

publisher.agency
Norway

December, 2025

No 12



Oslo, Norway

18-19.12.2025

International
Scientific
Conference

Theoretical Hypotheses and Empirical Results

UDC 001.1

P 97

Publisher.agency: Proceedings of the 12th International Scientific Conference «Theoretical Hypotheses and Empirical results» (December 18-19, 2025). Oslo, Norway, 2025. 350p



ISBN 978-9-4641-5779-6

DOI 10.5281/zenodo.18080503

Editor: Mary Olafsen, Professor, Nord University

International Editorial Board:

Anja Kazemi

Professor, University of South-Eastern Norway

Ståle Shokri

Professor, Universitetslektor - Universitetet i Sørøst-Norge

Karen Foray

Professor, University of Oslo

Hosein Nilsen

Professor, USN School of Business

Aida Drake

Professor, Buskerud University College

Gjerdalen Rolfson

Professor, University College Southeast Norway

Etty Allern

Professor, Norwegian Business School

Dr. Irmelin Kujanpää

Professor, University of South-Eastern Norway

Terje Øivind Madsen

Professor, Bergen National Academy of the Arts

Sigurd Sunagic

Professor, Inland Norway University of Applied Sciences

Miika Vesin

Professor, Norwegian Naval Academy

Dag Anderson-Glenna

Professor, Norwegian School of Economics

Mirha Seierstad

Professor, Norwegian University of Life Sciences

Boban Tavassoli

Professor, Norwegian University of Science and Technology

Cathrine Vikhagen

Professor, OsloMet - Oslo Metropolitan University

Sara Stendal

Professor, University of Agder

editor@publisher.agency

<https://publisher.agency/>

Table of Contents

Pedagogical Sciences

ACHIEVEMENT MOTIVATION IN LATE ADOLESCENCE: A SYSTEMATIC REVIEW OF EDUCATIONAL AND SOCIAL DETERMINANTS 6
SANIYA NURMUKHAMBETOVA

TEACHER MOTIVATION, WORKLOAD, AND RETENTION IN AZERBAIJAN’S GENERAL EDUCATION SYSTEM: A HUMAN RESOURCE MANAGEMENT PERSPECTIVE 9
MAHAMMAD AZIZI-MESHKIN

ORGANIZATIONAL AND EDUCATIONAL CONDITIONS FOR THE FORMATION OF EFFECTIVE MANAGEMENT IN PROFESSIONAL BOXING 19
*KAZANKAPOV AMAN
TELAKHYNOV YERKIN
UMIRZAKOV YEDIGE*

THE TYPOLOGICAL STRUCTURES OF AZERBAIJANI AND ENGLISH..... 26
NURAN MURSHUDZADA

ARTIFICIAL INTELLIGENCE AS A TOOL FOR FORMING INTEREST IN MATHEMATICS AMONG STUDENTS WITH LOW MOTIVATION TO LEARN 30
Y.S. KARYAKIN

EXPLORING THE IMPACT OF DIGITAL MEDIA ON READING SKILLS 34
A.S.OSPAN

ЦИФРОВЫЕ ИНСТРУМЕНТЫ КАК СРЕДСТВО ПРОВЕРКИ ТЕОРЕТИЧЕСКИХ ГИПОТЕЗ В ОБУЧЕНИИ МАТЕМАТИКЕ 39
АЛДИБАЕВА ТУРАТАЛДЫ АБИЛАКИМОВНА

INTERACTIVE METHODS FOR IMPROVING LEARNERS’ READING SKILLS AT THE ENGLISH LESSONS 44
HALIMA MAMMADOVA ELMAR

PEDAGOGICAL POTENTIAL OF 3D MODELING FOR DEVELOPING VISUAL LITERACY IN ART EDUCATION 52
*YESMAGAMBETOVA L.O.
KRYKBAYEVA S.M.*

THE IMPACT OF ARTIFICIAL INTELLIGENCE ON THE TRANSFORMATION OF THE TEACHER’S ROLE 62
ISKANDIROVA AIZHAN BAURZHANOVNA

БИОЛОГИЯЛЫҚ BIG DATA ТАЛДАУДА ЖАСАҢДЫ ИНТЕЛЛЕКТІНІҢ ИННОВАЦИЯЛЫҚ МҮМКІНДІКТЕРІ 67
*КЫДЫРБАЕВА Н.Х.
МУКАШЕВА Д.М.
АУЕЛБЕК М.А.*

FROM CLASSICAL TEXTS TO DIGITAL PLATFORMS 74
SEVINI ALIYEVA

DEVELOPING INCLUSION IN EDUCATION 77
QOCAYEVA NURANA MAMMAD

MÜƏLLİMİN PEŞƏ USTALIĞI VƏ NÜFUZU..... 81
RƏFIYEVA XURAMAN ƏLİ QIZI

Economic Sciences

РОЛЬ КАЧЕСТВЕННОГО ЧЕЛОВЕЧЕСКОГО КАПИТАЛА В РАЗВИТИИ ДЕЛОВОГО ТУРИЗМА В КАЗАХСТАНЕ 85
*ТЕМИРБЕКОВ А.Г.
БЕРДИБЕКОВА А.Ш.
МАЙДЫРОВА А.Б.*

INTERNATIONAL EXPERIENCE IN DENTAL BUSINESS MARKETING..... 89
TAMAR ORJONIKIDZE

МЕТОДОЛОГИЧЕСКИЕ ПОДХОДЫ К ОЦЕНКЕ ЭФФЕКТИВНОСТИ ИНТЕГРАЦИИ БИЗНЕСА: СРАВНИТЕЛЬНЫЙ АНАЛИЗ МОДЕЛЕЙ 97
*А. ЦОЙ
Н. НИКИФОРОВА*

REASSESSING GLOBAL INNOVATION METRICS: CRITICAL ANALYSIS OF GII INDICATORS AND INTANGIBLE INVESTMENT TRENDS 106
*ARCHIL CHIRAKADZE
NODAR MITAGVARIA
NELI MAKHVILADZE
TEIMURAZ CHUBINISHVILI
NODAR SULASHVILI
DEVA HARSHA UDAY GUNDLURU
GIORGI PALAVANDISHVILI
KHTUNA TSERODZE
KAKHA GORGADZE
NANA KHUSKIVADZE
DAVID APKHAZAVA*

