı biçimlerde öğrenildiği ve ifade edildiği konusunda görüş birliği içindedir. Hetherington ve Parke'ye (1986) göre erkek çocuklar daha çok fiziksel saldırganlığa, kız çocuklar ise sözel ya da dolaylı saldırganlığa yönlendirilmektedir. Toplumsallaşma süreci içerisinde saldırganlık, atılganlık ve rekabet gibi özellikler erkeklik rolleriyle ilişkilendirilirken, kadınlardan pasif, uyumlu ve çekingen olmaları beklenmektedir (Prentice ve Carranza, 2002). Bu toplumsal yapı, evlilik ve aile ilişkilerinde saldırganlığın cinsiyetlenmiş bir biçimde ortaya çıkmasına neden olmaktadır. ASAGEM (2011) tarafından gerçekleştirilen Aile Yapısı Araştırması, çatışma durumlarında erkeklerin bağırma, azarlama, hakaret etme, eşya kırma ve fiziksel şiddet gibi davranışlara kadınlara kıyasla daha sık başvurduğunu göstermektedir. Kadınların ise çatışma karşısında daha çok sessiz kalma, içe atma ve geri çekilme gibi tepkiler verdikleri görülmektedir. Bu bulgular, çatışma çözüm süreçlerinde güç ve kontrol dinamiklerinin belirleyici olduğunu ortaya koymaktadır.

Allen ve Thomson'a (1984) göre ilişkilerde güç dengesinin sağlanabilmesi için, daha fazla güce sahip olan tarafın (çoğunlukla erkek) daha az güce sahip olan tarafı (kadın) anlamaya yönelik daha fazla çaba göstermesi gerekmektedir. Ancak ataerkil yapı içerisinde bu sorumluluk çoğu zaman yerine getirilmemekte tam tersi evlilik ilişkilerinde güç eşitsizliği yeniden üretilmektedir. Bu eşitsizlik, şiddetin sürekliliğini beslemekte ve birçok olayda kadınların tekrar eden mağduriyet döngüleri içerisinde yaşamlarını yitirmelerine kadar varan sonuçlar doğurmaktadır. Bu bağlamda evlilik çatışmalarında öfkenin nasıl ifade edildiği, saldırganlığın hangi koşullarda ortaya çıktığı ve bu süreçlerin toplumsal cinsiyetle nasıl kesiştiği, çatışma ve şiddetin anlaşılmasında merkezi bir öneme sahiptir. Evlilikte çatışmanın ele alınış biçimi, yalnızca bireysel ilişki niteliğini değil aynı zamanda kadınların yaşam hakkı ve güvenliği açısından da belirleyici bir faktör olarak karşımıza çıkmaktadır.

4. Şiddet Döngüsü

Ataerkil toplumsal yapılarda evlilik, yalnızca iki birey arasında kurulan duygusal bir birliktelik değil, aynı zamanda erkek egemenliğinin kurumsallaştığı, toplumsal cinsiyet temelli iktidar ilişkilerinin yeniden üretildiği bir yapı olarak işlev görmektedir. Bu bağlamda evlilik, erkekler açısından kadın üzerinde denetim ve kontrol kurmaya olanak sağlayan bir mekanizma işlevi görürken şiddet, bu denetimi sürdürmenin araçlarından biri olarak ortaya çıkmaktadır. Feminist

kuram, kadına yönelik şiddeti bireysel öfke patlamaları ya da ilişki içi çatışmaların sonucu olarak değil, erkek egemenliğine dayalı toplumsal düzenin bir ürünü olarak ele almaktadır.

Öztürk'ün (2014) araştırma bulguları, evlilikte erkekliğin "koca" kimliği üzerinden iktidarla özdeşleştirildiğini ve kadınlardan bu egemen konuma rıza göstermelerinin beklendiğini ortaya koymaktadır. Bu çerçevede evlilik çatışmalarında erkeğin aktif, kadının ise çoğunlukla pasif bir rol üstlendiği söz konusu rol dağılımının, çatışmanın yönünü belirlediği görülmektedir. Kadının sessiz kalması, geri çekilmesi ya da uzlaşmacı tutumu, şiddetin sona ermesini sağlamaktan çok, erkek iktidarının yeniden tesis edilmesine hizmet edebilmektedir.

Kadına yönelik şiddet, evlilik bağlamında kocanın karısı üzerinde bilinçli biçimde fiziksel, psikolojik, cinsel ya da ekonomik zarar verici davranışlar sergilemesi olarak tanımlanabilir. Şiddetin bu farklı türleri çoğu zaman birbirinden bağımsız değildir daha çok iç içe geçmiş ve birbirini besleyen bir yapı sergilemektedir (Öztürk, 2014). Ancak aile bütünlüğünün korunmasına atfedilen kültürel önem ve evliliğin "özel alan" olarak tanımlanması, şiddetin görünür kılınmasını ve eleştirel biçimde tartışılmasını güçleştirmektedir (Aktaş, 2006; Erdoğan ve ark., 2009). Bu durum, kadına yönelik şiddetin toplumsal meşruiyet kazanmasına zemin hazırlamaktadır.

Evlilik çatışmaları üzerine yapılan çalışmalarda cinsiyet rolü çatışmaları, öfke, kıskançlık ve güç ilişkileri ön plana çıkmaktadır (Dobash ve Dobash, 1979; Johnson, 2008; Connell, 1995). Erkeklerin engellenme ya da otorite kaybı algıladıkları durumlarda şiddete başvurmaları, kadınların ise bedensel ve ruhsal olarak ezilmeleri, ataerkil yapının cinsellik ve saldırganlığı iç içe geçiren doğasına işaret etmektedir (Goode, 1971; Anderson ve Umberson, 2001; Walby, 1990). Freud'un saldırganlık ve cinselliği temel içgüdüler olarak ele alan yaklaşımı (Freud, 1920; Freud, 1930), erkek şiddetinin içgüdüsel bir zemine oturtulması riskini taşımakta bu da feminist literatürde eleştirel biçimde tartışılmaktadır (Mitchell, 1974; Benjamin, 1988; Horney, 1967).

Kadına yönelik şiddetin sürekliliğini açıklamada şiddet döngüsü kavramı önemli bir kavramsal araç sunmaktadır. Walker'ın (1979) tanımladığı ve Jordan ile Walker (1994) tarafından geliştirilen bu modele göre şiddet; gerginlik evresi, şiddet evresi ve balayı evresi olmak üzere üç aşamada gerçekleşmektedir. Gerginlik evresinde artan baskı ve duygusal istismar, şiddet evresinde açık saldırganlığa dönüşmekte, ardından gelen balayı evresinde ise erkeğin pişmanlık ve ilgi gösteren tutumları, kadının umutlarını yeniden canlandırmaktadır. Bu döngü, kadının ilişkiden kopmasını zorlaştırmakta ve şiddetin sürekliliğini sağlamaktadır. Bu süreçte kadın,

yaşanan şiddetin sorumluluğunu kendisine atfetmeye başlayarak içselleştirilmiş bir suçluluk duygusu geliştirebilmektedir (Köse ve Beşer, 2007; Katerndahl ve ark., 2014).

Kadına yönelik şiddetin devamlılığında yapısal faktörlerin yanı sıra kültürel kodlar da belirleyici rol oynamaktadır. Erkekliğe atfedilen güç, sertlik, duygusuzluk ve kontrol sahibi olma gibi özellikler, erkekliğin iktidar merkezli bir kimlik olarak inşa edilmesini destekleyerek cinsiyet rollerinin sorgulanmasını engellemektedir (Öztürk, 2014). Erdoğan ve arkadaşlarının (2009) sığınma evinde kalan kadınlarla yaptığı nitel çalışma, kadınların şiddetle baş etme çabalarının çoğu zaman etkisiz kaldığını, aile, akraba ve toplumdan gelen "sabret" söylemlerinin kadını şiddet ortamına geri ittiğini göstermektedir. Bu söylemler, kadına yönelik şiddetin kültürel olarak nasıl normalleştirildiğini açık biçimde ortaya koymaktadır.

Şiddet ortamında yetişen çocuklar açısından bakıldığında, aile içi şiddetin öğrenilen bir davranış biçimi olduğu görülmektedir. Şiddete tanıklık eden çocuklar, şiddeti çatışma çözmenin meşru bir yolu olarak içselleştirebilmekte bu durum şiddetin kuşaklar arası aktarımını güçlendirmektedir (Jaffe ve ark.; İçli, 1994). Bu bağlamda aile, yalnızca sevgi ve dayanışmanın değil, aynı zamanda şiddetin de öğretildiği bir sosyalizasyon alanı haline gelmektedir. Şiddet karşısında kadınların sıklıkla sergilediği geri çekilme ve ilişkiyi sürdürme eğilimi, Seligman'ın (1975) öğrenilmiş çaresizlik kavramı çerçevesinde değerlendirilebilir. Özellikle süreklilik gösteren şiddet deneyimleri, kadının kaçma ya da direnme girişimlerinden vazgeçmesine, çaresizlik ve depresyon duygularının derinleşmesine yol açmaktadır. Ekonomik bağımlılık, çocukların varlığı ve ölüm tehdidi, kadınların şiddet ortamında kalmalarını pekiştiren yapısal etkenler arasında yer almaktadır (Atkinson ve ark., 2008).

Türkiye'de yapılan araştırmalar, kadına yönelik şiddetin yaygın ve süreklilik gösteren bir toplumsal sorun olduğunu ortaya koymaktadır. Aile içi şiddet yardım hatlarına yapılan başvuruların büyük çoğunluğunun kadınlar tarafından gerçekleştirilmesi, şiddetin cinsiyetlenmiş doğasını gözler önüne sermektedir. Kadınların evli, boşanmış ya da ayrı yaşıyor olmasının şiddet riskini ortadan kaldırmadığı, aksine bazı durumlarda şiddeti daha da arttırdığı görülmektedir (Güler ve ark., 2005; Çalı, 2012). Bu bulgular, şiddetin yalnızca evlilik birliğine özgü bir sorun olmadığını, erkek egemenliğinin sürdüğü tüm toplumsal bağlamlarda yeniden üretildiğini göstermektedir.

Şiddetin bu denli yaygın olmasının ardında, toplumun hangi davranışları şiddet olarak tanımladığı ve hangilerini meşrulaştırdığı sorusu yatmaktadır. "Dayak"ın terbiye aracı olarak görülmesi, aile içinin mahrem alan kabul edilmesi ve devletin özel alan–kamusal alan ayrımı üzerinden şiddete müdahalede yetersiz kalması, kadına yönelik şiddetin görünmezleşmesine

neden olmaktadır (Özgüven, 2010). Feminist perspektiften bakıldığında, kadına yönelik şiddet bireysel bir sorun değil ataerkil toplumsal düzenin kadın bedeni ve yaşamı üzerindeki denetiminin en açık göstergelerinden biridir.

SONUÇ

Kişiler arası ilişkilerde hak olgusu, bireylerin karşılıklı sorumluluklarını, sınırlarını ve öznelliklerini tanımalarını gerektirir. Romantik ilişkiler ve özellikle evlilik bağlamında ise hak kavramı çoğu zaman eşitlik temelinde değil, toplumsal cinsiyet rolleri doğrultusunda yeniden tanımlanmaktadır. Evlilik, iki bireyin yaşamı paylaşmasını ve ortak bir düzen kurmasını içeren bir birliktelik olmakla birlikte, bu birlikteliğin sağlıklı biçimde sürdürülebilmesi, karşılıklı kabullere ve dengeli bir güç paylaşımına dayanmaktadır. Güç dengesinin bozulduğu durumlarda evlilik ilişkisi çatışmalı bir yapıya dönüşmekte ve bu çatışma çoğu zaman saldırganlık ve şiddet ile sonuçlanmaktadır.

Evliliklerdeki eşitsizliğin temelinde, erkeğin daha fazla güce ve daha geniş bir "hak çemberine" sahip olması, kadının ise daha dar bir hak alanı içerisinde konumlandırılması yer almaktadır (Bancroft, 2002). Bu yapısal eşitsizlik, evlilik çatışmalarında da kendini göstermekte, erkeğin baskı ve kontrol edici tutumlarını, kadının ise daha edilgen ve savunmasız bir pozisyonda kalmasını beraberinde getirmektedir. Aile içinde rollerin cinsiyete göre ayrıştırılması ve gücün erkekle özdeşleştirilmesi, çatışma süreçlerinde şiddetin bir çözüm yöntemi olarak devreye girmesine zemin hazırlamaktadır.

Saldırganlığın kaynağına ilişkin farklı kuramsal yaklaşımlar bulunmakla birlikte, saldırgan davranışların kadın ve erkekler arasında farklı biçimlerde ortaya çıktığı konusunda literatürde ortak bir görüş bulunmaktadır. Bu farklılık, kadın ve erkeklerin farklı sosyalizasyon süreçlerinden geçmeleriyle açıklanmaktadır. Erkeklerin çatışma durumlarında daha çok fiziksel saldırganlığa ve şiddete başvurdukları, kadınların ise çoğunlukla savunmasız kaldıkları, suçluluk ve çaresizlik duyguları geliştirdikleri, çatışmanın sorumluluğunu kendilerinde arama eğiliminde oldukları görülmektedir. Evlilik bağının sürmesi ya da sona ermesi, çoğu durumda bu çatışma ve şiddet dinamiğini ortadan kaldırmamaktadır.

Medyaya yansıyan kadın cinayetleri incelendiğinde, kadınların yaşamlarına son verilme gerekçelerinin çoğunlukla evliliğe atfedilen rol ve sorumlulukların "yerine getirilmemesi" ya da "toplumsal ahlak kurallarına" uyulmaması biçiminde gerekçelendirildiği dikkat çekmektedir. "Erkek" ve "koca" kimliklerinin şiddeti meşrulaştıran bir zemin oluşturması ve bu meşruiyetin toplumsal düzeyde yeterince sorgulanamaması, evlilik çatışmalarında kadına yönelik şiddetin sürekliliğini açıklayan önemli etkenler arasında yer almaktadır. Kadınlık ve

erkeklik rollerinin kültürel kodlarla aktarılması ve bu rollerin sorgulanmaksızın içselleştirilmesi, çatışma süreçlerinde eşitsizliğin yeniden üretilmesine yol açmaktadır.

Bancroft'un (2002) da vurguladığı gibi, istismar yalnızca bireysel ya da psikolojik bir sorun değil, değer sistemleriyle ve kültürel normlarla yakından ilişkili bir olgudur. Erkekler çocukluk dönemlerinden itibaren, toplumsal ve kültürel etkiler yoluyla istismarı model almakta, katı sosyalizasyon süreçleri içinde "uygun" kadınlık ve erkeklik davranışları eleştirilmeden kabul edilmektedir. Bu davranış kalıplarının ihlali ise çoğu zaman töresel yaptırımlar ve şiddetle karşılık bulmaktadır. Kültürel kabullerin evlilik ilişkilerinde belirleyici olması, iletişim becerilerinin ve eşitlik temelli çözüm yollarının geri planda kalmasına neden olmaktadır. Kriz durumlarında öfkenin saldırganlık yoluyla ifade edilmesi, çözülemeyen çatışmalar üretmekte, bu durum yalnızca eşler arasında değil, çocukların yetiştirilme süreçlerinde de olumsuz etkiler yaratmaktadır.

Sonuç olarak, evlilik çatışmalarının sağlıklı biçimde çözümlenebilmesi, kadın ve erkeğin çatışmaya yaklaşımlarının dönüştürülmesine bağlıdır. Evlilik ilişkilerinde her iki tarafın da olumlu çatışma çözme becerilerine sahip olması büyük önem taşımaktadır. Çatışma, öfkenin yanlış biçimde ifade edilmesi durumunda saldırganlık ve şiddetle sonuçlanabileceği gibi, eşitlikçi ve iletişime dayalı çözüm yollarının geliştirilmesi halinde, çiftler arasındaki güven ilişkisini güçlendiren bir sürece de dönüşebilir. Bu bağlamda, evlilik çatışmalarının olumlu sonuçlara ulaşabilmesi, öfke ve saldırganlığın kontrol edilmesine, toplumsal cinsiyet temelli eşitsizliklerin sorgulanmasına ve hak ihlallerini reddeden bir ilişki anlayışının benimsenmesine bağlıdır.

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SEREBRAL PALSİLİ ÇOCUKLARDA İŞİTSEL VE GÖRSEL DİKKAT EKSİKLİĞİ İLE DİL GELİŞİMİ

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ÖZET

Serebral palsili çocuklarda dil gelişimi, hem bilişsel hem de motor fonksiyonlarla yakından ilişkili olup, işitsel ve görsel dikkat eksikliklerinin bu süreç üzerindeki etkisi giderek daha fazla araştırılmaktadır. Ancak, mevcut literatürde bu ilişkilerin sistematik olarak incelendiği çalışmalar sınırlıdır ve çoğu araştırma yalnızca motor veya dil becerilerine odaklanmaktadır. Bu sistematik çalışmanın amacı, serebral palsili çocuklarda işitsel ve görsel dikkat eksikliklerinin dil gelişimi üzerindeki etkilerini değerlendiren mevcut araştırmaları bütüncül bir bakış açısıyla incelemektir. Literatür taraması sonucunda, dikkat eksikliklerinin özellikle sözcük dağarcığı, sözdizimsel yapı ve pragmatik dil kullanımı üzerinde belirgin olumsuz etkiler yarattığı görülmektedir. İşitsel dikkat zayıflığı olan çocuklar, sesleri ayırt etme ve sözcükleri doğru şekilde öğrenme konusunda güçlük yaşarken; görsel dikkat eksikliği, yazılı dil edinimi ve gözlem yoluyla öğrenilen dil becerilerini olumsuz etkileyebilmektedir. Bununla birlikte, araştırmalar genellikle küçük örneklemlerle sınırlı kalmakta ve uzunlamasına verilerin eksikliği nedeniyle dikkat-dil etkileşiminin gelişimsel dinamikleri tam olarak anlaşılamamaktadır. Gelecekte yapılacak uzunlamasına ve çok disiplinli çalışmaların, serebral palsili çocuklarda erken dönemde dikkat ve dil becerilerini eş zamanlı olarak değerlendirmesi önerilmektedir. Ayrıca, eğitim ve terapötik müdahalelerde işitsel ve görsel dikkat destekleyici yaklaşımların dil gelişimi üzerindeki potansiyel katkıları araştırılmalıdır. Bu çalışma, hem klinik uygulamalara hem de eğitimsel planlamalara özgün katkılar sunarak, serebral palsili çocuklarda dil gelişimini destekleyici stratejilerin geliştirilmesine ışık tutmayı amaçlamaktadır.

Anahtar Kelimeler: Serebral Palsi, Dil Gelişimi, İşitsel Dikkat, Görsel Dikkat, Çocuk Gelişimi

AUDITORY AND VISUAL ATTENTION DEFICITS AND LANGUAGE DEVELOPMENT IN CHILDREN WITH CEREBRAL PALSY

ABSTRACT

Language development in children with cerebral palsy is closely linked to both cognitive and motor functions, and the impact of auditory and visual attention deficits on this process has been increasingly investigated. However, the existing literature contains limited studies that systematically examine these relationships, with most research focusing solely on motor or language skills. The aim of this systematic review is to provide a comprehensive evaluation of existing studies investigating the effects of auditory and visual attention deficits on language

development in children with cerebral palsy. A review of the literature indicates that attention deficits have particularly pronounced negative effects on vocabulary acquisition, syntactic structure, and pragmatic language use. Children with impaired auditory attention experience difficulties in discriminating sounds and accurately learning words, whereas deficits in visual attention may negatively affect written language acquisition and observationally learned language skills. Nevertheless, studies are generally limited by small sample sizes, and the lack of longitudinal data prevents a full understanding of the developmental dynamics between attention and language. Future longitudinal and multidisciplinary research is recommended to simultaneously assess attention and language skills in the early stages of development in children with cerebral palsy. Additionally, the potential contributions of educational and therapeutic interventions that support auditory and visual attention on language development should be explored. This study aims to provide unique insights for both clinical practice and educational planning, ultimately guiding the development of strategies to support language acquisition in children with cerebral palsy.

Keywords: Cerebral Palsy, Language Development, Auditory Attention, Visual Attention, Child Development

1. GİRİŞ

Serebral palsi (SP), gelişmekte olan fetal ya da infantil beyinde meydana gelen ilerleyici olmayan hasarlara bağlı olarak ortaya çıkan, hareket ve postür bozukluklarıyla karakterize bir nörogelişimsel durumdur. Ancak güncel yaklaşımlar, serebral palsinin yalnızca motor işlevlerle sınırlı bir bozukluk olmadığını, buna ek olarak bilişsel, duyusal, algısal ve iletişimsel alanları da önemli ölçüde etkileyebildiğini ortaya koymaktadır (Rosenbaum et al., 2007; Bax et al., 2005). Özellikle dikkat, algı ve dil gibi üst düzey bilişsel süreçlerde gözlenen güçlükler, serebral palsili çocukların akademik başarılarını, sosyal etkileşimlerini ve yaşam kalitelerini doğrudan etkilemektedir. Bu nedenle SP, günümüzde motor bozuklukların ötesinde çok boyutlu bir nörogelişimsel sendrom olarak ele alınmaktadır.

Nörogelişimsel bozukluklar çerçevesinde serebral palsi, beyin hasarının erken dönemde gerçekleşmesi nedeniyle gelişimin birçok alanında zincirleme etkiler yaratmaktadır. Beynin dikkat, algı ve dil ile ilişkili kortikal ve subkortikal bölgelerindeki hasar, çocukların çevresel uyaranları algılama, seçme ve işleme kapasitelerini sınırlayabilmektedir (Anderson et al., 2018). Bu durum özellikle dikkat sistemleri üzerinde belirgin bir etki yaratmakta; işitsel ve görsel dikkat süreçlerinde yaşanan bozulmalar, dil edinimi ve dil işleme becerilerinin gelişimini olumsuz yönde etkilemektedir.

Dikkat, bilişsel gelişimin temel bileşenlerinden biri olarak öğrenme, bellek ve dil süreçleriyle yakından ilişkilidir. Dikkat sistemleri, bireyin çevresindeki uyaranlar arasından anlamlı olanları seçmesini, bu uyaranlara odaklanmasını ve bilgiyi etkili biçimde işlemesini sağlar (Posner & Petersen, 1990). İşitsel dikkat, özellikle konuşma seslerinin ayırt edilmesi, sözel girdinin sürdürülmesi ve fonolojik temsillerin oluşturulmasında kritik bir rol oynarken; görsel dikkat, ortak dikkat, yüz ifadelerinin izlenmesi ve sözcük-nesne eşleştirmeleri gibi dil gelişiminin erken evrelerinde belirleyici bir işlev üstlenmektedir (Colombo, 2001; Mundy & Newell, 2007). Dikkat süreçlerindeki aksaklıklar, çocuğun dilsel girdiyi yeterince işleyememesine ve bu nedenle dil gelişiminde gecikmelere yol açabilmektedir.

Serebral palsili çocuklarda dil ve iletişim sorunları oldukça yaygın olarak rapor edilmektedir. Araştırmalar, bu çocukların hem alıcı hem de ifade edici dil becerilerinde yaşıtlarına kıyasla anlamlı düzeyde gerilik gösterebildiklerini ortaya koymaktadır (Hustad et al., 2010). Sözcük dağarcığı sınırlılıkları, dilbilgisel yapıların kullanımında zorluklar, fonolojik hatalar ve konuşma anlaşılırlığında düşüş sık karşılaşılan sorunlar arasındadır. Buna ek olarak, pragmatik dil becerilerinde görülen yetersizlikler; sıra alma, konu sürdürme ve sosyal bağlama uygun dil kullanımı gibi alanlarda güçlükler yaratmakta ve çocukların sosyal katılımını olumsuz etkilemektedir (Pennington et al., 2013). Bu dil ve iletişim güçlükleri, eğitimsel süreçlerde akademik başarının düşmesine ve uzun vadede psikososyal sorunların ortaya çıkmasına neden olabilmektedir.

Bu çalışmanın amacı, serebral palsili çocuklarda işitsel ve görsel dikkat eksiklikleri ile dil gelişimi arasındaki ilişkiyi bütüncül bir bakış açısıyla incelemek ve mevcut literatürü tematik olarak değerlendirmektir. Bu bağlamda, işitsel ve görsel dikkat süreçlerinin dil edinimi ve dil performansı üzerindeki etkileri ele alınmakta; hangi dikkat bileşenlerinin dil gelişimini daha güçlü biçimde yordadığına odaklanılmaktadır. Ayrıca, dikkat ve dil alanlarını birlikte ele alan çalışmaların sınırlı olması, bu çalışmanın literatürdeki önemli bir boşluğu doldurmasını hedeflemektedir. Çalışmanın, klinik uygulamalar ve eğitimsel müdahaleler için kuramsal ve pratik çıkarımlar sunması beklenmektedir.

2. KAVRAMSAL VE KURAMSAL ÇERÇEVE

2.1. Dikkat Türleri

Dikkat, bireyin çevresindeki çok sayıdaki uyaran arasından belirli olanları seçmesini, bu uyaranlara odaklanmasını ve bilişsel kaynaklarını etkin biçimde kullanmasını sağlayan temel bir bilişsel süreçtir. Güncel bilişsel psikoloji ve nörobilim literatüründe dikkat, tek boyutlu bir

yapı olarak değil; farklı bileşenlerden oluşan çok katmanlı bir sistem olarak ele alınmaktadır (Posner & Petersen, 1990). Bu bağlamda seçici dikkat, bireyin çevredeki uyaranlar arasından hedef olan bilgiyi ayırt edebilmesini ve dikkatini bu uyaran üzerinde yoğunlaştırabilmesini ifade etmektedir. Dil gelişimi açısından seçici dikkat, konuşma ortamında anlamlı sözel girdinin arka plan gürültüsünden ayrıştırılmasında kritik bir rol oynamaktadır.

Süreklilik gösteren dikkat ise bireyin dikkatini belirli bir uyaran ya da görev üzerinde uzun süre boyunca sürdürebilme kapasitesini ifade eder. Özellikle dil öğrenimi sürecinde, dinleme etkinlikleri, yönergeleri takip etme ve etkileşim sırasında dikkatin sürekliliği, dil girdisinin yeterince işlenebilmesi açısından büyük önem taşımaktadır (Robertson & Garavan, 2004). Bölünmüş dikkat ise aynı anda birden fazla uyaran ya da görevin izlenmesini içeren daha karmaşık bir dikkat türüdür. Dilin doğal kullanımı sırasında konuşmayı dinleme, bağlamsal ipuçlarını değerlendirme ve eş zamanlı olarak motor ya da görsel görevleri yerine getirme gerekliliği, bölünmüş dikkat becerilerinin önemini ortaya koymaktadır. Serebral palsili çocuklarda bu dikkat türlerinin herhangi birinde görülen yetersizlikler, dil edinimi ve iletişimsel yeterlik üzerinde belirgin sınırlılıklara yol açabilmektedir.

2.2. İşitsel Dikkat ve Dil Gelişimi

İşitsel dikkat, bireyin işitsel uyaranlara yönelmesini, bu uyaranları ayırt etmesini ve anlamlandırmasını sağlayan bilişsel bir süreçtir. Dil gelişiminin temelinde yer alan işitsel ayrımlaştırma becerisi, konuşma seslerinin doğru biçimde algılanmasını ve fonemlerin birbirinden ayırt edilmesini mümkün kılar. Bu süreçte işitsel dikkat, dil girdisinin doğru şekilde kodlanabilmesi için ön koşul niteliğindedir (Tallal, 2004).

Fonolojik farkındalık, bireyin dilin ses yapısına ilişkin bilinçli farkındalık geliştirmesini ifade eder ve okuma-yazma becerilerinin yanı sıra sözlü dil gelişimiyle de yakından ilişkilidir. Araştırmalar, işitsel dikkat becerilerindeki yetersizliklerin fonolojik farkındalığın gelişimini olumsuz etkilediğini ve bunun da hem alıcı hem de ifade edici dil becerilerinde gecikmelere yol açtığını göstermektedir (Goswami, 2011). Konuşma algısı ve dinleme süreçleri de işitsel dikkatle doğrudan bağlantılıdır. Özellikle hızlı ve karmaşık konuşma girdisinin bulunduğu doğal iletişim ortamlarında, işitsel dikkatin etkin biçimde kullanılamaması, dil girdisinin parçalı ya da hatalı algılanmasına neden olabilmektedir. Serebral palsili çocuklarda sıklıkla bildirilen işitsel dikkat sorunları, bu çocukların dil gelişiminde karşılaştıkları güçlükleri açıklamada önemli bir kuramsal çerçeve sunmaktadır.

2.3. Görsel Dikkat ve Dil Gelişimi

Görsel dikkat, bireyin çevresel görsel uyaranlara yönelmesini ve bu uyaranları bilişsel olarak işlemesini sağlayan bir diğer temel dikkat bileşenidir. Dil gelişimi bağlamında görsel dikkatin en önemli boyutlarından biri ortak dikkat kavramıdır. Ortak dikkat, çocuğun bir yetişkinle aynı nesneye ya da olaya eş zamanlı olarak dikkatini yöneltebilmesini ifade eder ve erken dil gelişiminin en güçlü yordayıcılarından biri olarak kabul edilmektedir (Tomasello, 2003).

Görsel ipuçları, özellikle erken çocukluk döneminde sözcük öğrenimini destekleyen önemli araçlardır. Nesneye bakış, işaret etme ve bağlamın görsel olarak sunulması, yeni sözcüklerin anlamlandırılmasını kolaylaştırmaktadır. Bu süreçte görsel dikkat eksiklikleri, sözcük öğrenme hızını ve doğruluğunu olumsuz yönde etkileyebilmektedir (Yu & Smith, 2012). Ayrıca göz teması ve yüz ifadeleri, iletişimin pragmatik boyutunda merkezi bir rol oynamaktadır. Görsel dikkat sorunları yaşayan çocuklar, bu sosyal ipuçlarını yeterince takip edemediklerinde etkileşimsel iletişimde ve pragmatik dil kullanımında güçlük yaşayabilmektedir. Serebral palsili çocuklarda görsel dikkatle ilişkili bu sınırlılıklar, dil ve iletişim sorunlarının önemli bir bileşeni olarak değerlendirilmektedir.

2.4. Nörolinguistik ve Bilişsel Kuramlar

Serebral palsili çocuklarda dikkat ve dil gelişimi arasındaki ilişkiyi açıklamada çeşitli nörolinguistik ve bilişsel kuramsal yaklaşımlar öne çıkmaktadır. Bilgi işleme kuramı, bilişsel kaynakların sınırlı olduğu varsayımına dayanarak, dikkat süreçlerindeki yetersizliklerin dil girdisinin işlenmesini ve depolanmasını zorlaştırdığını ileri sürmektedir (Baddeley, 2003). Bu kuram çerçevesinde, dikkat kapasitesinin sınırlı olması, dil öğrenme sürecinde girdinin yüzeysel işlenmesine ve kalıcı dil temsillerinin oluşamamasına neden olabilmektedir.

Nöroplastisite kavramı ise erken dönemde beynin yapısal ve işlevsel olarak değişebilme kapasitesine vurgu yapmaktadır. Erken müdahale programlarının, dikkat ve dil gelişimini destekleyerek hasarlı sinir ağlarının telafi edilmesine katkı sağlayabileceği belirtilmektedir (Kolb & Gibb, 2011). Bu bağlamda, erken yaşta uygulanan dikkat temelli ve dil odaklı müdahaleler, serebral palsili çocukların iletişimsel yeterliklerini artırmada önemli bir potansiyele sahiptir.

Çoklu duyusal entegrasyon yaklaşımı, dil gelişiminin yalnızca işitsel değil, aynı zamanda görsel ve diğer duyusal girdilerin birlikte işlenmesiyle gerçekleştiğini savunmaktadır. İşitsel ve görsel dikkat süreçlerinin eşgüdümlü çalışması, dilin daha etkili biçimde öğrenilmesini ve kullanılmasını sağlamaktadır (Shams & Seitz, 2008). Serebral palsili çocuklarda bu

entegrasyonun bozulması, dil gelişimindeki güçlükleri açıklayan önemli kuramsal çerçevelerden biri olarak öne çıkmaktadır.

3. BULGULARIN TEMATİK DEĞERLENDİRİLMESİ

3.1. Serebral Palsili Çocuklarda İşitsel Dikkat Eksiklikleri

Literatürde yer alan çalışmaların önemli bir bölümü, serebral palsili çocuklarda işitsel uyaranlara odaklanma ve dikkati sürdürme becerilerinde belirgin sınırlılıklar bulunduğunu ortaya koymaktadır. Bu çocukların özellikle çevresel gürültünün bulunduğu ortamlarda konuşma seslerini ayırt etmekte zorlandıkları ve hedef uyaranlara dikkatlerini yöneltmekte güçlük yaşadıkları bildirilmektedir (Pirila et al., 2007). İşitsel dikkat eksiklikleri, konuşma sırasında anlamlı girdinin seçilmesini zorlaştırmakta ve dil girdisinin bütüncül olarak işlenmesini engellemektedir.

Konuşma algısı bağlamında değerlendirildiğinde, serebral palsili çocukların konuşma seslerini ayırt etme, hızlı konuşmayı takip etme ve sözel bilgiyi zamansal olarak doğru biçimde işleme konusunda güçlük yaşadıkları görülmektedir. Tallal (2004), işitsel dikkat ve zamansal işlemleme sorunlarının, özellikle fonolojik yapıların algılanmasını olumsuz etkilediğini ve bunun dil gelişiminde gecikmelere yol açtığını vurgulamaktadır. Bu durum, serebral palsili çocuklarda sıkça gözlenen artikülasyon ve fonolojik hata örüntülerini açıklamada önemli bir bulgusal dayanak sunmaktadır.

İşitsel dikkat eksikliğinin alıcı dil becerileri üzerindeki etkileri literatürde tutarlı biçimde rapor edilmiştir. Yönergeleri anlama, sözel bilgiyi kısa süreli bellekte tutma ve anlamlandırma gibi alıcı dil süreçleri, dikkat kapasitesiyle doğrudan ilişkilidir. Hustad ve arkadaşları (2010), işitsel dikkat sorunları yaşayan serebral palsili çocukların alıcı dil testlerinde anlamlı derecede daha düşük performans sergilediklerini ve bu durumun genel iletişim yeterliğini sınırladığını ortaya koymuştur.

3.2. Görsel Dikkat Eksiklikleri ve Dil Performansı

Görsel dikkat eksiklikleri, serebral palsili çocuklarda dil performansını etkileyen bir diğer önemli faktör olarak öne çıkmaktadır. Özellikle ortak dikkat kuramı çerçevesinde yürütülen çalışmalar, bu çocukların yetişkinlerle ortak dikkat kurma ve sürdürme konusunda güçlük yaşadıklarını göstermektedir (Adamson et al., 2010). Ortak dikkat eksikliği, dil girdisinin bağlamsal olarak yapılandırılmasını zorlaştırmakta ve erken sözcük öğrenimini olumsuz etkilemektedir.

Görsel izleme becerileri ile sözcük öğrenimi arasındaki ilişkiyi inceleyen araştırmalar, nesneye yöneltilen bakış ve görsel odaklanmanın yeni sözcüklerin anlamlandırılmasında belirleyici

olduğunu ortaya koymaktadır. Yu ve Smith (2012), görsel dikkat yoluyla nesne–sözcük eşleştirmesinin dil öğreniminde temel bir mekanizma olduğunu belirtmektedir. Serebral palsili çocuklarda görsel izleme ve dikkat sürekliliğindeki sınırlılıklar, bu eşleştirme sürecini sekteye uğratarak sözcük dağarcığının gelişimini yavaşlatabilmektedir.

Görsel dikkat eksikliklerinin pragmatik dil becerileri üzerindeki etkileri de literatürde sıklıkla vurgulanmaktadır. Göz teması kurma, yüz ifadelerini takip etme ve jestleri yorumlama gibi beceriler, etkili iletişimin temel bileşenleri arasında yer almaktadır. Bu alanlardaki yetersizlikler, serebral palsili çocukların sosyal etkileşimlerde uygun dilsel tepkiler vermesini zorlaştırmakta ve pragmatik dil kullanımında sınırlılıklara yol açmaktadır (Tomasello, 2003).

3.3. İşitsel ve Görsel Dikkatin Birlikte Etkisi

Derleme kapsamında incelenen çalışmalar, işitsel ve görsel dikkat süreçlerinin dil gelişimi üzerindeki etkilerinin çoğu zaman birbirinden bağımsız değil, etkileşimli olduğunu göstermektedir. Çoklu duyusal (multisensory) işlemleme becerilerindeki yetersizlikler, dil girdisinin bütüncül olarak algılanmasını ve işlenmesini zorlaştırmaktadır. Shams ve Seitz (2008), dil öğreniminin yalnızca işitsel girdiye değil, aynı zamanda görsel ve bağlamsal ipuçlarının entegrasyonuna dayandığını vurgulamaktadır.

Çapraz modal dikkat eksiklikleri, yani bir duyusal alandaki bilginin diğer duyusal girdilerle eşgüdümlü olarak işlenememesi, serebral palsili çocuklarda dil gelişimini sınırlayan önemli bir faktör olarak değerlendirilmektedir. İşitsel ve görsel bilgilerin senkronize biçimde işlenememesi, özellikle doğal iletişim ortamlarında dil girdisinin parçalı algılanmasına neden olmaktadır. Bu durum, dilin akıcı kullanımını ve anlamlandırılmasını zorlaştırmaktadır.

Dil gecikmesi ile dikkat düzeyi arasındaki ilişkiyi inceleyen çalışmalar, dikkat becerilerindeki düşüklüğün dil performansının güçlü bir yordayıcısı olduğunu ortaya koymaktadır. Anderson ve arkadaşları (2008), dikkat ve yürütücü işlevlerdeki sınırlılıkların, dil gelişiminde gözlenen gecikmelerle anlamlı biçimde ilişkili olduğunu belirtmektedir. Bu bulgu, dikkat süreçlerinin dil gelişimi açısından merkezi bir rol oynadığını desteklemektedir.

3.4. Müdahale ve Rehabilitasyon Odaklı Bulgular

Müdahale çalışmalarına odaklanan literatür, dikkat temelli yaklaşımların dil terapilerinde etkili sonuçlar doğurabileceğini göstermektedir. Dikkat sürekliliğini ve seçici dikkati hedefleyen dil terapilerinin, alıcı ve ifade edici dil becerilerinde anlamlı gelişmeler sağladığı bildirilmektedir (Law et al., 2012). Bu tür müdahaleler, dil girdisinin daha etkili işlenmesine katkıda bulunmaktadır.

Teknoloji destekli uygulamalar, özellikle bilgisayar tabanlı dikkat ve dil programları, serebral palsili çocuklar için umut vadeden bir alan olarak değerlendirilmektedir. Görsel ve işitsel uyaranların yapılandırılmış biçimde sunulduğu bu uygulamaların, dikkat motivasyonunu artırarak dil öğrenimini desteklediği ifade edilmektedir (Chen et al., 2019).

Erken müdahalenin rolü, derleme kapsamında incelenen çalışmaların ortak vurgu noktalarından biridir. Nöroplastisite kuramı doğrultusunda, erken yaşta uygulanan dikkat ve dil odaklı müdahalelerin uzun vadeli iletişimsel kazanımlar sağladığı belirtilmektedir (Kolb & Gibb, 2011). Bu bulgular, serebral palsili çocuklarda dikkat ve dil gelişiminin erken dönemde desteklenmesinin kritik önemini ortaya koymaktadır.

4. SINIRLILIKLAR VE GELECEK ARAŞTIRMALAR

Bu derleme kapsamında incelenen çalışmaların önemli bir bölümü, metodolojik açıdan bazı sınırlılıklar içermektedir. Öncelikle, araştırmalar arasında kullanılan ölçme araçlarının çeşitlilik göstermesi, dikkat ve dil becerilerinin farklı tanımsal çerçeveler üzerinden değerlendirilmesine yol açmaktadır. İşitsel ve görsel dikkat, bazı çalışmalarda standartlaştırılmış nöropsikolojik testlerle ölçülürken, bazı araştırmalarda gözlem temelli ya da ebeveyn raporlarına dayalı araçlar kullanılmıştır. Bu durum, bulguların doğrudan karşılaştırılmasını güçleştirmekte ve genellenebilirliği sınırlamaktadır (Snyder, 2019). Ayrıca çalışmaların büyük kısmının kesitsel tasarıma sahip olması, dikkat ve dil gelişimi arasındaki nedensel ilişkilerin ortaya konulmasını zorlaştırmaktadır.

Literatürde yer alan araştırmaların önemli bir kısmı, sınırlı örneklem büyüklükleriyle yürütülmüştür. Serebral palsinin heterojen doğası göz önünde bulundurulduğunda, küçük örneklemler motor tip, bilişsel düzey ve eşlik eden bozukluklar gibi değişkenlerin yeterince kontrol edilememesine neden olmaktadır. Bu durum, dikkat ve dil becerilerine ilişkin bulguların genellenebilirliğini azaltmaktadır (Bax et al., 2005). Ayrıca bazı çalışmalarda kontrol gruplarının bulunmaması ya da uygun eşleştirme yapılmaması, elde edilen sonuçların yorumlanmasını güçleştiren bir diğer sınırlılık olarak öne çıkmaktadır.