КОНВЕРСИЯ ИНТЕРЕСА В РЕАЛЬНЫЕ ПОЕЗДКИ 138
*ЕЛЕБЕКОВА МАДИНА ЕСТАЕВНА
КУЗНЕЦОВА ОЛЬГА НИКОЛАЕВНА*

Technical Sciences

APPLICATION OF ARTIFICIAL NEURAL NETWORKS IN AUTOMATION SYSTEMS.....	142
<i>BEKTEMIR ALMAS TANATULY</i> <i>JULAYEVA ZHAZIRA TULEGENOVNA</i> <i>KARATAYEVA ZHANBUBI YERZHANOVNA</i>	
РАЗРАБОТКА ПРОГРАММНОГО СРЕДСТВА `SME-PROMOOPTIMIZER` ДЛЯ ИНТЕЛЛЕКТУАЛЬНОГО АНАЛИЗА И СЕГМЕНТАЦИИ КЛИЕНТОВ МСБ	146
<i>АХМЕТОВ ТИМУР ХАФИЗОВИЧ</i> <i>КИМ Е. Р.</i>	
JUSTIFICATION OF THE PARAMETERS AND OPERATING MODES OF A BIOGAS PLANT FOR SMALL FARMS	150
<i>TELMANOV IMRAN</i> <i>SARKYNOV YERBOL</i> <i>ZHAKUPOVA ZHANAR</i> <i>ABILDA ZHANSAYYA</i>	
АҚПАРАТТЫҚ ЖҮЙЕЛЕРДЕ ҚОРҒАЛҒАН АУТЕНТИФИКАЦИЯ: МОДЕЛЬДЕУ ЖӘНЕ ТАЛДАУ.....	155
<i>ЕРГЕШ НҮРСҮЛТАН САГИТЯНҰЛЫ</i> <i>КАПАЛОВА НҮРСҮЛУ АЛДАЖАРОВНА</i>	
РАЗРАБОТКА МОДЕЛИ ЛОГИСТИЧЕСКОЙ СИСТЕМЫ ПОСТАВКИ ПЛОДООВОЩНЫХ ГРУЗОВ, ПЕРЕВОЗИМЫХ ЖЕЛЕЗНОДОРОЖНЫМ ТРАНСПОРТОМ	162
<i>ЖАТҚАНБАЕВА Э.А.</i> <i>БАҚЫТБЕК ҚҰШТАР</i>	
RƏQƏMSAL İNFRASRUKTURUN DİSTANT TƏHSİLİN KEYFİYYƏTİNƏ TƏSİRİ ÜZRƏ ANALİTİK ARAŞDIRMA	166
<i>RƏNAHOVA İLKANƏ MÜBARİZ QIZI</i>	
ОБЗОР И СИСТЕМАТИЧЕСКОЕ ИССЛЕДОВАНИЕ СОВРЕМЕННЫХ ВЕБ-АТАК, ЭКСПЛОЙТОВ И КИБЕРУГРОЗ 2025 ГОДА.....	172
<i>ТАНАТАР НУРГАЛИ</i>	

Physical and Mathematical Sciences

КОГНИТИВТІ КОНФЛИКТ ӘДІСІНІҢ МӘНІ ЖӘНЕ ОНЫҢ ФИЗИКА САБАҒЫНДАҒЫ РӨЛІ.....	182
<i>СУЛТАНОВА ИНАРА АСКАРОВНА</i> <i>КАЗАХБАЕВА ДАНАКУЛЬ МУКАЖАНОВНА</i>	

Legal Sciences

INTERNATIONAL LEGAL REGULATION OF ARTIFICIAL INTELLIGENCE AND GEORGIA	189
<i>NINO BOTCHORISHVILI</i>	
THE CRITERION OF ORIGINALITY IN WORKS CREATED BY ARTIFICIAL INTELLIGENCE	198
<i>DR. LIKA SAJAJA</i>	
DIGITAL TRANSFORMATION OF JUSTICE IN THE AGE OF ARTIFICIAL INTELLIGENCE.....	205
<i>GIORGİ SVIANADZE</i>	

Philological Sciences

A THEORETICAL STUDY OF INTERTEXTUALITY AND CULTURAL CODE IN AMERICAN CINEMA	211
<i>AIMYSHEVA TOMIRIS SULEIMENKYZY</i>	
NEUROBIOLOGICAL PATHWAYS OF FIRST WORD ACQUISITION.....	218
<i>ASMAR KARIMLI</i>	
COMPARATIVE ELLIPSIS IN BRITISH AND AMERICAN ENGLISH	222
<i>GONCHA AHMADOVA</i>	

Culturology

FRANSIZ DİLİNİ NİYƏ ÖYRƏNİRİK?	227
<i>ƏKBƏROVA ƏSMAYƏ BƏXTİYAR QIZI</i>	

Psychological Sciences

ОСОБЕННОСТИ ЛОКУСА КОНТРОЛЯ И КОПИНГ-СТРАТЕГИЙ У МУЖЧИН СРЕДНЕГО ВОЗРАСТА С РАЗЛИЧНЫМИ ФОРМАМИ АДДИКТИВНОГО ПОВЕДЕНИЯ	231
<i>ТОЛЕУХАНОВА ТОМИРИС ЕРЛАНОВНА</i> <i>ШИХОВА ОЛЬГА МИХАЙЛОВНА</i>	
МЕХАНИЗМЫ ПСИХОЛОГИЧЕСКОЙ ЗАЩИТЫ: ПСИХИКА ЧЕЛОВЕКА И СТРЕСС	251
<i>ТУЛЕКОВА Г. Х.</i> <i>БАЗАРБАЙ АНЕЛЬ ЕЛЕМЕСКЫЗЫ</i>	
ВЛИЯНИЕ СОЦИАЛЬНЫХ СЕТЕЙ НА САМОВОСПРИЯТИЕ ЧЕЛОВЕКА.....	255
<i>ТУЛЕКОВА Г. Х.</i> <i>БІНТЫМАККЫЗЫ СЫМБАТ</i>	

Sociological Sciences

SOCIAL, CULTURAL, ECONOMIC AND DEMOGRAPHIC FACTORS INFLUENCING AI REGULATION IN KAZAKHSTAN.....	259
<i>TOKHTAKHUNOV BAKHTIYAR NURAKHUNOVICH</i>	
NEGOTIATING SOCIAL IDENTITY IN URBAN SOCIAL SPACES	270
<i>SAGIDULLA G. S.</i>	
THE RELIGIOUS, SCIENTIFIC, CULTURAL, AND SOCIAL SIGNIFICANCE OF STUDYING BIOETHICS.....	278
<i>YERIMBET RAMZAN YEDILBEKULY. E.</i>	
<i>AMANKUL TEMUR ORALBAIULY</i>	
<i>ERIMBET RIZUAN EDILBEKOVICH</i>	
HIGHER EDUCATION AND RURAL YOUTH: A SYSTEMATIC BIBLIOGRAPHIC REVIEW	282
<i>SHAKENOV D. S.</i>	
<i>SARYBAYEVA I. S.</i>	

Medical Sciences

CLINICAL FEATURES OF EARLY DIAGNOSIS OF BREAST PATHOLOGY: THE ROLE OF ULTRASOUND IN THE DETECTION OF INFLAMMATORY, PRECANCEROUS DISEASES AND BREAST CANCER	293
<i>ARMAN KHOZHAYEV</i>	
<i>MARAT MAULETBAYEV</i>	
<i>AIGERIM AUBAKIROVA</i>	
<i>ASSEM GARIPOVA</i>	
<i>DAMIRA BAICHAPANOVA</i>	
<i>AIDA MANGUTOVA</i>	
<i>ALEXANDR KHALMETOV</i>	

Historical Sciences

ТАРИХ САБАҒЫНДА СЕМЕЙ ПОЛИГОНЫН ТАРИХЫН ОҚЫТУДА ЖИ ҚОЛДАНУ	306
<i>Н.Ж. ТОҚТАҒАНОВ</i>	
<i>А.М. САДЫКОВА</i>	

Political Studies

THE ROLE OF SMALL AND MEDIUM-SIZED STATES IN THE NEW WORLD ORDER: THE EXAMPLE OF AZERBAIJAN	317
<i>GÜLGÜN MÜBARİZ QULIYEVA</i>	
PROBLEMS AND PROSPECTS OF DEVELOPING KAZAKHSTAN'S POLITICAL SCIENCE AT THE CURRENT STAGE	333
<i>V.A. LUZANOV</i>	
<i>N.G. KABDII</i>	
<i>A.M. KENZHEBULATOVA</i>	

Geographic Sciences

İQLİM DƏYİŞİKLİYİ VƏ YENİ PANDEMIYALAR: XƏTƏLİKLƏRİN COĞRAFI XƏRİTƏSİ NECƏ DƏYİŞİR?	338
<i>ƏLİYEVA ŞƏFƏQ MƏMMƏD QIZI</i>	

Journalism

DIGITAL COMMUNICATION TECHNOLOGIES AS MEANS OF EFFECTIVE COMMUNICATION IN ORGANISATIONS	342
<i>ЇЇДОВІТ HАЇДУК</i>	
<i>STANISLAV BENČIČ</i>	

Pedagogical Sciences

Achievement Motivation in Late Adolescence: A Systematic Review of Educational and Social Determinants

Saniya Nurmukhambetova

Master's degree student (1st year) in Pedagogy and Psychology, A. Baitursynov Kostanay Regional University

Abstract:

This review synthesizes contemporary research (2010–2023) on the factors influencing the development of achievement motivation in adolescents aged 15–18. The focus is on the interplay between individual psychological characteristics, the educational environment, and the broader social context. The methodology involved a systematic search and analysis of articles in the Scopus, Web of Science, and PsycINFO databases using key term combinations. The review's findings are structured around three primary determinants: 1) the role of school and pedagogical practices, 2) the influence of family and peers, and 3) cognitive-personality factors (growth mindset, self-regulation). The analysis reveals that a supportive educational environment combining high expectations with autonomy is a key condition. Parental influence transforms from direct control to a consultative role, while peer influence becomes ambivalent, serving as both a source of support and social comparison. Special attention is paid to gender differences and the impact of the digital environment. The review identifies methodological gaps, including a lack of longitudinal and cross-cultural studies, and suggests directions for future research aimed at creating ecosystemic models of motivation support.

Keywords: achievement motivation, older adolescents, educational environment, social factors, self-efficacy, review.

Introduction

The period of late adolescence (ages 15–18) is a critical stage in shaping life trajectories, where academic and career decisions begin to define an individual's future. Achievement motivation, understood as the drive to improve mastery, meet high standards, and overcome challenges (Dweck, 2006; Elliot & McGregor, 2001), becomes a central psychological resource during this transition. However, its manifestations and sustainability are not static; they are formed through a complex interaction between the developing individual and their environment. Despite an extensive body of research scattered across disciplines (educational psychology, sociology of education, developmental psychology), there is a need for consolidation. The aim of this review is to systematize contemporary empirical and theoretical data to build a comprehensive picture of the key determinants of achievement motivation in older adolescents, giving equal attention to internal and external factors. The central thesis of this review is that adaptive achievement motivation in late adolescence is the product of a dynamic ecosystem where personal beliefs (such as mindset) are activated and supported (or suppressed) by specific characteristics of the educational environment and the quality of social relationships.

Methodology

This review follows the principles of a narrative systematic review (Snyder, 2019). A literature search was conducted in the Scopus, Web of Science, and PsycINFO databases for the period 2010–2023. Combinations of the following keywords were used: ["achievement motivation" OR "academic motivation"] AND ["late adolescence" OR "older adolescents" OR "high school students"] AND ["educational environment" OR "social factors" OR "parental influence" OR "peer influence"]. Inclusion criteria were met by empirical studies and meta-analyses published in peer-reviewed English-language journals, focusing on the 15–18 age group. Studies concerning clinical populations or highly specific types of motivation (e.g., solely in sports) were excluded. The initial search yielded 482 articles. After screening titles, abstracts, and full texts for relevance, 78 works were included in the final review.