Gelecek araştırmaların, serebral palsili çocuklarda işitsel ve görsel dikkat ile dil gelişimi arasındaki ilişkiyi daha net biçimde ortaya koyabilmesi için deneysel tasarımlara yönelmesi önerilmektedir. Özellikle dikkat temelli müdahale programlarının dil gelişimi üzerindeki etkilerini inceleyen kontrollü deneysel çalışmalar, klinik uygulamalara önemli katkılar sağlayabilir. Bunun yanı sıra uzunlamasına araştırmalar, dikkat ve dil becerilerinin gelişimsel seyrini izleyerek bu iki alan arasındaki etkileşimin zaman içindeki değişimini ortaya koymada kritik bir role sahiptir (Anderson et al., 2008).

Ayrıca gelecekte yapılacak çalışmaların, çoklu duyusal entegrasyon süreçlerini merkeze alan yaklaşımlar benimsemesi ve işitsel ile görsel dikkat bileşenlerini birlikte ele alması önerilmektedir. Daha büyük ve homojen örneklemlerle yürütülecek uzun vadeli araştırmalar, serebral palsili çocuklarda dikkat ve dil gelişimine ilişkin daha güçlü kanıtlar sunarak hem kuramsal literatüre hem de klinik müdahale modellerine önemli katkılar sağlayacaktır.

5. SONUÇ

Bu çalışma, serebral palsili çocuklarda işitsel ve görsel dikkat eksiklikleri ile dil gelişimi arasındaki ilişkiyi çok boyutlu bir bakış açısıyla ele alarak mevcut literatürü bütüncül biçimde değerlendirmiştir. İncelenen çalışmaların ortak bulguları, serebral palsinin yalnızca motor işlevlerle sınırlı olmayan, bilişsel ve iletişimsel süreçleri de derinden etkileyen nörogelişimsel bir durum olduğunu ortaya koymaktadır. Özellikle dikkat süreçlerindeki yetersizliklerin, dil girdisinin algılanması, işlenmesi ve kullanılması üzerinde belirleyici bir rol oynadığı görülmektedir. Bu durum, dil gelişiminde gözlenen gecikme ve bozuklukların yalnızca konuşma motoru sorunlarıyla açıklanamayacağını, altta yatan bilişsel mekanizmaların da dikkate alınması gerektiğini göstermektedir.

Çalışma kapsamında değerlendirilen bulgular, işitsel dikkatin konuşma algısı, fonolojik işlemleme ve alıcı dil becerileriyle; görsel dikkatin ise ortak dikkat, sözcük öğrenimi ve pragmatik dil kullanımıyla yakından ilişkili olduğunu ortaya koymuştur. Bununla birlikte, işitsel ve görsel dikkat süreçlerinin çoğu zaman etkileşimli biçimde çalıştığı ve çoklu duyusal entegrasyonun dil gelişimi açısından kritik bir öneme sahip olduğu vurgulanmaktadır (Shams & Seitz, 2008). Bu bağlamda, dikkat eksikliklerinin dil gelişimini dolaylı ve doğrudan yollarla etkilediği, özellikle dikkat kapasitesinin sınırlı olduğu durumlarda dil girdisinin yüzeysel işlendiği ve kalıcı dil temsillerinin oluşmasının zorlaştığı anlaşılmaktadır.

Elde edilen bulgular, klinik uygulamalar açısından önemli çıkarımlar sunmaktadır. Dil ve konuşma terapilerinde dikkat süreçlerinin değerlendirilmesi ve müdahale programlarının dikkat temelli bileşenleri içerecek şekilde yapılandırılması, serebral palsili çocukların iletişimsel yeterliklerini artırmada etkili bir yaklaşım olarak öne çıkmaktadır. Ayrıca erken müdahale programlarının, nöroplastisite ilkeleri doğrultusunda dikkat ve dil gelişimini destekleyecek biçimde planlanması, uzun vadeli dilsel kazanımlar açısından kritik önem taşımaktadır (Kolb & Gibb, 2011). Eğitim politikaları ve özel eğitim uygulamaları bağlamında ise disiplinlerarası iş birliğini temel alan, dikkat ve dil gelişimini birlikte ele alan bütüncül yaklaşımların desteklenmesi gerekmektedir.

Sonuç olarak bu çalışma, serebral palsili çocuklarda işitsel ve görsel dikkatin dil gelişimindeki belirleyici rolünü vurgulamakta ve dikkat–dil etkileşiminin hem kuramsal hem de uygulamalı düzeyde daha fazla araştırılması gerektiğine işaret etmektedir. Gelecekte yapılacak kapsamlı ve metodolojik açıdan güçlü çalışmaların, bu alandaki bilgi birikimini derinleştirerek klinik uygulamalara ve politika geliştirme süreçlerine önemli katkılar sağlayacağı düşünülmektedir.

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ERKEN DİL EDİNİMİ SÜRECİNDE DUYGUSAL DÜZENLEME VE BİPOLAR YATKINLIK

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ÖZET

Erken dil edinimi, çocuğun bilişsel, sosyal ve duygusal gelişiminin temel bileşenlerinden biri olup, bu sürecin duygusal düzenleme becerileriyle olan ilişkisi son yıllarda giderek daha fazla ilgi görmektedir. Bununla birlikte, erken çocukluk döneminde gözlenen duygusal düzenleme örüntülerinin, bipolar bozukluğa yönelik yatkınlıkla birlikte ele alındığı çalışmalar oldukça sınırlıdır. Bu sistematik derleme çalışmasının amacı, erken dil edinimi sürecinde duygusal düzenlemenin rolünü, bipolar yatkınlık bağlamında inceleyen mevcut literatürü bütüncül bir bakış açısıyla değerlendirmektir. Literatür incelendiğinde, bipolar bozukluğun genetik ve nörobiyolojik temelleri ayrıntılı biçimde ele alınmış olmasına rağmen, dil edinimi gibi erken gelişimsel göstergelerle olan ilişkilerinin büyük ölçüde ihmal edildiği görülmektedir. Mevcut çalışmalar çoğunlukla ileri yaş gruplarına veya klinik tanı almış bireylere odaklanmakta; erken çocukluk dönemindeki dil, duygu ve biliş etkileşimini ele alan araştırmalar sınırlı kalmaktadır. Bu durum, bipolar yatkınlığın erken belirtilerinin anlaşılmasında önemli bir boşluk yaratmaktadır. Bu çalışma, duygusal düzenleme becerilerinin dil edinimi üzerindeki dolaylı ve doğrudan etkilerini, özellikle duygu durum dalgalanmalarına yatkın çocuklar açısından tartışmaktadır. Bulgular, erken dönemde gözlenen duygu düzenleme güçlüklerinin sözcük dağarcığı gelişimi, pragmatik dil kullanımı ve iletişimsel esneklik üzerinde belirleyici olabileceğine işaret etmektedir. Gelecekte yapılacak boylamsal ve disiplinlerarası çalışmaların, erken dil gelişimini bipolar yatkınlığın potansiyel bir gelişimsel göstergesi olarak ele alması önerilmektedir. Bu çalışmanın, erken tanı, önleyici müdahaleler ve gelişimsel psikopatoloji alanına özgün katkılar sunması beklenmektedir.

Anahtar Kelimeler: Erken dil edinimi, Duygusal düzenleme, Bipolar yatkınlık, Gelişimsel psikopatoloji, Çocuk gelişimi

EMOTIONAL REGULATION AND BIPOLAR VULNERABILITY IN THE EARLY LANGUAGE ACQUISITION PROCESS

ABSTRACT

Early language acquisition constitutes a fundamental component of children's cognitive, social, and emotional development, and its relationship with emotional regulation abilities has attracted increasing scholarly attention in recent years. However, studies that examine emotional regulation patterns observed in early childhood in conjunction with vulnerability to

bipolar disorder remain remarkably limited. The aim of this systematic review is to provide a comprehensive evaluation of the existing literature that investigates the role of emotional regulation in early language acquisition within the context of bipolar vulnerability. A critical examination of the literature reveals that, despite extensive research on the genetic and neurobiological foundations of bipolar disorder, its associations with early developmental markers such as language acquisition have been largely neglected. Existing studies predominantly focus on older age groups or individuals with established clinical diagnoses, while research addressing the interaction between language, emotion, and cognition during early childhood remains scarce. This gap poses a significant limitation in understanding the early developmental indicators of bipolar vulnerability. In this sense, this study discusses both the direct and indirect effects of emotional regulation abilities on language acquisition, particularly in children who have vulnerability to mood fluctuations. The findings suggest that early difficulties in emotional regulation may play a decisive role in vocabulary development, pragmatic language use, and communicative flexibility. Future longitudinal and interdisciplinary research is recommended to conceptualize early language development as a potential developmental marker of bipolar vulnerability. This study is expected to contribute uniquely to early identification efforts, preventive interventions, and the broader field of developmental psychopathology.

Keywords: Early language acquisition, Emotional regulation, Bipolar vulnerability, Developmental psychopathology, Child development

1. GİRİŞ

Erken çocukluk dönemi, dil ediniminin en hızlı ve en kritik biçimde gerçekleştiği gelişimsel bir evre olarak kabul edilmektedir. Yaşamın ilk yıllarında edinilen dil becerileri yalnızca iletişimsel yeterliliğin temelini oluşturmakla kalmamakta, aynı zamanda bilişsel, sosyal ve duygusal gelişimin yapı taşları arasında yer almaktadır. Alıcı ve ifade edici dil becerilerinin bu dönemde kazanılması, çocuğun çevresiyle etkileşim kurma, ihtiyaçlarını ifade etme ve sosyal bağlar geliştirme kapasitesini doğrudan etkilemektedir. Bu nedenle erken dil edinimi, yalnızca dilbilimsel bir süreç değil, çok boyutlu bir gelişimsel olgu olarak ele alınmaktadır.

Dil gelişimi ile duygusal süreçler arasındaki ilişki, gelişimsel psikoloji ve psikolinguistik literatürde karşılıklı ve dinamik bir etkileşim olarak tanımlanmaktadır. Çocuklar, duygularını anlamlandırmayı ve düzenlemeyi büyük ölçüde sosyal etkileşimler aracılığıyla öğrenirken, dil bu sürecin temel aracı konumundadır. Duyguların sözel olarak etiketlenmesi, paylaşılması ve düzenlenmesi, dilsel yeterlilikle yakından ilişkilidir. Aynı zamanda yoğun duygusal durumların

dikkat, bellek ve öğrenme süreçlerini etkilemesi, dil edinimini dolaylı olarak şekillendirebilmektedir. Bu bağlamda, dil gelişimi ile duygusal işleyişin birbirinden bağımsız değil, karşılıklı olarak birbirini etkileyen süreçler olduğu görülmektedir (Cole et al., 2004).

Duygusal düzenleme (emotion regulation), bireyin duygusal tepkilerini başlatma, sürdürme, değiştirme ya da bastırma süreçlerini kapsayan çok boyutlu bir kavramdır. Erken çocukluk döneminde duygusal düzenleme becerileri büyük ölçüde bakım verenlerle kurulan etkileşimler yoluyla gelişmekte, zamanla çocuğun kendi kendini düzenleme kapasitesine dönüşmektedir. Bu süreçte dil, duyguların ifade edilmesi ve kontrol edilmesinde merkezi bir rol oynamaktadır. Çocuğun duygularını sözcüklerle ifade edebilmesi, hem duygusal yoğunluğun azalmasına hem de sosyal etkileşimlerin daha işlevsel hale gelmesine katkı sağlamaktadır. Bu nedenle erken dil becerileri ile duygusal düzenleme arasındaki ilişkinin gelişimsel açıdan kritik olduğu vurgulanmaktadır (Kopp, 1989).

Bipolar bozukluk, duygu durumunda belirgin dalgalanmalarla karakterize edilen, genellikle ergenlik ya da yetişkinlik döneminde tanı alan bir duygudurum bozukluğudur. Ancak son yıllarda yapılan çalışmalar, bipolar bozukluğa yönelik yatkınlığın çok daha erken gelişimsel dönemlerde bazı duygusal, davranışsal ve bilişsel göstergelerle kendini gösterebileceğini ortaya koymaktadır. Bipolar yatkınlık kavramı, klinik tanıdan farklı olarak, genetik, nörobiyolojik ve çevresel risk faktörlerinin varlığına işaret etmekte; özellikle yüksek duygusal reaktivite, yoğun duygu geçişleri ve duygusal düzenleme güçlükleriyle ilişkilendirilmektedir (Birmaher et al., 2009). Bu yatkınlığın erken dil ve iletişim süreçleriyle nasıl bir ilişki içinde olduğu ise henüz yeterince açıklığa kavuşmuş değildir.

Erken nörogelişimsel süreçler, duygusal düzenleme ve dil gelişiminin ortak nörobiyolojik temellere dayandığını göstermektedir. Limbik sistem ile prefrontal korteks arasındaki etkileşim, hem duyguların düzenlenmesi hem de dilsel işlemleme açısından kritik bir rol oynamaktadır. Bu ağlardaki erken işlevsel farklılıklar, çocuğun hem duygusal tepkilerinde hem de iletişimsel becerilerinde belirli risk örüntülerinin ortaya çıkmasına neden olabilmektedir. Dolayısıyla erken dönemde gözlemlenen dilsel ve duygusal göstergeler, ilerleyen yıllarda ortaya çıkabilecek psikopatolojik riskler açısından önemli ipuçları sunmaktadır (Panksepp, 2011).

Bu derleme çalışmasının amacı, erken dil edinimi sürecinde duygusal düzenleme ile bipolar yatkınlık arasındaki ilişkiyi disiplinlerarası bir bakış açısıyla ele almak ve mevcut literatürdeki bulguları bütüncül biçimde değerlendirmektir. Mevcut çalışmaların çoğu, dil gelişimi ve duygusal düzenlemeyi ayrı alanlar olarak incelemekte; bipolar bozukluk ise genellikle klinik tanı sonrası süreçlerle ilişkilendirilmektedir. Erken çocukluk döneminde bipolar yatkınlık

bağlamında dil ve duygusal düzenleme süreçlerini birlikte ele alan çalışmaların sınırlı olması, bu alanda belirgin bir literatür boşluğuna işaret etmektedir. Bu bağlamda sunulan derleme, erken gelişimsel göstergelerin daha iyi anlaşılmasına katkı sağlamayı ve klinik, eğitsel ve araştırma temelli yaklaşımlar için kuramsal bir zemin oluşturmayı hedeflemektedir.

2. KAVRAMSAL VE KURAMSAL ÇERÇEVE

2.1. Erken Dil Edinimi

Erken dil edinimi, doğumdan itibaren başlayan ve özellikle yaşamın ilk üç yılında hızla gelişen çok boyutlu bir süreçtir. Bu dönemde dil edinimi genellikle prelinguistik evre (ağlama, agulama, babıldama), tek sözcük dönemi ve iki sözcüklü ifadelerden çok sözcüklü yapılara geçiş şeklinde ilerlemektedir. Dil ediniminin bu evreleri, yalnızca biyolojik olgunlaşmaya değil, çocuğun sosyal çevresiyle kurduğu etkileşimin niteliğine de bağlıdır. Alıcı dil gelişimi, çocuğun sözel girdiyi ayırt etme ve anlamlandırma kapasitesini ifade ederken; ifade edici dil gelişimi, bu girdinin üretime dönüşmesini kapsamaktadır. Alıcı dil becerilerinin genellikle ifade edici becerilerden önce geliştiği ve her iki alanın birbirini karşılıklı olarak desteklediği kabul edilmektedir (Kuhl, 2004).

Dil öğreniminin temel itici güçlerinden biri sosyal etkileşimdir. Bakım verenlerle kurulan karşılıklı iletişim, ortak dikkat anları ve sözel-dışı ipuçları, çocuğun dilsel yapıları fark etmesini ve içselleştirmesini kolaylaştırmaktadır. Bu bağlamda erken dil edinimi, yalnızca bireysel bir bilişsel süreç değil, aynı zamanda duygusal ve sosyal bağlam içinde gerçekleşen etkileşimsel bir öğrenme süreci olarak değerlendirilmektedir.

2.2. Duygusal Düzenleme

Duygusal düzenleme, bireyin duygusal deneyimlerini başlatma, sürdürme, yoğunlaştırma ya da azaltma süreçlerini kapsayan gelişimsel bir yetidir. Erken çocukluk döneminde bu beceri, büyük ölçüde dışsal destekle şekillenmekte ve zamanla içselleştirilerek kendini düzenleme kapasitesine dönüşmektedir. Özellikle yaşamın ilk yıllarında bakım verenlerin sunduğu eş-düzenleme (co-regulation), çocuğun duygusal tepkilerini anlamlandırması ve yönetebilmesi açısından kritik bir rol oynamaktadır (Cole et al., 2004).

Duygusal düzenleme süreçleri, dikkat, bellek ve yürütücü işlevler gibi bilişsel alanlarla yakından ilişkilidir. Yoğun ve düzenlenemeyen duygusal durumlar, çocuğun çevresel girdilere odaklanmasını ve bu girdileri işlemlemesini zorlaştırabilmektedir. Bu durum, dil edinimi açısından değerlendirildiğinde, sözel girdinin yeterince işlenememesi ve dilsel öğrenmenin sekteye uğramasıyla sonuçlanabilmektedir. Dolayısıyla duygusal düzenleme, erken dil gelişiminin hem doğrudan hem de dolaylı belirleyicilerinden biri olarak ele alınmaktadır.

2.3. Bipolar Yatkınlık Kavramı

Bipolar yatkınlık kavramı, klinik tanıdan farklı olarak, bireyin ilerleyen gelişim dönemlerinde bipolar bozukluk geliştirme riskini artıran biyolojik, genetik ve davranışsal özellikleri ifade etmektedir. Bu yatkınlık, erken çocukluk döneminde açık bir psikiyatrik tablo şeklinde değil; daha çok yüksek duygusal reaktivite, ani duygu değişimleri, yoğun olumlu ya da olumsuz duygulanım ve duygusal düzenleme güçlükleri gibi göstergelerle ortaya çıkabilmektedir (Birmaher et al., 2009).

Erken çocuklukta gözlemlenen bu özellikler, gelişimsel açıdan normatif duygusal dalgalanmalardan ayırt edilmesi güç örüntüler sergileyebilir. Ancak duyguların yoğunluğu, süresi ve bağlama uygunluğu gibi ölçütler dikkate alındığında, bazı çocukların duygusal işleyiş açısından daha yüksek risk profiline sahip olduğu görülmektedir. Bu bağlamda bipolar yatkınlık, erken dil ve iletişim süreçleriyle etkileşim hâlinde olan gelişimsel bir risk faktörü olarak ele alınmaktadır.

2.4. Gelişimsel ve Nörolinguistik Kuramlar

Erken dil edinimi, duygusal düzenleme ve bipolar yatkınlık arasındaki ilişkiyi açıklamada çeşitli gelişimsel ve nörolinguistik kuramlar yol gösterici olmaktadır. Bağlanma kuramı, erken bakım veren–çocuk ilişkisinin duygusal güvenlik ve iletişim gelişimi üzerindeki belirleyici rolünü vurgulamaktadır. Güvenli bağlanma örüntülerinin, hem duygusal düzenleme becerilerini hem de dilsel etkileşimlerin niteliğini olumlu yönde etkilediği ileri sürülmektedir (Bowlby, 1988).

Nörolinguistik açıdan bakıldığında, limbik sistem ile prefrontal korteks arasındaki etkileşim, duyguların düzenlenmesi ve dilsel işlemleme açısından merkezi bir öneme sahiptir. Bu ağlardaki erken işlevsel farklılıklar, hem duygusal yoğunluğu hem de dil girdisinin işlenme biçimini etkileyebilmektedir. Nöroplastisite kuramı ise erken dönemde ortaya çıkan risk göstergelerinin, uygun çevresel destek ve müdahalelerle değiştirilebilir olduğunu savunmaktadır. Bu yaklaşım, erken dil ve duygusal düzenleme süreçlerinin birlikte ele alınmasının, olası psikopatolojik risklerin azaltılmasında önemli bir fırsat sunduğunu ortaya koymaktadır.

3. YÖNTEM

3.1. Derleme Türü

Bu çalışma, erken dil edinimi sürecinde duygusal düzenleme ve bipolar yatkınlık arasındaki ilişkiyi disiplinlerarası bir bakış açısıyla ele alan anlatı derleme (narrative review) niteliğindedir. Anlatı derleme yöntemi, farklı kuramsal yaklaşımlar ve ampirik bulguların

yorumlayıcı bir çerçevede bütünleştirilmesine olanak tanıması nedeniyle tercih edilmiştir. Özellikle erken gelişim, duygu düzenleme ve psikiyatrik risk alanlarının kesişiminde yer alan çalışmaların tek bir kuramsal çatı altında değerlendirilmesi açısından bu yaklaşım uygun görülmüştür (Green et al., 2006; Snyder, 2019).