Results and Discussion

1. The Educational Environment as a Key Context

The topic sentence of this section asserts that school characteristics and teaching practices play a decisive role in translating an adolescent's potential motivation into sustainable behavioral patterns. Contemporary research is shifting focus from formal school indicators (e.g., size) to the psychological classroom climate (Ruzek et al., 2016). A supportive climate characterized by mutual respect, trust, and a sense of belonging serves as the foundation. More specifically, pedagogical practices that support autonomy (autonomy-supportive teaching) show the most robust association with intrinsic achievement motivation. These practices include providing choice within tasks, explaining the relevance of learning material, using non-controlling language, and acknowledging the student's perspective (Jang et al., 2010). For example, a study by Patall et al. (2018) showed that even minimal choice in homework completion significantly increased high school students' engagement and striving for quality. In contrast, a controlling environment emphasizing external rewards, punishments, and rigid social comparison fosters learned helplessness or fragile extrinsic motivation.

2. Social Factors: The Transforming Influence of Parents and Peers

An adolescent's social context undergoes significant changes: while family influence remains important, its nature transforms, and the role of peers increases sharply. Parenting style evolves from direct control to a complex system of expectations, goal discussions, and emotional support (Pomerantz & Moorman, 2010). Parental expectations, when perceived as realistic and conveyed with belief in the child's competence (providing structure), correlate with high motivation and persistence. Conversely, excessively high, perfectionistic expectations or psychological control ("I will love you only if you become a straight-A student") lead to fear of failure and challenge avoidance (Kouros et al., 2020). Peer influence is paradoxical. On one hand, friendships based on mutual academic support create a "buffer zone" against stress and enhance self-efficacy. On the other hand, social comparison in the academic sphere, intensified by grade transparency and rankings, can lead to burnout and maladaptive perfectionism (Ryan & Shim, 2012). A new dimension of this comparison is the digital environment, where the showcasing of academic and extracurricular successes on social media creates additional pressure.

3. Cognitive-Personality Factors: Mindsets and Beliefs

Internal filters through which an adolescent perceives educational and social influences are the ultimate mediators of motivation. Central here is the concept of growth mindset (Dweck, 2006). Adolescents who believe in the malleability of intelligence and abilities (growth mindset) are more likely to interpret difficulties as learning opportunities, demonstrate perseverance, and choose challenging tasks. Conversely, a fixed mindset leads to risk avoidance, a desire to "look smart" rather than "become smarter," and a sharp decline in motivation after failure. Inseparable from this is self-efficacy—the belief in one's ability to organize and execute the actions required to achieve a goal (Bandura, 1997). For adolescents, sources of self-efficacy include mastery

experiences (e.g., successfully completing a complex project), vicarious experience (observing peer successes), verbal persuasion from significant adults, and emotional states. The development of self-regulation skills, including goal setting, time management, and distraction control, serves as the operational tool that transforms motivation into concrete results (Zimmerman, 2013).

Conclusion

This review concludes that the achievement motivation of an older adolescent is neither a stable personality trait nor a simple sum of external incentives. It is a dynamic state arising at the intersection of a developing personality (with its mindsets, self-efficacy, and self-regulation skills) and a multi-layered context. Key elements of this context are: 1) an educational environment built on the principles of autonomy and mastery support rather than control and comparison; 2) a social network providing realistic expectations, emotional support, and models of adaptive behavior. This review also identifies significant research gaps. Primarily, there is a lack of cross-cultural studies accounting for the specifics of collectivistic and individualistic societies. Secondly, longitudinal studies tracking motivation trajectories during critical transitions (e.g., from high school to university) are needed. Thirdly, the rapidly changing digital environment requires new conceptualization both as a source of new challenges (social comparison, digital distraction) and new opportunities (online mastery courses, educational communities). A practical implication of this review is the necessity for developing ecosystemic intervention programs that simultaneously address adolescent beliefs, enhance teacher competency in motivational teaching, and engage parents as partners in supporting autonomy.

References (Illustrative Fragment)

1. Bandura, A. (1997). *Self-efficacy: The exercise of control*. W.H. Freeman.
2. Dweck, C. S. (2006). *Mindset: The new psychology of success*. Random House.
3. Elliot, A. J., & McGregor, H. A. (2001). A 2x2 achievement goal framework. *Journal of Personality and Social Psychology*, 80(3), 501–519.
4. Jang, H., Reeve, J., & Deci, E. L. (2010). Engaging students in learning activities: It is not autonomy support or structure but autonomy support and structure. *Journal of Educational Psychology*, 102(3), 588–600.
5. Kouros, C. D., et al. (2020). Helicopter parenting, autonomy support, and college students' mental health and well-being. *Emerging Adulthood*, 8(3), 234–245.
6. Patall, E. A., et al. (2018). Daily autonomy supporting or thwarting and students' motivation and engagement in the high school science classroom. *Journal of Educational Psychology*, 110(2), 269–288.
7. Pomerantz, E. M., & Moorman, E. A. (2010). Parents' involvement in children's schooling. In J. L. Meece & J. S. Eccles (Eds.), *Handbook of research on schools, schooling, and human development* (pp. 398–416). Routledge.
8. Ruzek, E. A., et al. (2016). How teacher emotional support motivates students: The mediating roles of perceived peer relatedness, autonomy support, and competence. *Learning and Instruction*, 42, 95–103.
9. Ryan, A. M., & Shim, S. S. (2012). Changes in help seeking from peers during early adolescence: Associations with changes in achievement and perceptions of teachers. *Journal of Educational Psychology*, 104(4), 1122–1134.
10. Snyder, H. (2019). Literature review as a research methodology: An overview and guidelines. *Journal of Business Research*, 104, 333–339.
11. Zimmerman, B. J. (2013). From cognitive modeling to self-regulation: A social cognitive career path. *Educational Psychologist*, 48(3), 135–147.