3.2. Literatür Tarama Stratejisi

Literatür tarama süreci sistematik bir yapı izlenerek yürütülmüştür. Tarama işlemleri PubMed, Scopus, Web of Science, PsycINFO, ERIC ve TR Dizin veri tabanları üzerinden gerçekleştirilmiştir. Bu veri tabanları, gelişimsel psikoloji, dil edinimi, nörobilim ve psikiyatri alanlarında yayımlanan hakemli çalışmaları kapsaması nedeniyle seçilmiştir. Tarama sürecinde hem uluslararası hem de ulusal literatürün kapsanmasına özen gösterilmiştir.

3.3. Anahtar Kelimeler

Literatür taraması sırasında İngilizce anahtar kelimeler farklı kombinasyonlarla kullanılmıştır. Bu anahtar kelimeler arasında *early language acquisition, emotion regulation, bipolar risk* ve *affective development* terimleri yer almıştır. Anahtar kelimeler, başlık, özet ve anahtar kelime alanlarında taranmış; konuyla doğrudan ilişkili çalışmalara öncelik verilmiştir.

3.4. Dahil Etme ve Hariç Tutma Ölçütleri

Çalışmaya dâhil edilme ölçütleri, erken çocukluk dönemini (0–6 yaş) kapsayan araştırmalar, dil gelişimi ve/veya duygusal düzenleme süreçlerini ele alan çalışmalar ve bipolar bozukluk ya da bipolar yatkınlıkla ilişkili gelişimsel risk faktörlerini inceleyen yayınlar olarak belirlenmiştir. Hakemli dergilerde yayımlanmış ampirik araştırmalar, derleme makaleleri ve temel kuramsal çalışmalar değerlendirmeye alınmıştır. Hariç tutma ölçütleri ise yalnızca yetişkin örneklemiyle yürütülmüş çalışmalar, erken gelişimle doğrudan ilişkisi bulunmayan klinik vaka raporları ve yöntemsel açıdan sınırlı olan yayınlar olarak belirlenmiştir.

3.5. Çalışmaların Analizi

Seçilen çalışmaların analizi, **tematik analiz yaklaşımı** doğrultusunda gerçekleştirilmiştir. Bu süreçte literatürde öne çıkan ortak kavramlar, örüntüler ve eğilimler belirlenmiş; erken dil edinimi, duygusal düzenleme ve bipolar yatkınlık arasındaki ilişkiler temalar hâlinde sınıflandırılmıştır. Bulgular, karşılaştırmalı ve yorumlayıcı bir yaklaşımla ele alınarak kuramsal çerçeveyle ilişkilendirilmiştir. Tematik analiz yöntemi, karmaşık gelişimsel süreçlerin sistematik ve bütüncül biçimde değerlendirilmesine olanak tanımaktadır (Braun & Clarke, 2006).

4. BULGULARIN TEMATİK DEĞERLENDİRİLMESİ

4.1. Erken Dil Edinimi ve Duygusal Düzenleme İlişkisi

İncelenen çalışmalar, erken dil edinimi ile duygusal düzenleme arasında güçlü ve karşılıklı bir ilişki olduğunu ortaya koymaktadır. Dil, çocukların duygularını tanıma, adlandırma ve paylaşma süreçlerinde temel bir araç işlevi görmektedir. Özellikle erken dönemde duyguların sözel olarak ifade edilebilmesi, duygusal yoğunluğun azalmasına ve davranışsal tepkilerin daha düzenli hâle gelmesine katkı sağlamaktadır. Bu durum, dilin yalnızca bilişsel bir beceri değil, aynı zamanda duygusal düzenleme süreçlerinin ayrılmaz bir parçası olduğunu göstermektedir. Duygusal düzenleme becerileri gelişmiş olan çocukların, çevresel girdilere daha etkin biçimde odaklanabildikleri ve sözel etkileşimlere daha aktif katıldıkları bildirilmektedir. Bu durum, sözcük öğrenimini ve iletişimsel girişimleri olumlu yönde etkilemektedir. Özellikle bakım verenlerle kurulan duygusal açıdan senkronize etkileşimlerin, yeni sözcüklerin öğrenilmesi ve bağlama uygun kullanımında belirleyici olduğu vurgulanmaktadır. Literatürde duygu sözcüklerinin gelişimi, çocuğun içsel durumlarını temsil edebilme kapasitesiyle ilişkilendirilmekte; bu sözcüklerin ediniminin hem duygusal farkındalık hem de pragmatik dil becerileri açısından önemli bir dönüm noktası olduğu belirtilmektedir (Thompson, 1994).

4.2. Duygusal Düzensizlik ve Dil Gelişiminde Riskler

Duygusal düzensizlikle karakterize edilen gelişimsel örüntüler, erken dil gelişimi açısından çeşitli riskler barındırmaktadır. Yüksek duygusal reaktiviteye sahip çocukların, yoğun duygu durumları nedeniyle sözel girdiyi sürdürülebilir biçimde işlemekte zorlandıkları bildirilmektedir. Bu durum, dikkat süreçlerinin sık sık kesintiye uğramasına ve dilsel öğrenmenin yüzeysel kalmasına yol açabilmektedir. Özellikle öfke, aşırı neşe ya da huzursuzluk gibi yoğun duygusal tepkiler, çocuğun iletişimsel etkileşimlerden geri çekilmesine neden olabilmektedir.

Bu bağlamda, ifade edici dil gecikmeleri duygusal düzensizlikle sıkça ilişkilendirilen bulgular arasında yer almaktadır. Duygularını düzenlemekte zorlanan çocukların, sözel üretimde sınırlı kaldıkları, iletişim girişimlerinin daha az ve kısa süreli olduğu gözlemlenmektedir. Bunun yanı sıra sosyal-pragmatik dil sorunları, duygusal düzensizlikle birlikte ortaya çıkan önemli bir risk alanı olarak öne çıkmaktadır. Bu çocukların, sıra alma, duygusal ipuçlarını yorumlama ve bağlama uygun dil kullanımı gibi pragmatik becerilerde zorlandıkları rapor edilmektedir.

4.3. Bipolar Yatkınlık ve Erken Dil Göstergeleri

Derleme kapsamında değerlendirilen çalışmalar, bipolar bozukluk açısından ailesel risk taşıyan çocuklarda bazı erken dil ve iletişim örüntülerinin farklılaşabileceğine işaret etmektedir. Aile

öyküsünün varlığı, tek başına belirleyici bir faktör olmamakla birlikte, duygusal işleyiş ve dil gelişimi arasındaki etkileşimi daha hassas hâle getirebilmektedir. Özellikle duygusal yoğunluğun yüksek olduğu çocuklarda, dilsel anlatımın da bu yoğunluğu yansıtacak biçimde farklılaştığı belirtilmektedir.

Bazı çalışmalar, bipolar yatkınlığı olan çocuklarda duyguların sözel olarak ifade edilmesinde uç örüntüler görülebildiğini; duygusal anlatımın ya oldukça sınırlı ya da aşırı ayrıntılı olabildiğini ortaya koymaktadır. Bu durum, dilin duygusal içeriği düzenleme işlevinin yeterince dengelenemediğini düşündürmektedir. Erken dönemde gözlemlenen davranışsal dalgalanmalarla birlikte görülen bu dilsel özellikler, ilerleyen gelişim dönemlerinde ortaya çıkabilecek duygu durum bozukluklarına ilişkin erken belirteçler olarak değerlendirilmektedir (Birmaher et al., 2009).

4.4. Nörobiyolojik ve Psikolinguistik Bulgular

Nörobiyolojik ve psikolinguistik çalışmalar, duygu ve dil süreçlerinin büyük ölçüde ortak beyin ağları üzerinden işlediğini göstermektedir. Limbik sistem ile prefrontal korteks arasındaki etkileşim, hem duygusal düzenleme hem de dilsel planlama ve üretim süreçlerinde kritik bir rol oynamaktadır. Bu sistemler arasındaki işlevsel dengenin bozulması, duygusal tepkilerin yoğunlaşmasına ve dilsel işlemenin sekteye uğramasına neden olabilmektedir.

Erken beyin gelişimi sürecinde, dil ağlarının olgunlaşması ile duygusal işlemleme sistemlerinin gelişimi eş zamanlı olarak ilerlemektedir. Bu durum, erken dönemde ortaya çıkan nörogelişimsel farklılıkların hem duygusal hem de dilsel alanlarda eş zamanlı yansımalar üretmesine yol açabilmektedir. Psikolinguistik açıdan bakıldığında, duygusal yükü yüksek girdilerin dil işleme süreçlerini etkilediği; düzenlenemeyen duygusal durumların ise dilsel temsillerin kalıcılığını azalttığı ifade edilmektedir. Bu bulgular, erken gelişim döneminde duygu–dil entegrasyonunun sağlıklı biçimde desteklenmesinin, hem iletişimsel yeterlilik hem de psikopatoloji risklerinin azaltılması açısından önemli olduğunu ortaya koymaktadır (Panksepp, 2011).

5. TARTIŞMA

Bu derleme çalışmasında ele alınan bulgular, erken dil edinimi ile duygusal düzenleme süreçlerinin gelişimsel açıdan birbirinden bağımsız değil, karşılıklı etkileşim içinde ilerleyen yapılar olduğunu ortaya koymaktadır. Gelişimsel psikoloji perspektifinden bakıldığında, dilin yalnızca bilişsel bir araç değil, aynı zamanda duyguların düzenlenmesi ve sosyal etkileşimin yapılandırılmasında merkezi bir rol üstlendiği görülmektedir. Dilbilimsel açıdan ise erken dönemde edinilen sözcük dağarcığı, pragmatik beceriler ve anlatı kapasitesinin, çocuğun

duygusal deneyimlerini temsil edebilme ve paylaşabilme yetisiyle yakından ilişkili olduğu anlaşılmaktadır. Bu bağlamda, erken dil gelişimindeki aksaklıkların yalnızca dilsel sınırlılıklar olarak değil, daha geniş bir duygusal ve gelişimsel çerçeve içinde değerlendirilmesi gerekmektedir.

Bulgular, duygusal düzenleme becerilerindeki yetersizliklerin, erken dil edinimini hem doğrudan hem de dolaylı yollarla etkileyebileceğini göstermektedir. Yüksek duygusal reaktivite ve yoğun duygu dalgalanmaları, çocuğun dikkat ve öğrenme süreçlerini olumsuz yönde etkileyerek dil girdisinin etkin biçimde işlenmesini zorlaştırabilmektedir. Bu durum, ifade edici dil gecikmeleri ve sosyal-pragmatik dil sorunları gibi ikincil sonuçlara yol açabilmektedir. Dilbilimsel gelişimin sosyal bağlamdan ayrı düşünülemeyeceği göz önünde bulundurulduğunda, duygusal düzenleme güçlüklerinin erken dönemde dil kullanımını sınırlayıcı bir faktör hâline gelebileceği söylenebilir.

Bipolar yatkınlık bağlamında değerlendirildiğinde, erken dil ve duygusal düzenleme göstergeleri özellikle dikkat çekici bir önem kazanmaktadır. Her ne kadar bipolar bozukluk tanısı erken çocukluk döneminde konulamasa da, literatürde ailesel risk taşıyan çocuklarda bazı duygusal ve davranışsal örüntülerin erken dönemde ortaya çıkabildiği bildirilmektedir (Birmaher et al., 2009). Bu çocuklarda gözlemlenen yüksek duygu yoğunluğu, ani duygusal geçişler ve duyguların sözel ifadesinde görülen uç örüntüler, dilin duygusal düzenleme işlevinde zorlanmalar yaşandığını düşündürmektedir. Bu bulgular, erken dil gelişiminin, olası duygu durum risklerini yansıtan dolaylı bir gösterge olarak ele alınabileceğine işaret etmektedir.

Klinik gözlem ve erken tanılama açısından bakıldığında, bu derlemenin bulguları önemli çıkarımlar sunmaktadır. Erken çocukluk döneminde dil gelişimi değerlendirilirken, yalnızca sözcük sayısı ya da dilbilgisel doğruluk gibi nicel ölçütlerin değil, dilin duygusal içerikle nasıl kullanıldığının da dikkate alınması gerekmektedir. Çocuğun duygularını sözel olarak ifade edebilme kapasitesi, duygusal yoğunluğu düzenleyebilme becerisi ve sosyal etkileşimlerde dili kullanma biçimi, gelişimsel risklerin erken fark edilmesinde önemli ipuçları sağlayabilir. Bu bağlamda, dil ve konuşma terapistleri, çocuk gelişimciler ve klinik psikologlar arasında disiplinlerarası bir değerlendirme yaklaşımının benimsenmesi, erken müdahale süreçlerinin etkinliğini artırabilir.

Sonuç olarak, erken dil edinimi ile duygusal düzenleme arasındaki etkileşimin, bipolar yatkınlık gibi karmaşık gelişimsel risklerin anlaşılmasında önemli bir pencere sunduğu görülmektedir. Ancak bu göstergelerin hiçbirinin tek başına tanısal bir ölçüt olarak değerlendirilmemesi gerektiği açıktır. Bunun yerine, erken gelişimsel örüntülerin bütüncül ve uzunlamasına bir

perspektifle ele alınması, hem bilimsel araştırmalar hem de klinik uygulamalar açısından daha sağlıklı ve güvenilir bir yaklaşım sunacaktır.

6. SINIRLILIKLAR VE GELECEK ARAŞTIRMALAR

Bu derleme çalışmasının bulguları, mevcut literatürün sunduğu veriler çerçevesinde yorumlanmakla birlikte, bazı önemli sınırlılıkları da beraberinde getirmektedir. Öncelikle, bipolar yatkınlık kavramının gelişimsel bağlamda tanımlanmasına ilişkin kavramsal belirsizlikler, literatürde tutarlı bir çerçeve oluşturulmasını zorlaştırmaktadır. Tanısal ölçütlerle yatkınlık göstergeleri arasındaki ayrımın her çalışmada net biçimde yapılmaması, erken çocukluk döneminde gözlemlenen duygusal ve dilsel örüntülerin yorumlanmasında belirsizliklere yol açabilmektedir. Bu durum, özellikle erken dil ve duygusal düzenleme göstergelerinin bipolar bozuklukla doğrudan ilişkilendirilmesi konusunda temkinli olunması gerektiğini ortaya koymaktadır.

Bir diğer önemli sınırlılık, boylamsal çalışmaların sınırlı sayıda olmasıdır. Erken çocukluk döneminde gözlemlenen dil ve duygusal düzenleme özelliklerinin, ilerleyen gelişim dönemlerinde nasıl bir seyir izlediğini ortaya koyan uzunlamasına araştırmaların yetersizliği, neden–sonuç ilişkilerinin kurulmasını güçleştirmektedir. Çoğu çalışma kesitsel tasarıma dayanmakta ve erken göstergelerin uzun vadeli psikopatolojik sonuçlarla ilişkisini açıklamada sınırlı kalmaktadır. Bu durum, erken risk göstergelerinin geçerliliği ve öngörü gücü konusunda önemli bir metodolojik boşluğa işaret etmektedir.

Gelecek araştırmalar açısından, deneysel ve uzunlamasına çalışmaların artırılması önemli bir gereksinim olarak öne çıkmaktadır. Özellikle erken dil müdahaleleri ve duygusal düzenleme temelli programların, yüksek risk taşıyan çocuk grupları üzerindeki etkilerini inceleyen deneysel tasarımlar, nedensel ilişkilerin daha net biçimde ortaya konmasına katkı sağlayabilir. Bunun yanı sıra, dil gelişimi, duygusal düzenleme ve nörogelişimsel göstergeleri birlikte ele alan uzunlamasına çalışmalar, erken çocukluk döneminde gözlemlenen örüntülerin hangi koşullar altında risk ya da koruyucu faktörlere dönüştüğünü açıklamada önemli bir potansiyel taşımaktadır. Bu tür çalışmaların, erken tanılama ve müdahale yaklaşımlarının bilimsel temellerini güçlendireceği düşünülmektedir.

7. SONUÇ

Bu derleme çalışması, erken çocukluk döneminde dil edinimi ile duygusal düzenleme süreçleri arasındaki karşılıklı etkileşimi, bipolar yatkınlık bağlamında ele alarak disiplinlerarası bir çerçeve sunmayı amaçlamıştır. Bulgular, erken dil gelişiminin yalnızca bilişsel ve iletişimsel bir kazanım olmadığını; aynı zamanda duyguların ifade edilmesi, düzenlenmesi ve sosyal

etkileşimlerin yapılandırılmasında merkezi bir rol oynadığını göstermektedir. Özellikle alıcı ve ifade edici dil becerilerinin gelişimi ile duygusal düzenleme kapasitesi arasındaki ilişkinin, erken nörogelişimsel süreçlerle yakından bağlantılı olduğu görülmektedir. Literatür, yüksek duygusal reaktivite ve duygu yoğunluğunun, bazı çocuklarda dilsel anlatım örüntülerini ve sosyal-pragmatik iletişimi etkileyebileceğine işaret etmektedir.

Derlemenin öne çıkan sonuçlarından biri, erken dil ve duygusal düzenleme göstergelerinin, psikiyatrik tanı koyma amacıyla değil, gelişimsel risklerin izlenmesi açısından değerlendirilmesi gerektiğidir. Bipolar yatkınlık bağlamında ele alınan erken göstergeler, tek başına belirleyici olmaktan ziyade, çok boyutlu bir gelişimsel izlemin parçası olarak anlam kazanmaktadır. Bu nedenle erken çocukluk döneminde dil gelişimi, duygu düzenleme becerileri ve davranışsal özelliklerin birlikte değerlendirilmesi, olası risk örüntülerinin daha sağlıklı biçimde izlenmesine katkı sağlayabilir. Erken müdahale programlarının, yalnızca dil becerilerini değil, aynı zamanda duygusal düzenleme ve ebeveyn-çocuk etkileşimini destekleyecek şekilde yapılandırılması bu açıdan önem taşımaktadır.

Klinik uygulamalar açısından, dil ve duygusal düzenleme alanlarında çalışan uzmanlar için disiplinlerarası değerlendirme yaklaşımlarının teşvik edilmesi önerilmektedir. Eğitsel bağlamda ise, erken çocukluk eğitim programlarının dil gelişimi ile duygusal farkındalığı bütünleştiren içeriklere yer vermesi, koruyucu bir rol üstlenebilir. Politika yapıcılar içinse, erken çocukluk dönemine yönelik tarama, izlem ve destek programlarının güçlendirilmesi, uzun vadede ruh sağlığı ve eğitim çıktılarının iyileştirilmesine katkı sağlayacak stratejik bir yatırım olarak değerlendirilebilir. Bu bağlamda, erken gelişim dönemine odaklanan bütüncül yaklaşımların desteklenmesi, hem bireysel hem de toplumsal düzeyde önemli kazanımlar sunma potansiyeline sahiptir.

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2003-2022 ARASI TÜRKİYE'DE İSİM VERME PRATİKLERİNİN DÖNÜŞÜMÜ: SOSYO-ONOMASTİK BİR DEĞERLENDİRME

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ÖZET

Bir insanın nasıl adlandırılacağı tarihsel olduğu kadar toplumsal bir süreçtir. İsim verme yalnızca bireyi başka insanlardan ayıran bir etiket değildir. Bu bağlamda isim verme "sosyal" bir olgudur. Doğan çocuğa ebeveynleri tarafından verilen bir isim, kültürel süreklilik, sınıfsal ideolojik ve etnik aidiyet gibi sosyal kodlara dair ipuçları verir. Türkiye'de isim verme pratiği sabit bir olgu olmamakla birlikte, döneminin sosyokültürel şartlarından etkilenerek zamanın ruhu paralelinde farklı formlar halini almıştır. İsimlerin toplumsal süreçlerden etkilenme şekillerini, toplumsal olarak içerdiği kodları inceleyen bilim dalı olan sosyo-onomastik, isim verme pratiklerinin toplumsal yönünü teorize eden bir disiplindir. Bu bağlamda yaklaşıldığında Türkiye'de isim verme pratikleri üç dönüşümle analiz edilebilir. Türkiye'de aileler belirgin bir şekilde geleneksel isimlerden koparak, isimler üzerinden bir modernleşme arayışına girmiştir. Bu modernleşme girişimine rağmen dini ve geleneksel isimler ise isim verme örüntülerinde kendine yine de yüksek sıralarda yer bulabilmiştir. Türkiye'nin çok kültürlü yapısı isim verme tercihlerine doğrudan etki eden unsurlardan biri olmuştur. Gramsci sınıf tahakkümünün yalnızca devletin baskı aygıtı ile değil ideoloji ve kültürel mekanizmalarıyla üretilen rıza ile de işlediğini savunur. Cumhuriyet döneminden günümüze değin oluşan farklı dönem tarihsel bloklar incelendiğinde, kişilere verilen isimlerin araçsallaştırılarak ideolojik bir rıza üretim çabalarının bir ayağı olarak kullanıldığı görülmektedir. Özellikle 2003-2022 yılları arasında Türkiye'deki isim verme pratikleri üzerinden muhafazakâr-milliyetçi bir isim verme trendinin artarak devam ettiği söylenebilir.

Anahtar Kelimeler: Kişi isimleri, sosyo-onomastik, kültürel hegemonya, muhafazakarlık.

THE TRANSFORMATION OF NAMING PRACTICES IN TURKEY BETWEEN 2003-2022: A SOCIO-ONOMASTIC ASSESSMENT

ABSTRACT

How a person is named is both a historical and a social process. Naming is not merely a label that distinguishes an individual from others. In this context, naming is a "social" phenomenon. A name given to a newborn child by their parents provides clues about social codes such as cultural continuity, class, ideology, and ethnic belonging. While naming practices in Turkey are not static, they have taken on different forms in line with the spirit of the times, influenced

by the socio-cultural conditions of the period. Socio-onomastics, the branch of science that examines how names are affected by social processes and the social codes they contain, is a discipline that theorizes the social aspect of naming practices. Approached in this context, naming practices in Türkiye can be analyzed through three transformations. In Türkiye, families have significantly broken away from traditional names, seeking modernization through names. Despite this modernization attempt, religious and traditional names have still managed to find a high place in naming patterns. Türkiye's multicultural structure has been one of the factors directly influencing naming preferences. Gramsci argues that class domination operates not only through the state's repressive apparatus but also through consent produced by ideology and cultural mechanisms. Examining different historical periods from the Republican era to the present day reveals that names given to individuals are instrumentalized and used as a tool in efforts to produce ideological consent. Particularly in Turkey, between 2003 and 2022, a trend towards conservative-nationalist naming practices can be observed.

Keywords: Personal names, socio-onomastics, cultural hegemony, conservatism

SANAL ATASÖZLERİ ARACILIĞIYLA KÜLTÜREL ANLAMLARIN İNŞASI: CHATGPT'NİN DİL ÜRETİMİ

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ÖZET

Bu çalışma, yapay zeka destekli bir büyük bir dil modeli (LLM) olan ChatGPT'nin özgün Türkçe atasözleri üreterek kültürel anlam yaratmaya katkıda bulunup bulunamayacağını tartışmaya açmaktadır. Bu maksatla, ChatGPT'den mevcut Türkçe atasözlerini temel alarak literatürde yer almayan, benzersiz, toplam 50 adet Türkçe atasözü üretmesi istenmiş ve sanal atasözü derlemi olarak ele alınan bu ifadeler biçimsel ve anlamsal açıdan analiz edilmiştir. Bu sanal atasözleri Türkçede yer alan gerçek atasözlerinden rastgele oluşturulan ve aynı sayıda atasözü barındıran Türkçe atasözleri derlemi ile mukayese edilmiştir. Çalışmada, yapay zeka üretimi olan sanal atasözlerinin geleneksel Türkçe atasözleriyle metaforik yapılar ve tematik paralellikler paylaşıp paylaşmadığı incelenmiştir. Bulgular, sanal atasözlerinin biçimsel olarak, geleneksel atasözleriyle uyumlu olacak şekilde kısa, ritmik ve paralel kalıpları takip etme eğiliminde olduğunu göstermiştir. Benzer şekilde, anlamsal olarak da genellikle emek, sabır, bilgelik, zaman ve bireyler ile toplum arasındaki ilişki gibi geleneksel değerlerle uyumlu oldukları görülmüştür. Çalışmada, Kavramsal Metafor Teorisi (CMT), sanal atasözlerinin altında yatan metaforik alanları belirlemek ve bunları Türk sözlü geleneğinde bulunan metaforik kalıplarla karşılaştırmak için kullanılmıştır. Bulgular, ChatGPT'nin yüzeysel formun ötesinde temel kültürel temsilleri yansıtan atasözü benzeri ifadeler üretebildiğini göstermektedir. Ancak, yapay zeka tarafından üretilen bu atasözlerinin bağlamdan bağımsız kaldığı ve yaşanmış deneyimlere, tarihsel derinliğe veya sosyokültürel hafızaya dayanmadığı ve güncel çağın kavramlarıyla metaforlar ürettiği görülmüştür. Bu çalışma, yapay zekanın kültürel söylemi nasıl şekillendirebileceği veya yansıtabileceği konusundaki daha geniş tartışmalara kapı aralamaktadır. Ayrıca, yapay zeka odaklı dil üretimi, metaforik düşünce ve kültürel ifadenin dijital biçimleri arasındaki kesişim noktasını vurgulayarak dilbilimsel ve kültürel araştırmalar için yeni bir tartışma evreni önermektedir.

Anahtar Kelimeler: atasözü, ChatGPT, kültürel anlam, metafor analizi, dil üretimi

THE CONSTRUCTION OF CULTURAL MEANINGS THROUGH VIRTUAL PROVERBS: CHATGPT'S LANGUAGE GENERATION

ABSTRACT

This study explores whether ChatGPT, an artificial intelligence-based large language model (LLM), can contribute to creating cultural meaning by generating original Turkish proverbs. To this end, ChatGPT was asked to generate 50 unique Turkish proverbs, not found in the literature,

based on existing Turkish proverbs. These expressions, treated as a collection of virtual proverbs, were analyzed in terms of form and meaning. These virtual proverbs were compared with a collection of Turkish proverbs randomly generated from traditional ones in Turkish and containing the same number of proverbs. The study examined whether the AI-generated virtual proverbs shared metaphorical structures and thematic parallels with traditional Turkish proverbs. The findings indicate that virtual proverbs tend to follow short, rhythmic, and parallel patterns that are formally consistent with traditional proverbs. Similarly, they are generally found to be consistent with traditional values such as labor, patience, wisdom, time, and the relationship between individuals and society. In the study, Conceptual Metaphor Theory (CMT) was used to identify the underlying metaphorical domains of virtual proverbs and compare them with metaphorical patterns found in the Turkish oral tradition. The findings show that ChatGPT can generate proverb-like expressions that reflect fundamental cultural representations beyond superficial form. However, it was observed that these AI-generated proverbs remain context-independent, lacking grounding in lived experiences, historical depth, or sociocultural memory, and instead produce metaphors using concepts of the contemporary era. This study opens the door to broader discussions on how AI can shape or reflect cultural discourse. Furthermore, AI-focused language generation highlights the intersection between metaphorical thinking and digital forms of cultural expression, suggesting a new universe of discussion for linguistic and cultural research.

Keywords: proverb, ChatGPT, cultural meaning, metaphor analysis, language generation

1. Introduction

Proverbs are linguistic expressions that have been distilled from the shared life experiences of societies and passed down from generation to generation. They are formulaic, instructive or summarising in nature. These short but dense expressions are not only linguistic units but also established expressions that encode cultural values, social norms, collective consciousness, and the worldview of the relevant society (Tabar, 2015). Their multi-layered structure makes proverbs extremely valuable data sets for both linguistic and cultural research. On the other hand, Franceschelli and Musolesi (2024) state that today's artificial intelligence-based large language models (LLMs) not only produce human-like expressions with their language generation capabilities, but also participate in meaning creation processes. The capacity of these models to generate cultural discourse is increasingly attracting attention and has become a subject that needs to be examined through cultural science. In other words, advanced large language models such as ChatGPT can generate culturally dense phrases such as proverbs based

on user input (prompts). However, these outputs raise the question of whether they are the product of genuine cultural memory or merely the imitation of statistical patterns. This study aims to examine cultural meaning construction through the proverb-generating capacity of ChatGPT, an artificial intelligence-based language model. Specifically, it aims to analyse the extent to which 50 original proverbs generated by ChatGPT, which did not previously exist in Turkish, possess cultural values, metaphorical structures, and normative meanings. In doing so, it opens up the discussion on whether artificial intelligence can be positioned not only as a linguistic but also as a cultural producer through these 'virtual proverbs.' From this perspective, the study questions assumptions about whether proverbs are merely human-produced cultural forms that emerged within the historical flow, while also aiming to examine the potential of large language models such as ChatGPT to produce cultural symbols, create normative discourse, and construct meaning universes. In this context, the extent to which it is possible to consider artificial intelligence not only as a technical language model but also as a potential 'culture producer' is discussed. In this context, the aim of the study is shaped by the following two fundamental questions:

1. What similarities and differences do the proverbs generated by ChatGPT share with traditional Turkish proverbs in terms of theme, structure, and metaphor?
2. What potential do these virtual proverbs hold for artificial intelligence's cultural productivity in the context of cultural value transfer and normative meaning construction?

2. Theoretical Framework

2.1. Proverbs and the transmission of culture

Proverbs are not only fixed verbal structures of language, but also discursive forms that reflect the historical experiences, value judgements, behavioural norms and cultural memory of society (Bulut, 2013). Aydın (2018) states that proverbs are 'the product of the collective mind of society' and that these sayings not only serve to give advice but also build collective identity. Similarly, Atlı (2019) emphasises that proverbs are the fundamental carriers of oral culture and are 'fixed expressions that contain information on many topics such as a nation's mindset, creativity, quick wit, and cultural layers, and are the common product of the people.' Studies on proverbs and idioms in Turkish have revealed the multifaceted role of these fixed expressions in the transmission of cultural values. Proverbs have been shaped over time and intertwined with the collective consciousness of the people, becoming, as Korkmaz (2005) puts it, sociocultural code carriers over time. When viewed from the perspective of metaphor theory, it can be seen that proverbs often concretise abstract concepts through nature, animals, seasons,

family structure and religious themes (Lakoff & Johnson, 1980; Kövecses, 2005). In this context, proverbs contain conceptual metaphors, which are the most intense expression of cultural forms of understanding. Oğuz (2021) examined directional metaphors in Turkish proverbs and attempted to show which concepts these metaphors are associated with, such as 'good, bad, successful, unsuccessful, happy, unhappy, healthy, unhealthy.' Yıldırmış (2023) examined animal metaphors in proverbs and discussed how the Turkish people concretise their way of life, cultural values, and beliefs through animal symbols. On the other hand, Pourhossein (2016) compared animal metaphors in Persian and Turkish proverbs and showed how two neighbouring cultures can differ in their use of metaphors.

2.2 Artificial intelligence, language generation, and cultural meaning

Artificial intelligence-based language models are the product of the latest advances in natural language processing (NLP). Large language models (LLMs) in particular can learn the statistical patterns of human language and generate new sentences, expressions and even idioms. The productivity of these models is not limited to grammatical accuracy; it can also include advanced layers of meaning such as establishing discursive context, creating metaphors, and generating cultural associations (Bender et al., 2021). Theoretical approaches that view language production not merely as a formal process but also as a cultural act have opened up discussions about the cultural potential of these models' linguistic outputs. Thinkers such as Haraway (2016) argue that machines can contribute to cultural forms with their storytelling capabilities, while Hutson (2022) draws attention to the potential of LLMs to reproduce or disrupt social norms. Adıgüzel (2024), in his corpus-based study discussing the differences in meaning between similar words, emphasises that language models such as ChatGPT are mostly consistent, but that it is necessary to be sensitive and selective about the data they provide when it comes to subtle semantic distinctions. In this context, the fact that models such as ChatGPT can generate words with dense cultural content, such as proverbs, opens up a new area of discussion in terms of meaning creation and cultural construction. In other words, the extent to which these virtual productions are 'meaningful' and 'cultural' should be examined not only in terms of linguistic accuracy but also in terms of discourse context, normative content, and metaphorical structure. The question of whether the proverbs produced by artificial intelligence—linguistic expressions referred to as 'virtual proverbs' in this study—are a reflection of cultural memory or a simulation of that memory transforms virtual proverbs into a new discourse field. In this context, virtual proverbs can be considered not only as linguistic games created by artificial intelligence, but also as potential new carriers of cultural discourse.

Therefore, in this study, the structure, meaning, and function of virtual proverbs will be evaluated both in comparison with traditional Turkish proverbs and in the context of cultural productivity. From this standpoint, virtual proverbs can be considered not merely as linguistic games or algorithmic artefacts but as potential new carriers of cultural discourse and symbolic meaning. Therefore, in this study, the structure, meaning, and function of virtual proverbs will be evaluated comparatively—both in relation to traditional Turkish proverbs and within the broader framework of cultural productivity and meaning construction in artificial intelligence. This approach ultimately aims to illuminate how human and machine cognition intersect in the symbolic re-creation of culture through language.

3. Method

3.1. Research design

This study was conducted using a descriptive and comparative approach that combines discourse analysis and conceptual metaphor analysis techniques within the framework of qualitative research methods. The primary objective of the research is to reveal how proverbs generated by ChatGPT align with or differ from traditional Turkish proverbs in terms of structural, semantic, and cultural aspects. In pursuit of this objective, the AI-generated 'virtual proverbs' were systematically examined and evaluated in terms of cultural meaning production.

3.2. Data collection

The data for the study was generated using open-ended prompts directed at ChatGPT, a large language model developed by OpenAI. In these prompts, the model was asked to generate 50 new proverbs that were original, not found in Turkish, meaningful, and suitable for producing cultural context. Along with all the proverbs generated, the explanations of meaning provided by the model were also recorded.

The decision to set the data size at 50 was a deliberate choice, considering both representativeness and the possibility of in-depth analysis. Proverbs are discourse units that carry high-density cultural and linguistic content. Therefore, examining 50 units in qualitative analysis will both ensure diversity and provide sufficient coverage for detailed structural and semantic analysis. If necessary, this number can be expanded to include new productions in the analysis scope.

3.3. Comparative data set: traditional Turkish proverbs

In order to evaluate the cultural and semantic equivalents of virtual proverbs generated by ChatGPT, a comparative corpus was created consisting of traditional proverbs compiled from sources such as the TDK Proverbs and Idioms Dictionary (Çotuksöken, 2004). This corpus was

compared with ChatGPT's outputs both structurally (syntax, degree of fossilisation, verb tense usage, etc.) and thematically/metaphorically (e.g., 'time,' 'nature,' 'woman,' 'fate').

3.4 Data analysis process

Data analysis was conducted at two basic levels:

3.4.1 Structural discourse analysis

The formal characteristics of proverbs (length, tense structure, subject-verb relationships, repetition and parallelism structures, frequency of negative tenses, etc.) were subjected to discourse analysis. In this regard, each proverb was analysed as a linguistic structure unit, and structural overlaps or deviations with traditional proverbs were determined.

3.4.2 Conceptual metaphor analysis

Lakoff and Johnson's (1980) Conceptual Metaphor Theory (CMT) was used as the basis for identifying metaphorical domains and classifying meaning worlds. According to this theory, people produce meaning by associating abstract concepts with concrete areas of experience. In this context, the metaphors used in ChatGPT proverbs and traditional proverbs were classified according to metaphorical domains and analysed comparatively in terms of both metaphor frequency and the meaning universe created.

3.5 Ethical and Methodological Assessment

All data obtained from ChatGPT was generated in accordance with the model's ethical usage conditions, and the content was verified by the researcher. The proverbs generated are not human-made, but are used to evaluate the cultural and semantic production capabilities of artificial intelligence. Therefore, this study opens up a discussion on both the limitations and potential of digital discourse production.

4. Findings and Discussion

4.1 Findings based on structural characteristics

The 50 proverbs generated by ChatGPT were first analysed in terms of their formal and structural aspects. Structural analysis covers the formal length, syntactic structure, tense usage, subject-verb relationships, and degree of idiomaticity of the proverbs. This analysis is important in showing the extent to which AI-based proverbs resemble or differ from traditional Turkish proverbs.

4.1.1 Length and sentence types

The virtual proverbs in the data set vary between 4 and 7 words on average. This length varies between 3 and 10 words in the collection of proverbs in Turkish. This numerical data generally aligns with the concise and brief narrative style observed in traditional Turkish proverbs (Altun,

2004). For example, proverbs such as "Geceyi dinlemeyen sabaha küs olur" (Literally 'Those who do not listen to the night will be angry with the morning') evoke the syntactic volume of classical structures such as "Gülü seven dikenine katlanır" (Literally 'Those who love roses must endure their thorns.').

When looking at virtual proverbs in terms of sentence type, it was observed that 18 (36%) of the proverbs were negative and 32 (64%) were positive. This number is 60% positive and 40% negative in real proverbs. This numerical similarity demonstrates that ChatGPT can successfully model Turkish sentence structure. Table 1 compares the formal (word length) and functional (verb type) characteristics of virtual proverbs generated by ChatGPT with traditional proverbs selected from Turkish culture.

Table 1. Distribution of virtual and real proverbs in terms of formal length and verb type.

Qualification	Virtual Proverbs	Real Proverbs
Length	4 – 7 words	3 – 10 words
Positive Predicate	32 (%64)	30 (%60)
Negative Predicate	18 (%36)	20 (%40)

4.1.2 Verb usage and tense distribution

When proverbs are examined in terms of verb tenses, it is seen that the present tense is predominantly used in almost all of them. For instance, "Gölgesine aşık olan, güneşi kıskanır" (Literally, 'The one who falls in love with his shade envies the sun' or "Gözden uzak olan gönülden de uzak olur" (Literally, 'Out of sight is out of mind.') are two examples from virtual and real proverbs respectively. This usage is consistent with the nature of proverbs, which are based on generalisations and universal advice. While the past tense is never directly encountered in virtual proverbs, it is possible to find an example of this in real proverbs: "Yalancının evi yanmış, kimse inanmamış" (Literally, 'The liar's house burned down, but no one believed it'). This demonstrates that proverbs play an active role in conveying real-life experiences and in the creation of stories and myths, highlighting the importance of connecting with the past and lived events. It also shows that virtual proverbs are more focused on producing advice and assumptions related to the future.

Among the verb tenses, it has been observed that the conditional tense is the most preferred after the present tense: Examples such as "Aynaya küsersen suretin sana darılır" (Literally, 'If you turn away from the mirror, your reflection turns away from you) are parallel to typical Turkish proverbs that contain conditional-consequential relationships. It was observed that 36

of the generated proverbs (72%) contained either direct conditional structures (e.g., "Taş susarsa, yosun konuşur" (Literally, 'If the stone is silent, the moss speaks') or indirect conditional structures (e.g., "Kar tanesiyle övünen, güneşte ağlar" (Literally, 'He who boasts of a snowflake, weeps under the sun'). On the other hand, this ratio was calculated as 11 proverbs and 22% in real proverbs. This difference suggests that ChatGPT focuses more on cause-and-effect relationships when generating proverbs and adopts a more uniform production method compared to real proverbs.

Table 2 shows the distribution of the verb tenses and conditional structures of the 50 virtual (generated by ChatGPT) proverbs and 50 real (compiled from Turkish culture) proverbs analysed in the study. When creating the table, present tense suffixes (-(I)r, -mAz) added to the verb stem or direct simple present tense forms were calculated. Since the basic expression in Turkish proverbs is the present tense to convey general truths, all proverbs fall into the present tense category. Since no verb form containing the future tense suffix (-AcAk) was observed, even though meanings suggesting future-related advice and expectations were produced, this tense was not included in the evaluation. Similarly, suffixes such as –dI and –mIş, which could be considered past tense suffixes morphologically, were evaluated as past tense suffixes and added to the numerical data.

Conditional structures were evaluated by considering suffixes that directly express conditionality in Turkish, such as –sA, and suffixes that indirectly express conditionality, such as –mAdAn, -(y)IncA, and –dIkçA.

Table 2: Predicate Tenses and Conditional Structures in Virtual and Real Proverbs

Tense type	Virtual Proverbs	Real Proverbs
Present Tense	50 (%100)	50 (%100)
Conditionals	36 (%72)	11 (%22)
Past Tense	0 (%0)	2 (%4)

In the verb inflections of proverbs in both groups, it is evident that the third person singular is used and the subject is often not specified. This situation can be said to be in line with the tendency to universalise the meaning of proverbs, distancing them from being specific to a person or situation. On the other hand, it is noticeable that the expression filling the subject position in virtual proverbs is generally formed by describing it with a participle created with the suffix -An (e.g. Güneşe aşık olan (kişi); yarım ekmek paylaşan (kişi); kuyusunu tanımayan (kişi) etc (Literally, the person who is in love with the sun; the person who shares half a loaf of

bread; the person who does not know his own well respectively etc.). This usage pattern, which is also observed in most traditional proverbs, serves to generalise the meaning and, as Gürel and Tat (2019) also point out, is a feature that allows the proverb to address social experience rather than the individual.

4.1.3 Fixed expressions and expressive stability

In terms of fixed expressions, virtual proverbs contain idiomatic or metaphorical expressions, but fixed linguistic forms are limited. For example, the structure "Islak odun geç yanar, uzun ısıtır" (Literally, 'Wet wood burns late but provides long-lasting heat) contains a powerful metaphor, but this expression is not a fixed phrase that has previously been established in Turkish. This situation stems from the fact that virtual proverbs have not yet reached the level of stereotyping in social memory, but it can also be argued that such metaphors have the potential to become established if they are in line with cultural codes.