Teacher Motivation, Workload, and Retention in Azerbaijan's General Education System: A Human Resource Management Perspective

Mahammad Azizi-Meshkin

PhD student, University: ISTU

Abstract

Teacher motivation, workload, and retention are increasingly recognized as central determinants of education system quality and sustainability. While Azerbaijan has implemented substantial reforms in curriculum modernization, assessment mechanisms, and digital infrastructure within general education, comparatively limited attention has been paid to the human resource management (HRM) dimensions shaping teachers' professional experiences. This article examines teacher motivation, workload, and retention in Azerbaijan's general education system through an HRM perspective, drawing on international theoretical frameworks and secondary statistical evidence from OECD, UNESCO, the World Bank, and the International Labour Organization. The analysis reveals that excessive administrative workload, compliance-oriented performance management, limited career progression pathways, and uneven incentive structures undermine teacher motivation and increase retention risks, particularly among early-career and rural teachers. By reframing these challenges as systemic HR governance issues rather than individual shortcomings, the article proposes evidence-based policy and HRM reforms aimed at strengthening workforce sustainability, improving teacher motivation, and enhancing education quality in Azerbaijan.

Keywords: Human Resource Management, Teacher Motivation, Workload, Retention, General Education, Azerbaijan, Public Sector HRM

1. Introduction

Teachers constitute the most critical human resource in any education system, directly influencing student learning outcomes, institutional effectiveness, and long-term socioeconomic development. International research consistently demonstrates that motivated, well-supported, and professionally satisfied teachers are essential for achieving quality education and sustaining reform outcomes (OECD, 2021; UNESCO, 2023). Conversely, excessive workload, declining motivation, and high attrition rates undermine system performance and generate significant fiscal and social costs.

Over the past decade, Azerbaijan has undertaken a series of reforms aimed at modernizing its general education system. These reforms have focused on curriculum renewal, digital learning platforms, centralized assessment mechanisms, and governance restructuring. While these initiatives have strengthened institutional capacity, they have also intensified expectations placed on teachers without proportionate adaptation of human resource management practices. As a result, concerns related to teacher workload, motivation, and retention have become increasingly salient.

Despite their importance, these issues remain underexplored in the Azerbaijani academic literature, particularly from an HRM perspective. Teachers are often examined primarily as pedagogical actors rather than as public-sector employees embedded within complex HR

governance systems. This article addresses this gap by analyzing teacher motivation, workload, and retention through the conceptual lens of human resource management.

2. Problem Statement

Despite ongoing education reforms, Azerbaijan's general education system continues to face persistent challenges related to teacher motivation, workload, and retention. These challenges are not episodic but systemic, reflecting structural misalignments between education policy objectives and HRM practices.

Teachers are expected to deliver increasingly complex instructional outcomes while managing extensive administrative and reporting responsibilities. At the same time, performance management systems emphasize compliance rather than professional development, and career advancement opportunities remain limited. This combination undermines motivation, particularly among early-career teachers, and contributes to retention risks in rural and disadvantaged regions.

From an HRM perspective, the core problem lies in the continued dominance of administrative personnel management over strategic human resource governance. Without addressing this imbalance, education reforms risk placing unsustainable demands on teachers and weakening long-term workforce stability.

3. Literature Review and Theoretical Framework

The analysis of teacher motivation, workload, and retention has received sustained attention in international education and human resource management literature. Scholars increasingly emphasize that teaching should be understood not only as a pedagogical profession but also as a form of public-sector employment shaped by institutional HRM systems, governance structures, and organizational culture. This perspective is particularly relevant in centralized education systems, where teacher performance and well-being are closely linked to state-led human resource policies.

From a human resource management standpoint, education systems function as large public-sector organizations in which teachers constitute the core workforce responsible for policy implementation at the street level. Public sector HRM literature highlights that employee motivation, job satisfaction, and retention are strongly influenced by how institutions manage recruitment, performance evaluation, workload allocation, career progression, and professional recognition (Boxall & Purcell, 2016). In education, these HR functions directly affect not only teachers' working conditions but also instructional quality and student outcomes.

3.1 Human Resource Management in Education Systems

Human resource management in education has evolved from traditional personnel administration toward more strategic approaches that emphasize workforce sustainability and organizational effectiveness. Traditional personnel systems, common in centralized and post-Soviet contexts, prioritize compliance, standardized procedures, and hierarchical control. While such systems can ensure equity and uniformity, they often lack flexibility and responsiveness to individual and contextual needs (OECD, 2020).

Strategic HRM, by contrast, views teachers as long-term human capital investments rather than interchangeable labor inputs. This approach emphasizes alignment between institutional goals and individual motivation, continuous professional development, and the creation of supportive working environments. International comparative studies demonstrate that education systems with more strategic HRM practices tend to exhibit higher teacher motivation, stronger professional commitment, and lower attrition rates (World Bank, 2022).

In centralized education systems, however, the transition from administrative personnel management to strategic HRM remains incomplete. Teachers are frequently subject to extensive regulation, limited autonomy, and standardized evaluation mechanisms that prioritize accountability over professional growth. Such arrangements can undermine intrinsic motivation and weaken teachers' sense of professional ownership, particularly in reform-intensive contexts.

3.2 Teacher Motivation

Teacher motivation has been widely examined through both classical and contemporary motivational theories. Herzberg's Two-Factor Theory provides a foundational framework by distinguishing between hygiene factors—such as salary, job security, and working conditions—and motivators, including recognition, responsibility, and opportunities for advancement (Herzberg, 1966). While hygiene factors prevent dissatisfaction, they do not generate long-term engagement unless complemented by intrinsic motivators.

Self-Determination Theory further advances this understanding by identifying autonomy, competence, and relatedness as essential psychological needs underlying intrinsic motivation (Deci & Ryan, 2000). Empirical research consistently shows that teachers who perceive higher levels of professional autonomy, receive constructive feedback, and experience collegial support report greater job satisfaction and stronger commitment to the profession (OECD, 2019).

In public education systems characterized by strong central control, these motivational drivers are often constrained. Standardized curricula, prescriptive teaching guidelines, and compliance-oriented evaluation systems can limit teachers' autonomy and creativity. As a result, motivation becomes increasingly dependent on extrinsic factors, which are often insufficient to sustain long-term professional engagement.

3.3 Workload, Job Design, and Burnout

Workload has emerged as a central concern in contemporary education research, particularly in relation to teacher burnout and attrition. The Job Demands–Resources (JD-R) model provides a useful analytical lens for understanding how workload intensity affects employee well-being. According to this model, high job demands—such as excessive administrative tasks or emotional labor—lead to stress and exhaustion when not balanced by adequate resources, including time, support, and professional autonomy (ILO, 2021).