Indeed, in some examples, formal imitations of traditional structures can be observed. For example, the proverb "Ay ışığına güvenen, sabaha donuk uyanır." (Literally, 'Those who trust in moonlight wake up frozen in the morning') resembles dual (binary) structures with parallel syntax, such as "Sona kalan dona kalır" (Literally, 'The last one standing is the one who freezes' or "Kurt kocayınca, köpeğin maskarası olur" 'When the wolf grows old, it becomes the dog's clown.' This suggests that ChatGPT models formal patterns from existing proverb examples.

4.1.4 Syntactic symmetry and contrast

Syntactic symmetry and semantic contrast, which are frequently seen in traditional Turkish proverbs, are also clearly observed in virtual proverbs. For example, in the proverb "Gölgesiyle yarışan, güneşi kaçırır" (Literally, 'The one who competes with his shade, misses the sun' a positive situation (competing) is followed by a negative outcome (missing) in a symmetrical structure. This structure is similar to balanced expressions found in Turkish proverbs such as "Rüzgar eken fırtına biçer" (Literally, 'The one who plants the wind reaps the whirlwind.'

This structural analysis reveals that ChatGPT has the potential to achieve a high degree of consistency not only at the semantic level but also at the formal and grammatical levels when generating Turkish proverbs. However, since these structures have not yet become established in the social memory, there are noticeable differences in terms of fixed patterns when compared to traditional proverbs.

4.2 Thematic and conceptual metaphor analysis

The themes that emerge clearly in the 50 proverbs generated by ChatGPT reveal not only the content of linguistic production but also the extent to which artificial intelligence can mimic

human-like cultural patterns. These proverbs were analysed within the framework of conceptual metaphors, which are the building blocks of metaphorical thinking. This analysis is based on the Conceptual Metaphor Theory (CMT) developed by Lakoff and Johnson (1980). According to the theory, humans comprehend and express abstract concepts through concrete domains; this form of conceptualisation is the foundation of cultural meaning construction.

4.2.1 Main themes

The following themes are frequently encountered in the data set:

• Time (e.g., "Akşamın sözü sabaha sarkar" (Literally, 'The word of the evening carries over into the morning.')

• Nature and the environment (e.g., "Rüzgârla yarışan yaprak, kökünü unutur." (Literally, 'A leaf racing with the wind forgets its roots.')

• Social relations (e.g., "Ters akan su köprüyü zorlar." (Literally, 'Water flowing backwards strains the bridge')

• Wisdom/experience (e.g., "Gölgede büyüyen, güneşi tanımaz." (Literally, 'That which grows in the shade does not know the sun')

• Effort and result (e.g., "Toprak yorulmadan ekin vermez" (Literally, 'The soil does not yield crops without toil')

• Identity and self (e.g. "Kabuğunu inkâr eden ceviz çürür." (Literally, 'The walnut that denies its shell rots')

• Harm and foresight (e.g. "Kılıçla eken, diken biçer." (Literally, 'He who plants with a sword reaps thorns')

These themes also appear in similar forms in Turkish proverbs (see Aksoy, 1998; Gülensoy, 2004), but ChatGPT's production features some creative shifts and contemporary motifs (e.g., "Renk seçmeyen fırça her tuvale yakışır" (Literally, 'A brush that does not choose colours suits every canvas'). On the other hand, Pourhossein (2016) analysed animal metaphors used in Turkish proverbs in his study, listing the most frequently used animal metaphors and stating that the horse, dog, wolf, donkey, and sheep metaphors are the most frequently used metaphors. However, these animals are not mentioned at all in the virtual proverbs generated by ChatGPT. Instead, animals such as roosters, snakes, seagulls, foxes, and fish appear in the virtual proverbs. In Pourhossein's study, it is evident that animals such as horses and donkeys, which are indispensable to nomadic Turkish culture, and wolves, which are a cultural motif, are prominent. Despite being a country surrounded by seas on three sides, the relatively low use of the fish metaphor also parallels this nomadic culture. However, the presence of sea-related

animals such as seagulls and fish in the virtual proverbs suggests that ChatGPT operates around concepts appropriate to the conditions of the day and produces proverbs independent of historical context and past experiences. Considering both the creative shifts used and the animal metaphors employed, it can be said that virtual proverbs have a synthetic structure rather than being based on historical, experiential, and contextual accumulation.

4.2.2 Conceptual metaphors

The examples selected from the data set below demonstrate their analysis based on conceptual metaphor theory (Lakoff & Johnson, 1980). In each proverb, concrete source domains (e.g., nature, tools, agriculture) are associated with abstract target domains related to human life (identity, relationships, mental processes). The mental mappings between the two domains are explained in the last column.

Table 3. Conceptual Metaphor Analysis of Virtual Proverbs

Proverb	Source Domain	Target Domain	Mapping
Rüzgârla yarışan yaprak, kökünü unutur. (A leaf racing with the wind forgets its roots.)	Nature (leaves, roots, wind)	Identity, norms, belonging	root = basic norms; leaf = individual; wind = desire, speed
Akşamın sözü, sabaha sarkar. (What is said in the evening carries over into the morning.)	The length of time	Effects of sayings	evening = sayings; morning = results; carry over = continuation
Pas tutmuş bıçak bilenmeden kesmez. (A rusty knife cannot cut without sharpening.)	Tool (knife, rust, sharpening)	skill, mind	knife = skill; rust = blunted; sharpening = improving
Kalbi çürük tohum, çiçeğe kin besler. (A rotten seed nurtures hatred for flowers)	Agriculture (seed, flower, rottenness)	Intentions and results	seed = beginnig; flower = good result; rottenness = evil intentions
Kabuğunu inkâr eden ceviz çürür. (A walnut that denies its shell rots.)	Wallnut and its shell	Norms of an individual and identity	shell = norms; walnut = self; rotten = getting harm
Aynaya küs yüz, güzelliğini göremez. (A face that turns away from the mirror cannot see its beauty.)	Seeing, reflection (mirror, face)	Knowing oneself, acceptance	mirror =awareness; turning away = ignorance; beauty = norms, values
Gölgesiz ağaçta serinlik aranmaz. (You cannot seek coolness in a tree without shade.)	Nature (tree, shade, coolness)	Social relations, protection	shade = support; tree = individual/ society; coolness = peace

4.2.3 Cultural continuity and transformation

The metaphorical structures found in these proverbs largely parallel the traditional metaphorical systems of Turkish culture. For example, metaphors such as ‘MAN IS A TREE,’ ‘LABOUR IS

A SEED,' and 'LIFE IS A JOURNEY' correspond to the nature-centred oral culture in Turkish (Duman, 2012; Bekiroğlu, 2014).

However, in some proverbs, contemporary images and emotional intensity come to the fore. This can be explained by the cultural diversity of the texts used to train artificial intelligence (Floridi & Chiriatti, 2020). In this respect, production is important both in terms of the reimagining of traditional metaphors and the emergence of potential new metaphor systems.

4.2.4 Metaphorical creativity or imitation?

Metaphor analyses show that ChatGPT does not merely make statistical comparisons, but also reproduces conceptual structures in appropriate contexts. However, it is important to note that this production is either creative or merely paradigmatic variation (Bender & Koller, 2020). For now, it appears that the production remains within the framework of culturally familiar metaphors and does not offer radical innovation. Nevertheless, the variations in original examples give positive signals about the creative cultural contribution potential of artificial intelligence.

4.3. Forms of cultural expression and layers of meaning

The 50 proverbs generated by ChatGPT are not limited to syntactic and metaphorical structures, but also reflect cultural values, norms, and mindsets at various levels. Proverbs are forms of discourse that encode social memory, behavioural norms, and collective experience (Kramsch, 1998), so this dataset provides important clues about cultural meaning construction.

4.3.1 Normative discourse and moral orientations

Most virtual proverbs convey normative messages that guide society through dichotomies such as right–wrong, good–bad, effort–result, belonging–separation. In this respect, they share a discourse plane that overlaps with traditional Turkish proverbs. For example:

• "Kabuğunu inkar eden ceviz çürür" ('A walnut that denies its shell rots') → The necessity of preserving identity and belonging is emphasised.

• "Toprak yorulmadan ekin vermez" ('The soil does not yield crops without toil') → The message that there is no success without effort is conveyed.

Such discourses are one of the sustaining moral structures of culture, and the reproduction of these norms in artificial intelligence production points to the cultural richness of the language examples from which it draws inspiration (Shane, 2020).

4.3.2 Silent narratives and cultural memory

Some proverbs reflect cultural memory, collective fears, or concerns about social change in a more subtle way. For example:

• “Kör aynada güzellik aranmaz” (‘Beauty cannot be found in a blind mirror’) → This refers to the subjective nature of the concepts of beauty and value, but also to the futility of searching for objective criteria.

• “Aynaya küs yüz güzelliğini göremez”(‘A face that turns away from the mirror cannot see its beauty’) → This proverb carries a layered meaning about self-perception, connections with society, and alienation.

These words represent not only individual experience, but also a society's view of itself, its criticism, or its desire for change. In a manner that can be linked to Bourdieu's (1991) concept of ‘linguistic habits,’ these productions encode the individual-society relationship through cultural agreements.

4.3.3 Gender, Belonging, and Individuality

While proverbs generated by ChatGPT rarely contain direct references to gender, some meanings related to individuality and community are noteworthy:

• “Rüzgarla yarışan yaprak kökünü unutur” (‘A leaf that races with the wind forgets its roots’) → The loss of an individual who strays from where they belong.

• “Islak odun geç yanar ama uzun ısıtır” (‘Wet wood burns late but provides long-lasting heat’) → Emphasises that work done with patience yields delayed but lasting results.

• “Kuyusunu tanımayan suya düşer” (‘He who does not know his well will fall into the water’) → Emphasises that a person who does not know his own limits is vulnerable to danger.

Such verbal expressions not only perpetuate the traditional societal values of belonging, loyalty, hard work, and patience but also nod to modern values such as individual decision-making and awareness.

4.3.4 Time, Transformation and Uncertainty

The concept of time and coping with change are also themes encountered in virtual productions. These themes can be considered in the context of reinterpreting traditional wisdom in response to the rapid transformation of modern societies:

• “Gün uzar, gölge derinleşir” (‘The day grows longer, the shadow deepens’) → Problems can grow as time passes; early intervention is important.

• “Kuru dal gölge yapmaz” (‘A dry branch casts no shadow’) → Structures or individuals that have lost their function cannot be of use.

• “İzi olmayan yol, yolcuyu şaşırtır” (‘A path without a trace confuses the traveller’) → If lessons are not learned from the past, direction will be lost in the future.

These sayings reflect experiential attitudes developed in response to the linear flow of time, as indicated by the universal metaphor “LIFE IS A JOURNEY” (Kövecses, 2002), and represent ways of coping with cultural uncertainty at both the individual and collective levels.

5. Conclusion and Evaluation

This study examined whether virtual language production can contribute to cultural meaning construction by analysing 50 original proverbs generated by the artificial intelligence-powered language model ChatGPT. Comparative analyses conducted with traditional Turkish proverbs in terms of structural, thematic, and metaphorical characteristics have shown that ChatGPT is a highly competent discourse producer in proverb generation, not only formally but also conceptually and culturally. In this context, answers were sought to the following two research questions: 1. To what extent do the proverbs generated by ChatGPT correspond to the Turkish proverb tradition in terms of structure and theme? 2. To what extent do these virtual proverbs reflect or reproduce cultural values, normative discourses, and collective meanings? As a result of the analyses conducted, it was observed that the proverbs generated by ChatGPT largely adhere to traditional formal patterns (short structure, parallelism, rhythm, harmony, semantic density) and thematically align with traditional values (diligence, self-sacrifice, belonging, wisdom, resilience, individual-society relations). However, it should not be forgotten that these productions are based on linguistic patterns ‘learned’ by the language model rather than direct life experience. In this respect, ChatGPT's proverbs should be evaluated as synthetic cultural products based on the statistical reflection of cultural memory rather than representations of that memory.

5.1. Limitations

This study has some limitations. First, only 50 proverbs were selected as samples; it should be noted that quantitative and qualitative analyses conducted with a larger data set could provide stronger findings in terms of generalisability. On the other hand, only Turkish proverbs were used for comparison, and the proverb traditions of other cultures were excluded. Furthermore, pragmatic dimensions such as the potential for use in real life, acceptability, and the likelihood of cultural circulation of the generated words were not examined.

5.2. Recommendations for Future Research

Future research could include a comparative analysis of the proverb-generating capabilities of different artificial intelligence models (e.g., Claude, Gemini, Mistral, etc.). Alternatively, experimental studies (focus group discussions, surveys, etc.) could be conducted to determine the extent to which words generated by ChatGPT are accepted by the general public. Finally,

by comparing artificial proverbs from different cultures in the context of cross-cultural meaning production, insights can be gained into the quality of AI-supported linguistic production in different cultural contexts.

In conclusion, this study has shown that large language models such as ChatGPT have the potential to reproduce not only the superficial levels of language but also its deep structures, which are carriers of cultural meanings. However, this reproduction always constructs a synthetic reality; it is distant from the experiential and historical context of traditional cultural memory. In this regard, virtual proverbs offer clues about how we might shape the cultural lexicon of the future, yet they also necessitate a critical distance.

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ÇOCUKLAR İÇİN FELSEFE (P4C) KAPSAMINDA 2019 İLE 2024 TÜRKÇE DERSİ ÖĞRETİM PROGRAMLARININ DEĞERLENDİRİLMESİ

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ÖZET

Dil; insanların tarih sahnesine çıkmasıyla kendilerini anlatmalarına, diğer insanlarla iletişim kurmalarına, toplumu ve sosyal hayatı oluşturmalarına imkân sunan bir yapıdır. Dile dair ilk edinimler aile ve çevreyle başlamakta ardından eğitim kurumları ile planlı bir şekilde yürütülmektedir. Ana dili eğitiminde okuduğunu, dinlediğini, eksiksiz anlayabilen; kendini yazılı ve sözlü olarak kusursuz ifade edebilen bireyler yetiştirmek temel amaçtır. Bununla birlikte dil eğitimi günümüzde dil ve iletişim becerilerini kazandırmanın yanında, düşünme, sorgulama, ilişkilendirme, eleştirme, tahmin etme, analiz ve sentez yapabilme, değerlendirme gibi bilişsel becerileri geliştirmeye de odaklanmıştır. Bu noktada karşımıza Amerikalı felsefeci ve eğitimci Matthew Lipman'ın fikir babası ve kurucusu olduğu P4C çıkmaktadır. P4C, çocukları küçük yaşlarda felsefî düşünme şekliyle tanıştıran; çocukların eleştirel, yaratıcı, dayanışmacı ve özenli düşünme, akıl yürütme, sorgulama becerilerini geliştiren; okulöncesinden liseye kadar okul içi ve okul dışı eğitim etkinliklerini kapsayan modern bir eğitimdir. Öğretim programlarının eğitim sürecinin yol haritası olması, P4C'nin öğrencilerin düşünme becerilerini geliştirmeyi amaçlaması, günümüz dil eğitiminin anlayışı göz önünde tutularak bu çalışmanın amacı, P4C kapsamında 2019 Türkçe Dersi Öğretim Programı (TDÖP) 5. sınıf kazanımları ile 2024 TDÖP 5. sınıf öğrenme çıktıları açısından karşılaştırarak değerlendirmektir. Nitel bir yaklaşımla desenlenen araştırma, doküman incelemesi yöntemiyle yapılandırılmış; veri kaynağı olarak kullanılan her iki programın metinlerinden elde edilen veriler içerik analizi yoluyla çözümlenmiştir. Araştırma sürecinde literatür taraması yapılarak P4C'ye dair 17 kod oluşturulmuş, ardından 2019 TDÖP 5. sınıf kazanımlarının ve 2024 TDÖP 5. sınıf öğrenme çıktılarının bu kodlarla örtüşme durumu incelenmiştir. Ayrıca programların 5. sınıf kazanımları/öğrenme çıktıları sayılarına ve öğrenme alanlarına göre dağılımlarına da yer verilmiştir. Bu kapsamda, 2024 programının 2019 programına göre kazanım/öğrenme çıktısı bakımından daha yoğun olduğu ve bilişsel süreçlere daha fazla önem verdiği görülmüştür. Araştırma sonucunda 2019 programının %68,11 oranında, 2024 programının ise %88,79 oranında P4C kodlarıyla uyumlu olduğu belirlenmiştir.

Anahtar Kelimeler: çocuklar için felsefe (P4C), Türkçe Dersi Öğretim Programı (TDÖP), Türkçe dersi, dil becerileri

THE EVALUATION OF TURKISH COURSE CURRICULUMS DATED 2019 AND 2024 IN THE CONTEXT OF PHILOSOPHY FOR CHILDREN (P4C)

ABSTRACT

Language is a structure that enables people to express themselves, communicate with others, and form society and social life since their emergence on the historical stage. Initial language acquisition begins with the family and environment, followed by a planned process through educational institutions. The fundamental aim of mother tongue education is to nurture individuals who can read, listen and understand comprehensively, and express themselves flawlessly in both written and spoken form. However, language education today focuses not only on imparting language and communication skills, but also on developing cognitive skills such as thinking, questioning, relating, criticising, predicting, analysing, synthesising and evaluating. At this point, we encounter P4C, conceived and founded by American philosopher and educator Matthew Lipman. P4C is a modern educational approach that introduces children to philosophical thinking at an early age; develops their critical, creative, collaborative and careful thinking, reasoning and questioning skills; and encompasses both in-school and out-of-school educational activities from pre-school to secondary school. Considering that teaching programmes serve as roadmaps for the educational process and that P4C aims to develop students' thinking skills, the purpose of this study is to evaluate and compare the 2019 Turkish Language Teaching Programme (TDÖP) 5th grade learning outcomes with the 2024 TDÖP 5th grade learning outcomes within the scope of P4C, taking into account the current understanding of language education. The research, designed using a qualitative approach, was structured using the document review method; data obtained from the texts of both programmes used as data sources were analysed through content analysis. During the research process, a literature review was conducted, resulting in the creation of 17 codes related to P4C. Subsequently, the alignment of these codes with the 2019 TDÖP 5th grade learning outcomes and the 2024 TDÖP 5th grade learning outcomes was examined. Furthermore, the distribution of the programmes' 5th grade learning outcomes/gains according to their number and learning areas was also included. In this context, it was observed that the 2024 programme was more intensive in terms of learning outcomes/gains compared to the 2019 programme and placed greater emphasis on cognitive processes. Specifically, 68.11% of the 2019 curriculum's learning outcomes were found to be aligned with Philosophy for Children codes, compared to 88.79% in the 2024 curriculum.

Keywords: philosophy for children (P4C), Turkish Course Curriculum, Turkish course, language skills

FULL DYNAMIC MODELING OF COUPLED DYNAMICS AND ENERGY HARVESTING IN A GIMBALED PENDULUM SYSTEM

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Keywords: Gimbaled Pendulum (Gimbal), Coupled Dynamics, Lagrange's Equations, Nonlinear Dynamics, Power Take-Off (PTO)

1. ABSTRACT

This study presents a comprehensive and integrated mathematical model for investigating the coupled dynamics and energy-harvesting performance of a two-degree-of-freedom (2-DOF) gimbaled pendulum system designed to extract energy from multi-directional excitations. In contrast to earlier theoretical works that relied on simplified assumptions to handle orthogonal-axis interactions, the proposed model is derived rigorously from the full Lagrangian formulation without geometric or kinematic simplifications. This approach enables an accurate characterization of the nonlinear dynamic coupling between the gimbal axes, a phenomenon that is difficult to capture using conventional simplified analyses. For efficient numerical implementation, the model is developed using detailed Simulink block diagrams, offering high flexibility for visual simulation and seamless integration with additional energy components. A Power Take-Off (PTO) unit is incorporated to assess energy-harvesting performance and the conversion of mechanical energy into electrical power. Simulation results show strong agreement with previously reported experimental data, confirming the validity and accuracy of the proposed model. The results also reveal the impact of dynamic coupling, including reduced power output in the 2-DOF configuration compared with the 1-DOF case under certain excitation angles. Moreover, the simulations highlight the critical role of the PTO not only in energy harvesting but also in attenuating oscillation amplitudes and enhancing dynamic stability under variable excitation conditions. This work provides a robust and flexible modeling framework for the development of high-efficiency environmental and marine energy-harvesting systems, with potential applications in smart cities, environmental monitoring, and self-powered sustainable technologies.

2. Introduction

Energy harvesting from vibrations has become a rapidly growing research topic in recent years, driven by the increasing demand for self-powered and sustainable solutions to supply wireless

sensing systems and Internet of Things (IoT) devices. However, conventional models in this field are often based on single-degree-of-freedom (1-DOF) pendulum systems, which are inherently limited to motion within a single plane.

This limitation significantly reduces their efficiency when subjected to multidirectional disturbances, such as those commonly encountered in marine environments or naturally varying conditions.

To address this challenge, pendulum systems equipped with a gimbal mechanism have been proposed as a promising solution. This mechanical configuration allows the pendulum to rotate about two orthogonal axes, enabling orbital motion in multiple directions and thereby expanding the range of exploitable vibration frequencies and excitation sources. Although several experimental studies have demonstrated the feasibility of this concept, most existing research relies on simplified mathematical formulations to facilitate numerical analysis, which may neglect important nonlinear effects and dynamic coupling between degrees of freedom.

In this work, a complete mathematical model based on the full Lagrangian formulation without simplifications is developed, along with a numerical representation using block diagrams to analyze the system dynamics and energy harvesting performance. This approach provides a more accurate description of the interactions between different degrees of freedom and reveals characteristics that cannot be observed using simplified models. In addition, a comprehensive comparison is conducted between the numerical results obtained from the full model and those derived from simplified models, highlighting the practical advantages of the proposed methodology.

3. Literature Review

Vibration-based energy harvesting systems relying on pendulum mechanisms have witnessed significant development over the past two decades. Early research predominantly focused on simple single-degree-of-freedom (1-DOF) models due to their structural simplicity and analytical tractability. Several studies demonstrated that such systems can achieve satisfactory performance at resonant frequencies; however, their response remains limited to unidirectional excitations [1], [2]. This inherent limitation motivated researchers to explore more advanced configurations capable of handling multidirectional disturbances.

To overcome these constraints, multi-degree-of-freedom pendulum systems, including spherical pendulums and gimbal-based configurations, have been proposed to broaden the operational frequency range and enhance responsiveness to multidirectional vibrations. For instance, the work of Crowley *et al.* [3] on the WITT device highlighted the potential of such

systems to operate under complex excitation conditions. In this context, the study by Anurakpandit *et al.* [4] is often regarded as a key reference, as it presented both numerical and experimental investigations of a pendulum mounted on a two-degree-of-freedom gimbal mechanism. Their results demonstrated that while the gimballed design enables multidirectional response, it may generate lower electrical power than a single-DOF pendulum under similar conditions due to dynamic coupling effects.

These findings are consistent with other studies that examined nonlinear pendulum-based energy harvesters, such as double-mass pendulum systems or variable-length pendulums, where nonlinearities and chaotic dynamics were deliberately exploited to increase bandwidth and improve energy harvesting performance [5]–[8]. Additional research directions have focused on hybrid energy conversion techniques, combining piezoelectric and electromagnetic generators to achieve more stable power output in highly random environments, as demonstrated in the work of Zhao *et al.* [9], [10].

Moreover, alternative approaches have aimed at enhancing system efficiency through innovative mechanical designs, including motion rectification mechanisms and scalable configurations suitable for marine energy harvesting or smart monitoring platforms. Building upon this body of work, the foundational study by Anurakpandit *et al.* [4] represents a transitional step between traditional simplified models and more advanced coupled systems. Their results indicate that future energy harvesting solutions should integrate multidirectional response with nonlinear or hybrid energy enhancement mechanisms to achieve higher efficiency and long-term sustainability in marine energy harvesting applications.

4. Methodology

4.1 Numerical Modeling Using Simulink

Starting from the governing equation describing the dynamics of a single-degree-of-freedom (1-DOF) pendulum, a numerical model was developed to represent the system behavior. As illustrated in Figure (1), the model is based on three principal torque components acting on the pendulum.

The first component is the gravitational torque, which is expressed as a sine function of the angular displacement and scaled by an equivalent coefficient representing the system parameters. The second component corresponds to the external excitation torque induced by base accelerations, which is formulated as a function of the platform accelerations along the horizontal and vertical directions. These excitation terms account for the influence of base

motion on the pendulum response. The third component represents the damping torque, which is associated with angular velocity and is implemented in the model through a gain block.

After assembling these torque contributions within the main summation block (denoted as *Theta_ddot_sum* in Figure (1)), the angular acceleration is obtained. This signal is subsequently integrated twice to yield the angular velocity and angular displacement, respectively. Consequently, the developed Simulink model provides a direct numerical implementation of the governing equation of motion for the single-DOF pendulum system.

$$\ddot{\theta}(t) + \frac{m_\theta g I_\theta}{I_\theta} \sin(\theta(t)) + \frac{m_\theta I_\theta}{I_\theta} + \left(\left(\ddot{X}(t)\right) cos(\theta(t)) + \left(\ddot{Z}(t) sin(\theta(t))\right)\right) = \theta_\theta for\ \theta - plane \quad (1)$$

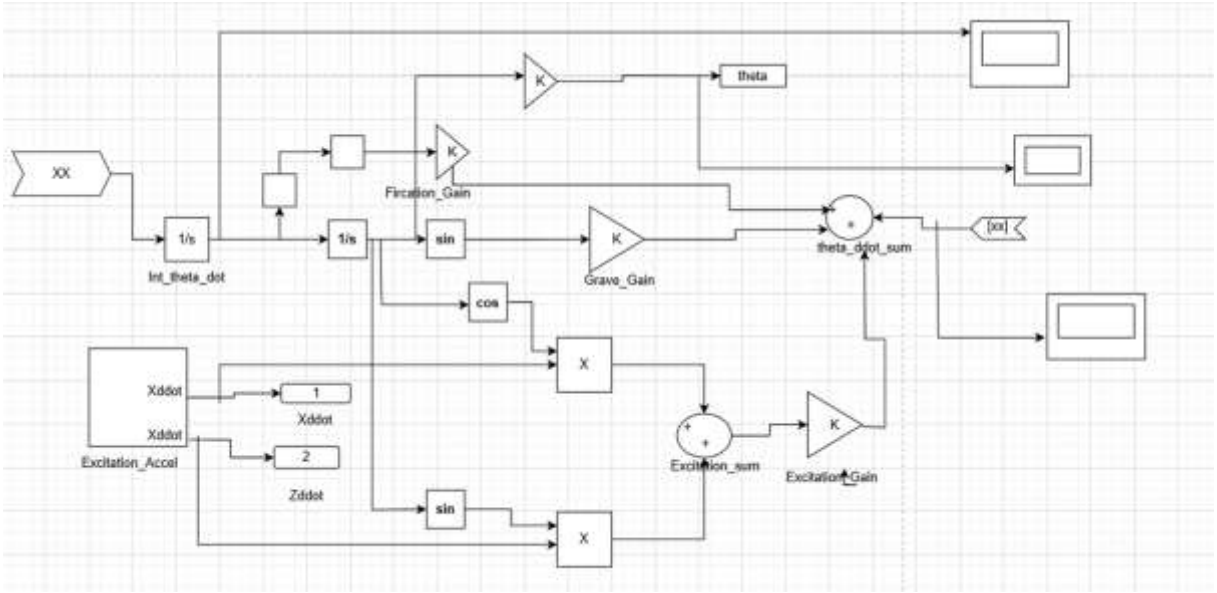


Figure 1 Equation 1

4.2 Incorporation of the Power Take-Off (PTO) and Power Calculation

In the next stage, the numerical model was extended to include a Power Take-Off (PTO) element, as shown in Figure (2). An additional torque term was introduced to represent the effect of the PTO units, which can be expressed as a function proportional to the angular velocity.

$$\tau_{pto} = k\dot{\theta}_{pto} \quad (2)$$

This torque reflects the extraction of a portion of the mechanical energy generated by the angular motion and its conversion into electrical energy. Within the Simulink framework, this enhancement is implemented through a gain block (*PTO_gain*) directly connected to the angular velocity signal. The resulting PTO torque is incorporated into the main torque summation block (*Theta_ddot_sum*), thereby influencing the overall system dynamics.

Moreover, to evaluate the energy performance of the system, an additional computational path was programmed to calculate the instantaneous power (*P_inst*). This is achieved by multiplying

the PTO torque by the angular velocity and subsequently squaring the resulting signal to obtain a direct measure of the instantaneous extracted power. This formulation enables continuous monitoring of the energy harvesting capability of the system.

As a result, the enhanced model is capable of:

- Capturing the dynamic response of the pendulum while accounting for the influence of the PTO,
- Computing the root mean square (RMS) value of the response as an indicator of system stability and effectiveness,
- Estimating the instantaneous power and extracted energy through the PTO, allowing direct comparison with published reference results.

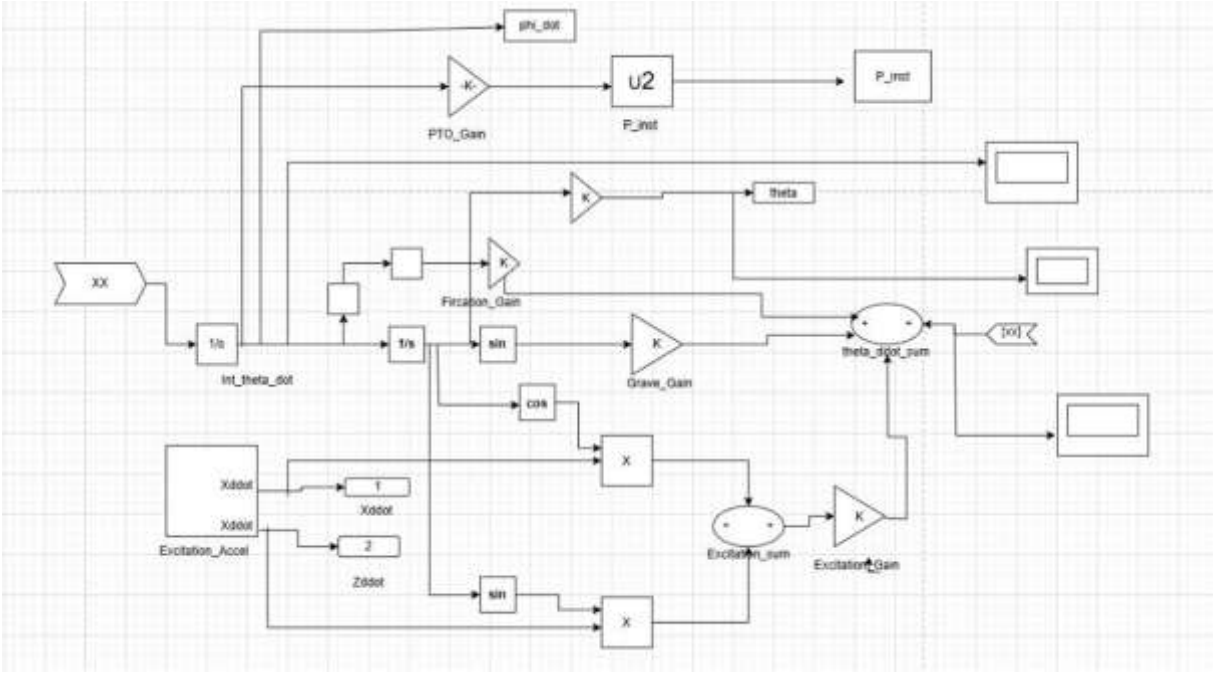


Figure 2 Equation 1 with PTO

4.3 Simplified Models and the Coupled Dual-Plane Model

The equation governing motion in the second plane is mathematically similar to that of the first plane, with differences arising only in the generalized coordinates and parametric values such as mass, pendulum length, and moment of inertia. In this formulation, the angular variable is replaced accordingly, and the base excitation terms are adjusted to reflect the excitation direction.

While each simplified equation describes motion within a single plane independently, the coupled dual-plane model integrates both equations to form a dynamically coupled system. In

this configuration, the outputs of each equation act as inputs to the other, enabling a full representation of the dynamic interaction between the two orthogonal axes.

This coupling demonstrates how each plane transitions from an independent dynamic state to a complex coupled behavior under inclined excitation conditions, thereby providing deeper insight into the dynamics of the real gimballed pendulum system.

$$\ddot{\emptyset}(t) + \frac{m_{\emptyset} g I_{\emptyset}}{I_{\emptyset}} sin(\emptyset(t)) + \frac{m_{\emptyset} I_{\emptyset}}{I_{\emptyset}} + \left(\left(\ddot{Y}(t)\right) cos\left(\emptyset(t)\right) + \left(\ddot{Z}(t) sin\left(\emptyset(t)\right)\right)\right) = Q_{\emptyset} for\ \emptyset - plane \quad (3)$$

4.4 Full Coupled Model of the Governing Equations

The full coupled model represents the complete dynamic behavior of the gimballed pendulum system by simultaneously considering the motion in two orthogonal planes. In contrast to simplified single-plane formulations, this model accounts for the mutual interaction between the angular motions, allowing an accurate description of the dynamic coupling effects that arise under multidirectional excitation.

The governing equations of motion for the coupled system are derived from the full Lagrangian formulation without simplifications. In this framework, the angular displacement of each plane not only determines its own dynamic response but also directly influences the motion in the other plane through nonlinear coupling terms. Consequently, the outputs of each equation act as dynamic inputs to the other, forming a fully interdependent system.

The block diagram representation of the coupled model, as illustrated in Figure (3), highlights how the dynamic equations associated with each plane are integrated into a unified numerical structure. The upper subsystem represents the dynamics of the θ-plane, while the lower subsystem corresponds to the φ-plane. The angular displacement, velocity, and acceleration generated in each subsystem are fed back into the other through nonlinear trigonometric coupling terms, preserving the physical nature of the governing equations.

$$\ddot{\emptyset}(t) + \frac{m_{\emptyset} g I_{\emptyset}}{cos\,\emptyset(t)} sin\,\theta(t) - \dot{\emptyset}(t) sin\,\emptyset(t) \left(\frac{2\dot{\theta}(t)}{\cos\emptyset(t)} + \frac{m_{\emptyset} I_{\theta}}{I_{\theta} \cos\left(\emptyset(t)\right)^2} \left(\left(\dot{X}(t) \cos\left(\emptyset(t)\right) + \left(\dot{Z}\,(t) \sin\left(\theta(t)\right)\right)\right)\right)\right)$$
$$+ \frac{m_{\theta} g l_{\theta}}{I_{\theta} \cos\left(\emptyset(t)\right)} + \left(\left(\ddot{X}(t)\right) cos\left(\emptyset(t)\right) + \left(\ddot{Z}(t) sin\left(\emptyset(t)\right)\right)\right) = \frac{Q_{\emptyset}}{I_{\theta} \cos(\emptyset(t))^2} \quad (4)$$

$$\ddot{\emptyset}(t) + \frac{m_{\emptyset} g I_{\emptyset}}{I_{\emptyset} cos\,\emptyset(t)} sin\,\theta(t) - \dot{\theta}(t) sin\,\theta(t) \left(\frac{2\dot{\theta}(t)}{\cos\theta(t)} + \frac{m_{\emptyset} I_{\emptyset}}{I_{\emptyset} \cos\left(\theta(t)\right)^2} \left(\left(\dot{Y}(t) \cos\left(\emptyset(t)\right) + \left(\dot{Z}\,(t) \sin\left(\emptyset(t)\right)\right)\right)\right)\right)$$
$$+ \frac{m_{\emptyset} g l_{\emptyset}}{I_{\theta} \cos\left(\emptyset(t)\right)} + \left(\left(\ddot{X}(t)\right) cos\left(\emptyset(t)\right) + \left(\ddot{Z}(t) sin\left(\emptyset(t)\right)\right)\right) = \frac{Q_{\emptyset}}{I_{\emptyset} \cos(\theta(t))^2} \quad (5)$$

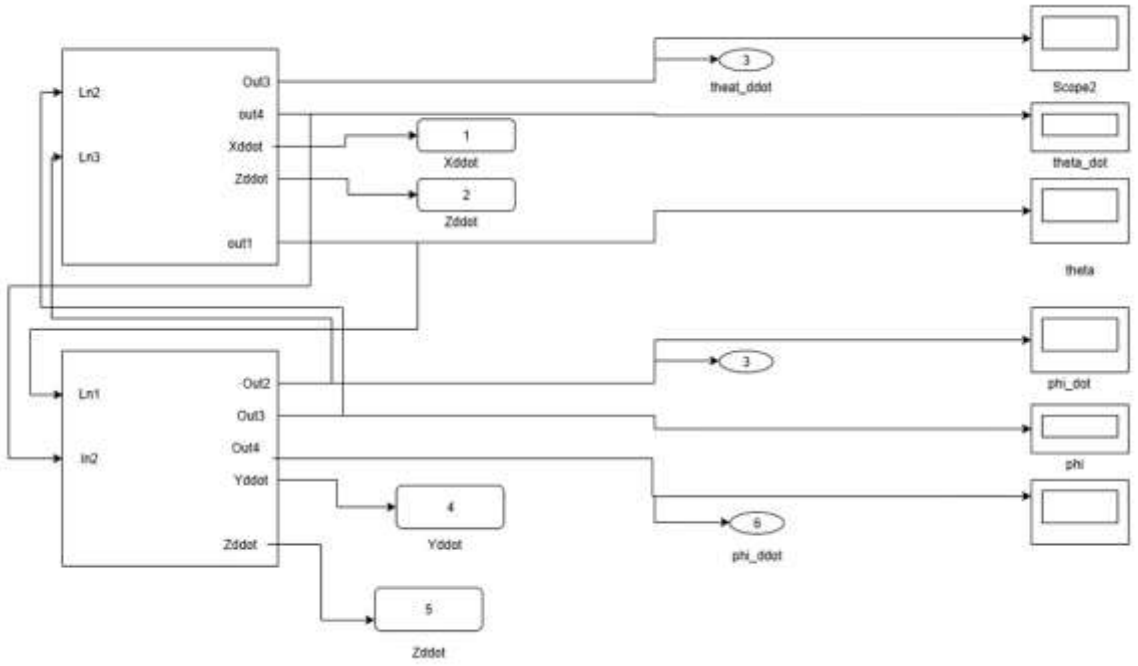


Figure 3

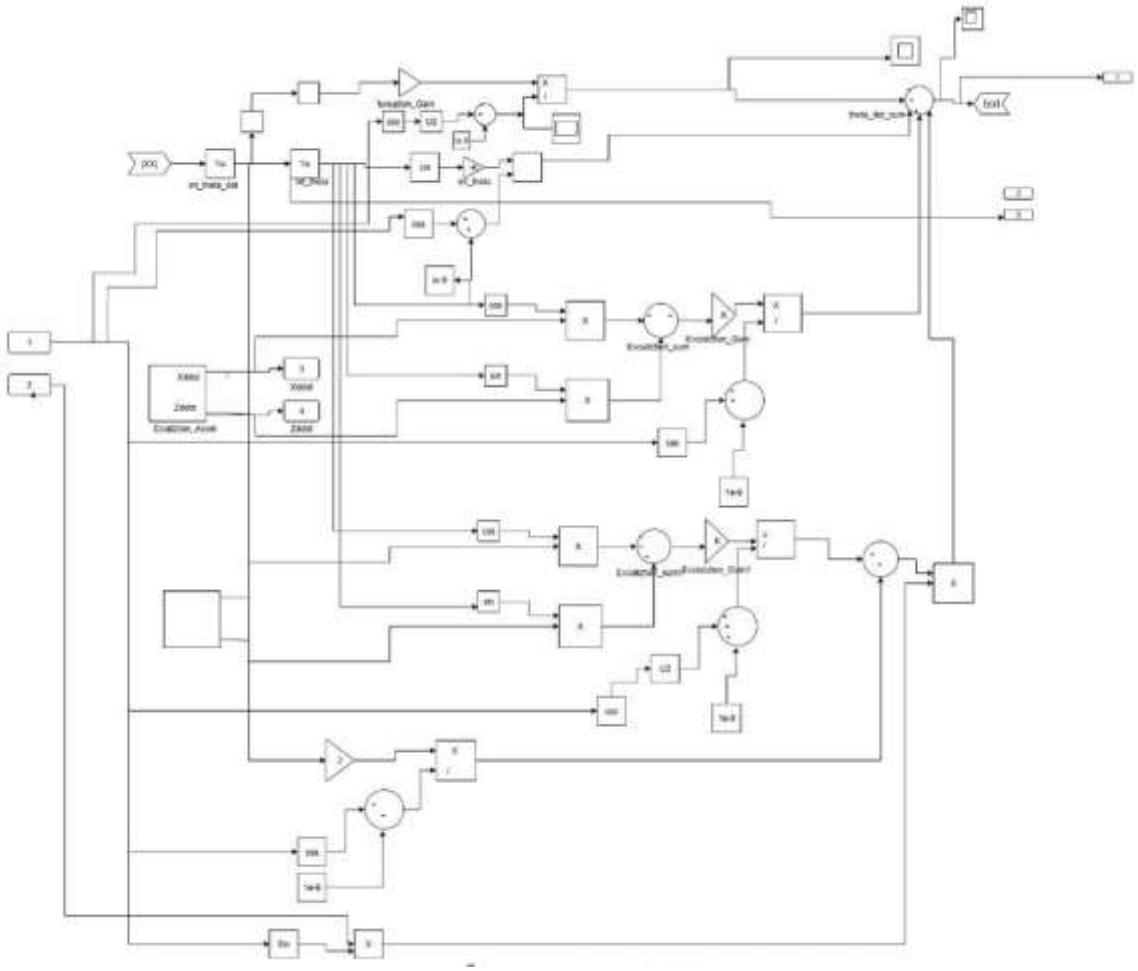


Figure 3 -a-

Base excitation inputs in the form of translational accelerations are applied along different directions for each plane. Specifically, the θ-plane is excited by accelerations along the X–Z

directions, whereas the φ-plane is driven by excitations along the Y–Z directions. Apart from these directional differences in base excitation, both subsystems share identical structural components, including gravitational effects, inertial coupling, damping terms, and the torque associated with energy extraction through the Power Take-Off (PTO).