International evidence indicates that teachers' workloads have expanded significantly over the past two decades, largely due to increased accountability requirements, data reporting, and administrative documentation (OECD, 2021). UNESCO (2023) notes that administrative intensification is particularly pronounced in centralized public systems, where accountability mechanisms are implemented uniformly without sufficient consideration of local capacity and support structures.

Excessive non-instructional workload not only reduces time available for lesson preparation and professional development but also erodes teachers' professional identity. When teachers spend a substantial proportion of their working time on administrative tasks, their core instructional role becomes diluted, leading to frustration, disengagement, and reduced job satisfaction.

3.4 Retention and Workforce Sustainability

Teacher retention is increasingly conceptualized as a systemic workforce sustainability issue rather than an individual career decision. Ingersoll's (2001) seminal work demonstrates that teacher attrition is more strongly associated with organizational conditions—such as leadership quality, workload, and career opportunities—than with personal characteristics or salary alone.

Subsequent studies reinforce this perspective, emphasizing that sustainable education systems invest in structured induction programs, mentoring for early-career teachers, and diversified

career pathways that allow professional growth without leaving classroom practice (Johnson et al., 2012). Where such supports are absent, attrition rates are higher, particularly among younger and more qualified teachers who possess alternative employment opportunities.

In centralized systems, limited career mobility and rigid hierarchical structures further exacerbate retention challenges. Teachers who perceive stagnation or lack of recognition are more likely to disengage or exit the profession, undermining workforce stability and increasing recruitment and training costs for the state.

3.5 Analytical Implications for the Azerbaijani Context

The literature reviewed above underscores that teacher motivation, workload, and retention are deeply interconnected and shaped by institutional HRM arrangements. In systems where HR governance emphasizes control, standardization, and compliance, teachers are more likely to experience motivation decline, workload stress, and increased attrition risk.

Applying this theoretical framework to Azerbaijan's general education system allows teacher-related challenges to be interpreted as **systemic HRM and governance issues** rather than individual shortcomings. This perspective provides the conceptual foundation for the subsequent analysis of teacher motivation, workload, and retention and informs the development of policy-oriented HRM recommendations tailored to the Azerbaijani context.

4. Methodology

This study employs a **qualitative policy analysis supported by secondary statistical data**, a methodology widely accepted in international education research where access to national micro-level datasets is limited.

The analysis draws on authoritative international sources, including OECD, UNESCO, World Bank, and ILO reports, as well as comparative evidence from Eastern Europe and Central Asia. Data were analyzed thematically, focusing on three HRM dimensions: motivation, workload, and retention. International benchmarks are used to contextualize Azerbaijan's experience and identify structural patterns relevant to policy reform.

5. Teacher Motivation in Azerbaijan: An HRM Analysis

Teacher motivation in Azerbaijan reflects a complex interaction between strong intrinsic commitment and restrictive institutional conditions. While many teachers enter the profession driven by social purpose and professional identity, systemic HRM constraints undermine sustained engagement.

Professional recognition mechanisms remain limited, and performance management systems focus primarily on compliance rather than development. Evaluation processes are weakly connected to feedback, mentoring, or career progression, reducing their motivational impact. Moreover, centralized curricula and reporting frameworks constrain professional autonomy, limiting teachers' sense of agency and ownership.

These factors disproportionately affect early-career teachers, who often expect opportunities for innovation and professional growth but encounter rigid institutional environments instead.

6. Teacher Workload and Administrative Burden

International data indicate that teachers spend a substantial portion of their working time on non-instructional tasks, with administrative duties accounting for approximately 30% of workload in many systems (OECD, 2021). Excessive administrative burden is a key contributor to burnout and reduced instructional focus (ILO, 2021).

In Azerbaijan, centralized reporting requirements, multiple digital platforms, and limited administrative support intensify workload pressures. Teachers are responsible not only for

instruction but also for extensive documentation, data entry, extracurricular supervision, and coordination tasks. This imbalance reduces time available for lesson preparation and professional development, undermining both motivation and instructional quality.

6.1 International Workload Patterns

International evidence consistently demonstrates that teacher workload extends far beyond classroom instruction and has become increasingly dominated by administrative and non-instructional tasks. According to the OECD (2021), teachers in lower secondary education spend on average between **43% and 48% of their total working time on direct teaching activities**, while **approximately 30% is allocated to administrative and reporting tasks**. The remaining portion of working time is divided between student supervision, extracurricular responsibilities, and professional development.

This distribution reflects a global trend toward administrative intensification in public education systems, driven largely by expanded accountability frameworks, performance monitoring requirements, and data-driven governance reforms. While these mechanisms aim to improve transparency and educational outcomes, international research suggests that they often generate unintended workload pressures when not accompanied by job redesign or additional institutional support.

The International Labour Organization (2021) identifies excessive administrative workload as one of the most significant contributors to teacher stress, burnout, and reduced job satisfaction worldwide. Teachers report that administrative tasks—such as documentation, reporting, and compliance procedures—frequently encroach upon time intended for lesson preparation, individualized student support, and professional learning. Over time, this imbalance undermines both instructional quality and teacher well-being.

UNESCO (2023) further emphasizes that systems with centralized governance structures are particularly vulnerable to workload overload, as standardized reporting requirements are applied uniformly across diverse school contexts. In such systems, teachers are often expected to compensate for institutional capacity gaps by absorbing additional administrative responsibilities, thereby intensifying workload and increasing attrition risk.