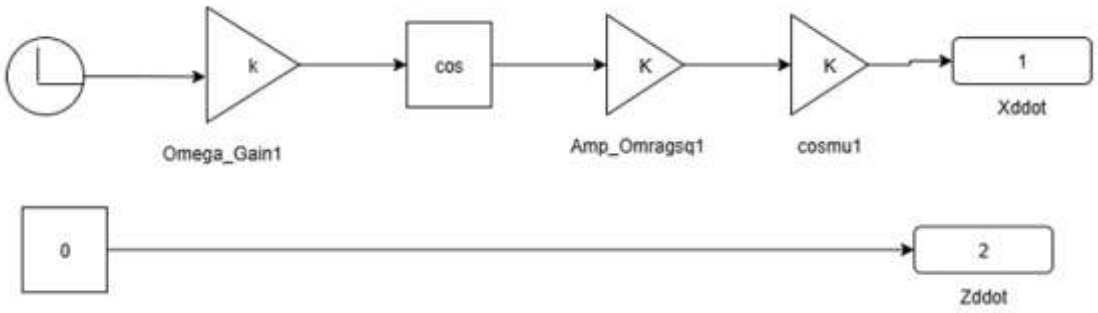


Figure 3 -b-

Within each subsystem, all torque contributions—namely gravitational torque, base excitation torque, coupling-induced torque, damping torque, and PTO torque—are assembled within a central summation block. The resulting angular acceleration is then integrated twice to obtain the angular velocity and angular displacement. These state variables are continuously exchanged between the two subsystems, ensuring that the nonlinear coupling between the planes is fully retained throughout the simulation.

The full coupled model reveals how the system transitions from independent planar motion to complex coupled dynamics as the excitation angle deviates from the principal axes. Under aligned excitation, each plane behaves similarly to an uncoupled single-degree-of-freedom pendulum. However, when subjected to inclined excitation, strong energy transfer between the planes emerges, leading to amplitude redistribution, modified resonance characteristics, and increased dynamic complexity.

By capturing these interactions, the full coupled model provides a realistic representation of the physical behavior of a gimballed pendulum energy harvester. It therefore constitutes a robust analytical and numerical framework for studying multidirectional vibration energy harvesting, assessing the impact of coupling on power extraction, and guiding the design of efficient and stable coupled dynamical systems.

5. Results

When comparing the results obtained from the developed numerical models with the published results reported by previous researchers, a strong agreement in terms of waveform shape, dynamic behavior, and overall pendulum response can be clearly observed. The simulations show that the maximum vibration amplitude occurs at a resonant frequency of approximately

0.9 Hz for excitation angles of ±60°, corresponding to the cases μ = 0° and μ = 90°. This behavior is fully consistent with the numerical and experimental findings reported in the reference studies.

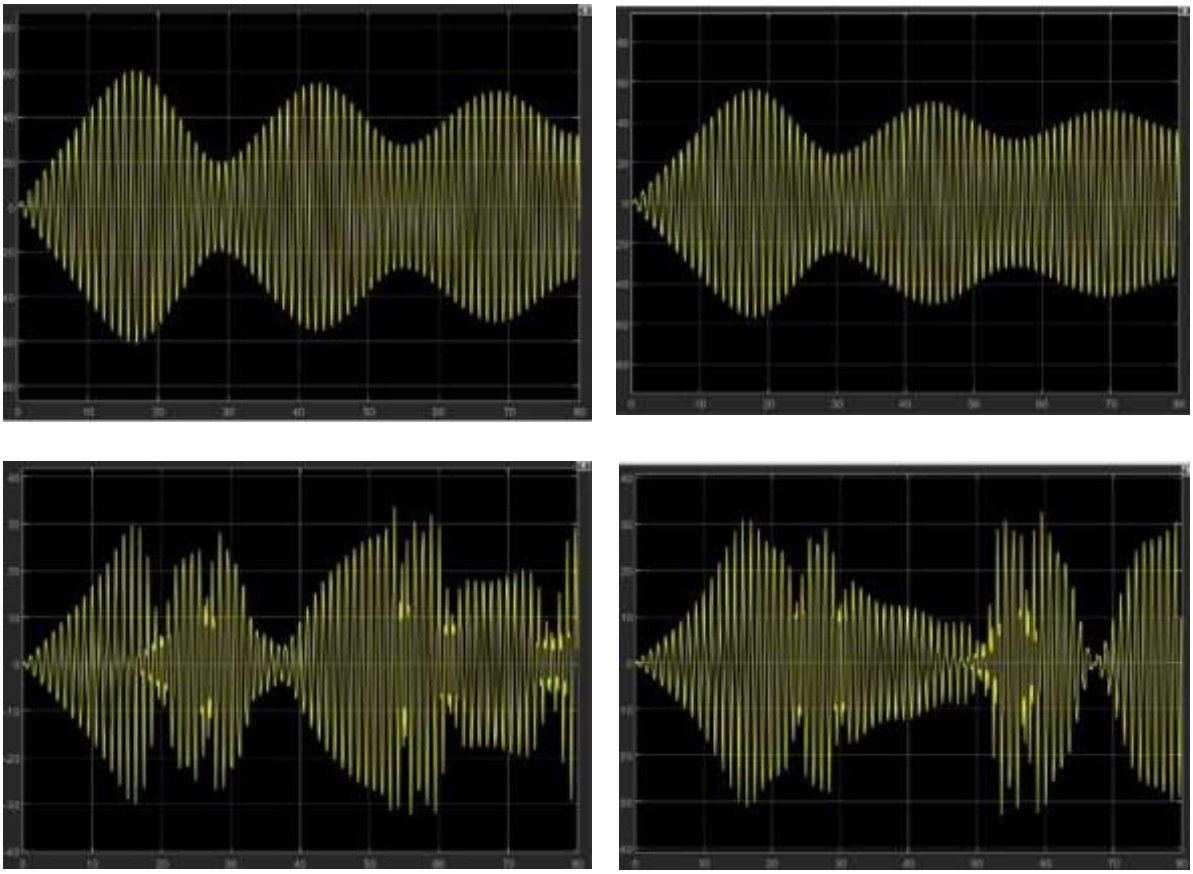


Figure 4 Time-domain response of the pendulum system without PTO under different excitation angles, showing amplitude modulation and resonance behavior near the natural frequency.

For an excitation angle of μ = 45°, a noticeable reduction in vibration amplitude is observed, decreasing to values around ±30°. This reduction is attributed to the coupling effects between the two motion planes, a trend that has also been reported by previous researchers. These results confirm that the introduction of multidirectional excitation leads to energy redistribution between the planes, thereby reducing the response amplitude in each individual direction.

Furthermore, the comparison confirms that the response of the pendulum under μ = 0° and μ = 90° excitation conditions closely resembles that of a simple single-degree-of-freedom pendulum, exhibiting relatively high vibration amplitudes. In contrast, inclined excitation angles significantly enhance the coupling effects between the axes, resulting in a pronounced reduction in vibration amplitude. The agreement between the present results and the reference data extends beyond qualitative trends and includes quantitative agreement in peak values and response limits, thereby validating the accuracy and reliability of the proposed mathematical model and its ability to represent the underlying physical phenomenon.

Additional analysis of the simplified models for each individual plane confirms consistency with previously reported findings. For the θ-plane model, the maximum response occurs near the resonant frequency of 0.9 Hz at an excitation angle of $\mu = 30°$, while the response diminishes at $\mu = 0°$ and nearly vanishes at $\mu = 45°$ and $\mu = 90°$. This behavior matches the reported observations that the θ-plane behaves as a simple pendulum when excitation is aligned with the corresponding axis.

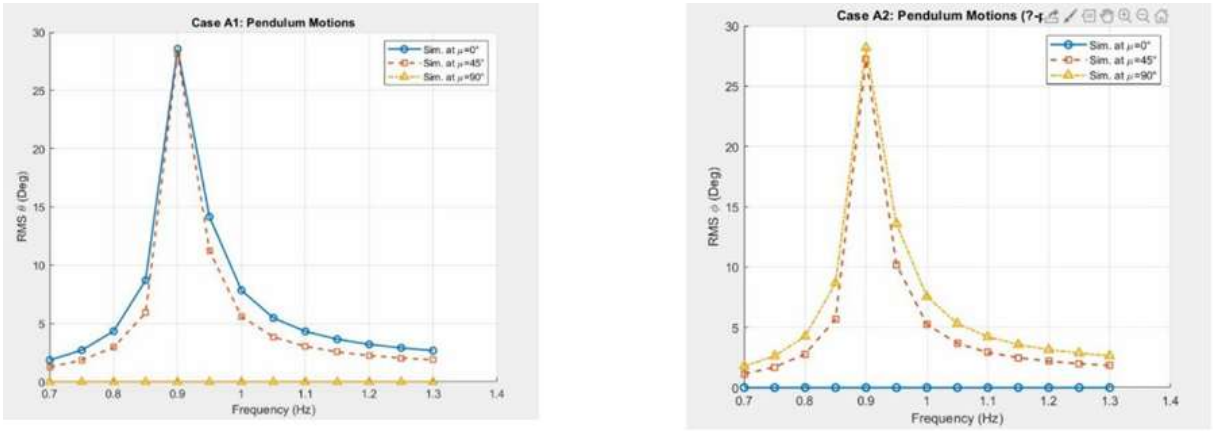


Figure 5 RMS frequency response of the simplified single-plane models: (a) θ-plane response and (b) φ-plane response for different excitation angles.

Similarly, for the φ-plane model, the maximum vibration amplitude is observed near $\mu = -90°$, while the response becomes negligible at $\mu = 0°$. These results further support the complementary nature of the two planes, where the response in one plane is suppressed as the response in the other increases.

In the fully coupled model, the system behaves as a simple pendulum under $\mu = 0°$ excitation, whereas strong coupling effects emerge at $\mu = 45°$, leading to simultaneous interaction between both planes. This confirms that dynamic coupling only becomes significant under inclined excitation conditions, in agreement with previously published experimental and numerical studies. Overall, the coupled model successfully reproduces all key response characteristics reported in the literature, including resonance location, peak amplitude values, and the influence of excitation angle.

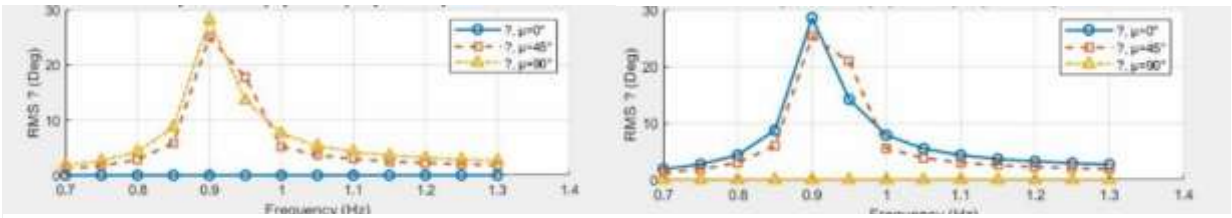


Figure 6 RMS frequency response of the fully coupled model without PTO: (a) θ-plane response and (b) ϕ-plane response, highlighting the effect of dynamic coupling under inclined excitation.

The inclusion of the Power Take-Off (PTO) element further reveals its significant influence on system dynamics. The results indicate that the PTO introduces noticeable damping, particularly outside the resonant frequency region, leading to a substantial reduction in vibration amplitudes. At resonance, oscillations remain pronounced but with lower peak values compared to the case without PTO, which is consistent with reported observations in the literature.

Both single-plane and coupled models demonstrate that the PTO effectively suppresses large oscillations and promotes faster decay of vibrations, confirming its critical role in vibration mitigation and dynamic stabilization. These findings validate the dual function of the PTO as both an energy extraction mechanism and a st abilizing element within the system.

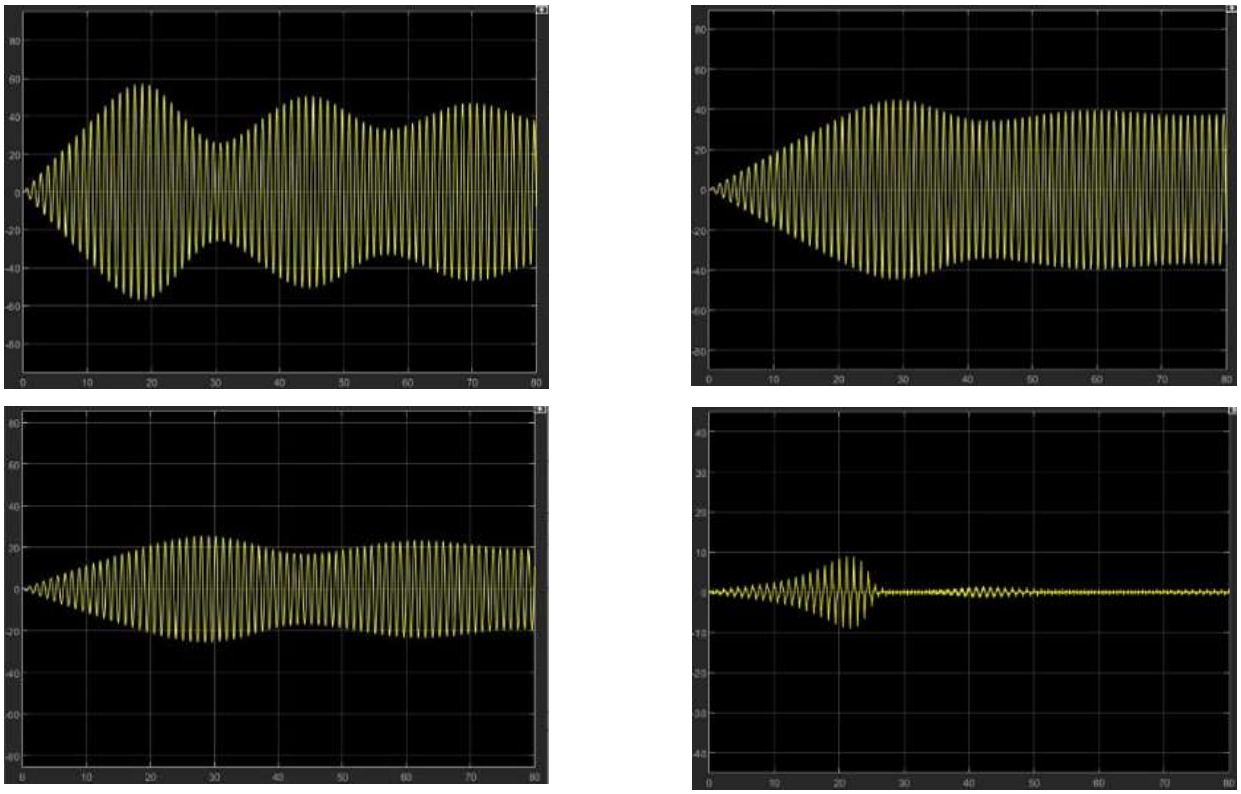


Figure 7 RMS frequency response of the fully coupled model without PTO: (a) θ-plane response and (b) ϕ-plane response, highlighting the effect of dynamic coupling under inclined excitation

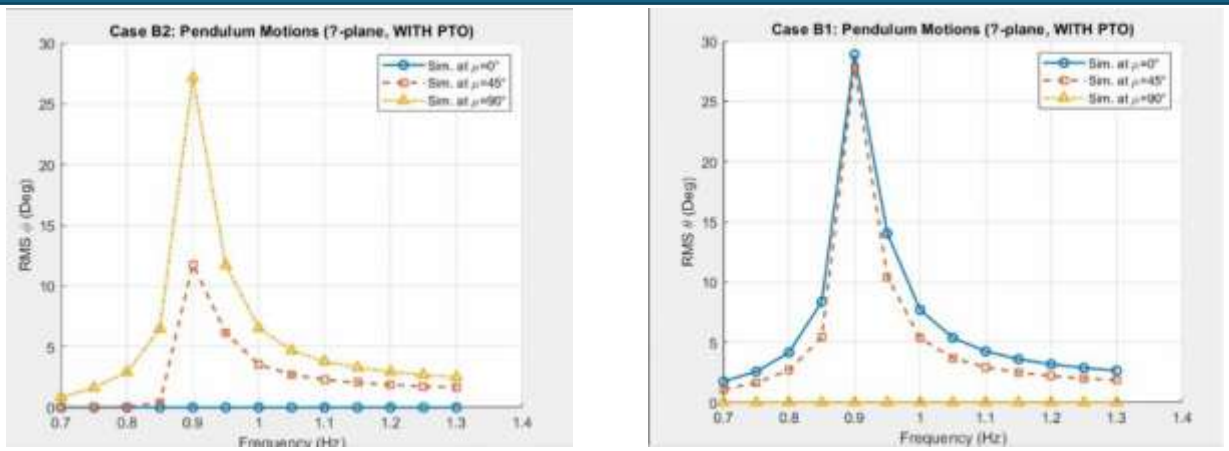


Figure 8 RMS frequency response of the single-plane models with PTO: (a) θ-plane and (b) ϕ-plane, demonstrating vibration suppression due to energy extraction

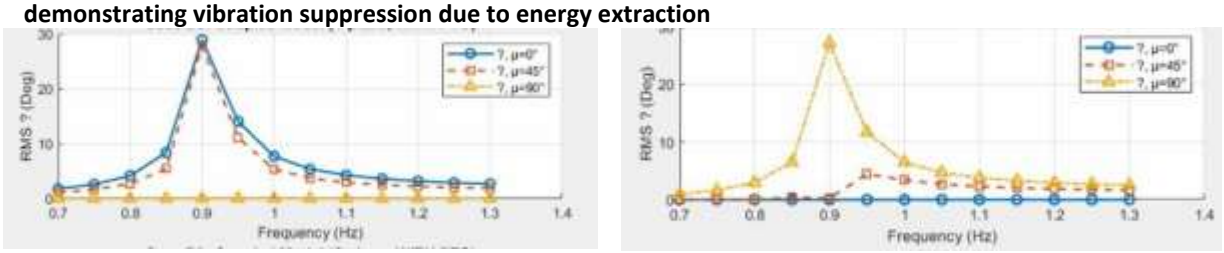


Figure 9 RMS frequency response of the fully coupled model with PTO for both θ-plane and ϕ-plane, confirming the stabilizing role of the PTO and the persistence of coupling effects.

6. Conclusions and Implications

The results of this study demonstrate that employing a full numerical modeling approach for a gimballed pendulum system, without any mathematical simplifications, enables a more accurate characterization of the dynamic coupling between orthogonal axes compared to conventional simplified models. This approach successfully reproduces previously published experimental results with high accuracy, particularly in identifying resonant frequencies, peak vibration amplitudes, and the influence of excitation angle. These outcomes confirm the robustness and validity of the proposed model for both research and practical applications.

The simulations further show that the integration of a Power Take-Off (PTO) element plays a crucial role in converting mechanical energy into electrical power while simultaneously reducing vibration amplitudes and enhancing dynamic stability, especially outside the resonance region. Consequently, the developed model can be considered a reliable analytical tool for investigating coupled dynamical systems and a practical reference for the design of efficient marine and environmental energy harvesting devices.

From an application perspective, the proposed framework offers several advantages, including:

- Accurate simulation and analysis of multi-degree-of-freedom systems,

- Quantitative evaluation of energy harvesting performance when PTO units are integrated,
- Support for the development of sustainable energy harvesting systems capable of operating under multidirectional and random excitation conditions,
- Contribution to improved design strategies for self-powered sensing systems and Internet of Things (IoT) applications.

In addition, the full gimballed pendulum model demonstrates a strong capability to capture complex dynamic responses induced by multidirectional vibrations. This opens new avenues for the development of advanced energy harvesting systems tailored to realistic environments characterized by randomness and multiple excitation sources, such as marine, urban, and natural settings.

Future research should focus on optimizing mechanical design through adaptive pendulum configurations, integrating hybrid energy conversion techniques, and exploiting nonlinear and chaotic dynamics to further broaden the operational bandwidth and enhance energy harvesting efficiency. These directions will facilitate the transition from theoretical modeling to practical deployment of next-generation self-powered systems.

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