6.2 Workload in Azerbaijan

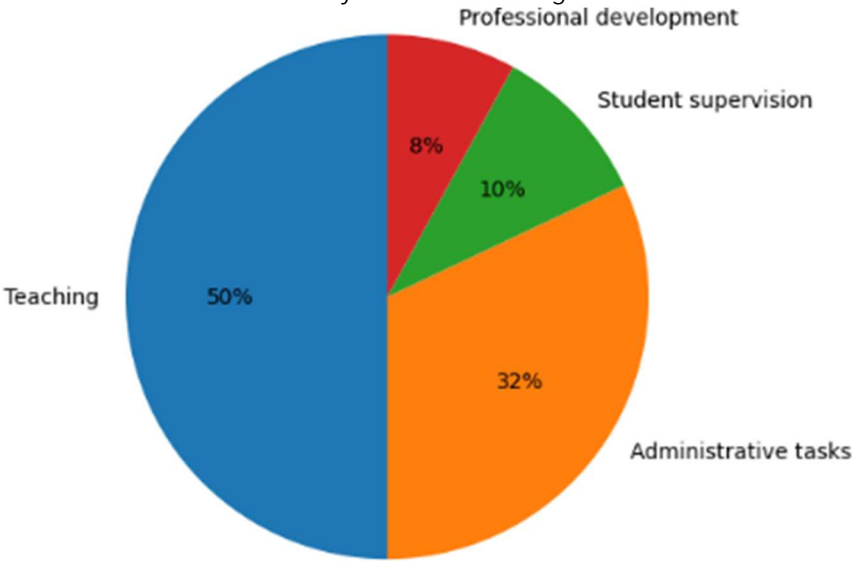
The workload challenges identified in international literature are strongly reflected in Azerbaijan's general education system. Centralized governance arrangements, combined with ongoing education reforms and digitalization initiatives, have significantly expanded teachers' non-instructional responsibilities. Teachers are required to comply with multiple reporting and data-entry obligations across centralized digital platforms, often without corresponding reductions in other duties or the provision of dedicated administrative support.

In addition to instructional responsibilities, teachers in Azerbaijan are commonly responsible for extensive documentation, performance reporting, student monitoring, extracurricular supervision, and coordination with school administration and external stakeholders. These tasks are frequently time-consuming and procedurally complex, contributing to workload intensification and role overload. The limited availability of school-level administrative staff further exacerbates this burden, as teachers assume responsibilities that would otherwise be managed by specialized support personnel.

The estimated distribution of teacher working time in Azerbaijan, as illustrated in **Figure 3**, suggests that while teaching remains the primary activity, administrative tasks account for nearly one-third of total working time. This pattern closely mirrors international benchmarks identified by the OECD and ILO, reinforcing the argument that workload challenges in Azerbaijan are structurally embedded rather than exceptional.

Importantly, the expansion of digital education platforms—while enhancing transparency and data availability—has not uniformly reduced workload. In practice, digitalization has often increased reporting frequency and documentation requirements, particularly in the absence of integrated systems and streamlined processes. As a result, teachers experience heightened time pressure and reduced opportunities for lesson preparation and professional development. From an HRM perspective, these workload dynamics reflect insufficient job design and task allocation rather than individual inefficiency. When administrative and supervisory duties disproportionately consume teachers’ working time, the core instructional mission of schools is compromised. Over time, such conditions erode motivation, increase burnout risk, and contribute to higher attrition, particularly among early-career teachers who lack institutional coping mechanisms.

Table 1: Estimated distribution of teacher working time



7. Teacher Retention and Workforce Risks

7.1 Global Retention Trends

Globally, teacher attrition is highest during the first five years of service, with UNESCO (2023) estimating that up to 40% of new teachers consider leaving the profession during this period. Attrition rates are higher in rural areas and among teachers in high-demand subjects.

7.2 Retention Risks in Azerbaijan’s General Education System

Retention challenges in Azerbaijan’s general education system are increasingly shaped by structural and human resource governance factors rather than individual teacher characteristics. While teaching remains a socially respected profession, especially among older generations, the system exhibits growing difficulty in retaining early-career and mid-career teachers, particularly in rural and socioeconomically disadvantaged regions. These retention risks threaten workforce sustainability and undermine the long-term effectiveness of education reforms.

One of the most significant retention challenges relates to **early-career teacher vulnerability**. International evidence demonstrates that the first five years of teaching are decisive for long-term professional commitment (Ingersoll, 2001; OECD, 2021). In Azerbaijan, newly recruited teachers often enter the profession with high intrinsic motivation but face a professional reality characterized by heavy workloads, limited autonomy, and insufficient mentoring support. The absence of structured induction programs and systematic mentoring exacerbates adjustment difficulties, increasing frustration and exit intentions among younger educators.

Geographical disparities further intensify retention risks. Rural and remote schools face persistent staffing challenges due to limited access to professional development opportunities, weaker infrastructure, and fewer financial and non-financial incentives. Teachers assigned to these

schools frequently experience professional isolation, heavier multitasking responsibilities, and reduced access to peer learning networks. International studies confirm that such conditions significantly elevate attrition rates in rural education systems, particularly when compensatory HR mechanisms are weak or absent (UNESCO, 2023; World Bank, 2020).

Another critical factor influencing retention is the **limited availability of career progression pathways**. In Azerbaijan's centralized education system, career advancement opportunities for teachers remain narrow and largely hierarchical, often linked to administrative roles rather than pedagogical excellence. This structure discourages long-term professional commitment among teachers who wish to develop as instructional leaders, mentors, or subject specialists without transitioning into management positions. Research consistently shows that when career development options are constrained, teachers are more likely to seek alternative employment or exit the profession altogether (Johnson et al., 2012).

Compensation structures also play an indirect yet significant role in retention decisions. Although teacher salaries have increased over time, they remain modest relative to urban living costs and alternative professional opportunities available to university graduates. Moreover, salary differentiation based on workload complexity, subject specialization, or school context remains limited. This uniformity reduces the perceived fairness of the compensation system and weakens its capacity to function as a retention tool, particularly for high-demand subject teachers and those working in challenging environments.

Taken together, these factors suggest that teacher retention challenges in Azerbaijan are not episodic or temporary but **systemic HRM issues** embedded in governance arrangements, workload design, and career management structures. Addressing retention therefore requires comprehensive HR reforms that extend beyond salary adjustments to include mentoring, career diversification, workload rationalization, and location-sensitive incentives.

8. Discussion

The findings demonstrate that teacher motivation, workload, and retention challenges in Azerbaijan are interconnected outcomes of institutional HRM arrangements. Education reforms have expanded expectations without corresponding adaptation of HR systems, resulting in workload intensification and motivation decline.

From an HRM perspective, the system prioritizes compliance over development and standardization over flexibility. Without strategic HR reform, these dynamics risk undermining the sustainability of education reforms and weakening long-term education quality.

9. Policy and Human Resource Management Recommendations

Addressing these challenges requires a transition from administrative personnel management to strategic human resource governance.

Strategic workforce planning should be strengthened through data-driven forecasting of teacher supply and demand, particularly across regions and subject areas. Workload rationalization should involve auditing non-instructional tasks, simplifying reporting systems, and introducing administrative support roles at the school level.

Motivation-oriented incentive systems should balance financial and non-financial recognition, emphasizing professional value, transparency, and developmental feedback. Career development structures should be diversified through multi-track pathways that allow teachers to advance professionally without leaving classroom practice.

Finally, retention-focused policies should address geographic disparities through rural incentives, housing and transport support, and structured induction and mentoring programs for early-career teachers.

9.1 Strategic Workforce Planning and Forecasting

A core priority for education governance should be the development of systematic workforce planning mechanisms. Currently, teacher recruitment and deployment processes are largely reactive, responding to immediate staffing needs rather than long-term demographic and regional trends. Strategic workforce planning would enable education authorities to anticipate teacher supply and demand across regions, subjects, and experience levels.

By integrating demographic data, retirement projections, and regional enrollment trends, policymakers could proactively address emerging shortages, particularly in rural areas and STEM subjects. International experience demonstrates that data-driven workforce planning significantly improves retention outcomes by reducing job insecurity, preventing overburdening of existing staff, and ensuring more equitable teacher distribution (World Bank, 2022). For Azerbaijan, embedding workforce planning within national education strategies would strengthen institutional resilience and support sustainable reform implementation.

9.2 Workload Rationalization and Job Redesign

Reducing excessive workload is essential for improving teacher motivation and preventing burnout. Workload rationalization should begin with a comprehensive audit of teachers' non-instructional duties, including administrative reporting, data entry, and extracurricular supervision. International evidence indicates that many such tasks can be streamlined, automated, or reassigned without compromising accountability (OECD, 2021).

In Azerbaijan, the expansion of digital education platforms has improved transparency but has also increased reporting requirements. HRM reforms should therefore focus on simplifying reporting processes, integrating digital systems, and clearly distinguishing between pedagogical and administrative responsibilities. Introducing school-level administrative support staff could significantly reduce teachers' non-teaching workload, allowing them to concentrate on instructional quality and professional development.

Effective job redesign not only improves efficiency but also enhances professional satisfaction by reinforcing teachers' core identity as educators rather than administrative functionaries.

9.3 Motivation-Oriented Incentive Systems

Motivation-enhancing HRM practices should balance financial and non-financial incentives. While salary improvements are necessary, international research consistently shows that recognition, professional autonomy, and career acknowledgment play equally important roles in sustaining motivation (Deci & Ryan, 2000; OECD, 2019).

In the Azerbaijani context, performance-based recognition systems could be introduced to acknowledge pedagogical innovation, mentoring contributions, and sustained professional commitment. Such systems should prioritize transparency and developmental feedback rather than punitive evaluation. Public recognition, professional awards, and opportunities to participate in national education initiatives can strengthen intrinsic motivation and reinforce teachers' sense of professional value.

Importantly, incentive systems should avoid excessive competition and instead promote collaboration and collective improvement within schools.

9.4 Career Development and Professional Pathways

Expanding career development opportunities is critical for long-term teacher retention. Azerbaijan's education system would benefit from the introduction of **multi-track career pathways** that allow teachers to advance professionally without leaving classroom practice. These pathways could include roles such as mentor teacher, instructional coach, curriculum specialist, or professional development trainer.

Clear and transparent criteria for progression would enhance fairness and predictability, addressing one of the major sources of dissatisfaction among mid-career teachers. International

evidence suggests that diversified career structures increase retention by aligning individual aspirations with organizational needs (Johnson et al., 2012).

Moreover, linking career advancement to continuous professional development would strengthen the connection between performance management and capacity building.

9.5 Retention-Focused and Location-Sensitive Policies

Given persistent urban–rural disparities, retention strategies must be geographically sensitive. Financial incentives such as rural hardship allowances, housing support, and transport subsidies have proven effective in comparable contexts (ILO, 2021; UNESCO, 2023). However, such measures should be complemented by professional incentives, including priority access to training, accelerated career progression, and enhanced mentoring support.

Early-career retention deserves particular attention. Structured induction programs, reduced teaching loads during initial years, and formal mentoring arrangements can significantly improve retention outcomes. These measures signal institutional commitment to teacher development and reduce the likelihood of early exit due to professional overload or unmet expectations.

10. Conclusion

Teacher motivation, workload, and retention in Azerbaijan’s general education system constitute interrelated and systemic human resource management challenges with far-reaching implications for education quality, workforce sustainability, and the long-term success of education reforms. While recent policy initiatives have modernized curricular frameworks, assessment mechanisms, and digital infrastructure, this study demonstrates that insufficient attention to HRM dimensions has limited the effectiveness of these reforms at the level of implementation.

By applying an HRM lens and drawing on internationally recognized secondary data, the article shows that excessive administrative workload, compliance-oriented performance management, constrained professional autonomy, and limited career progression pathways collectively undermine teacher motivation and increase retention risks. These challenges are particularly acute among early-career teachers and those working in rural or disadvantaged contexts, where institutional support mechanisms remain weaker and professional isolation is more pronounced. The findings underscore that teacher-related challenges in Azerbaijan should not be interpreted as individual performance deficiencies or short-term adjustment issues. Rather, they reflect structural features of education governance and human resource systems that prioritize control and standardization over professional development and workforce sustainability. Without addressing these underlying HRM constraints, further reforms risk intensifying workload pressures and accelerating attrition, thereby weakening the very human capital on which education quality depends.

The study argues for a strategic shift from administrative personnel management toward **strategic human resource management**, in which teachers are recognized as central assets rather than passive implementers of policy. Such a shift requires integrating workforce planning, workload rationalization, motivation-oriented incentive structures, diversified career pathways, and retention-focused support mechanisms into the core of education governance. International experience suggests that education systems adopting this approach are better positioned to sustain reform outcomes, improve instructional quality, and retain skilled teaching personnel.

From a policy perspective, strengthening HRM practices offers a cost-effective and sustainable pathway to improving education outcomes. Investments in teacher well-being, professional development, and retention reduce turnover costs, enhance institutional memory, and foster a more stable and motivated workforce. For Azerbaijan, embedding HRM considerations into education reform agendas is therefore not supplementary but essential to achieving long-term system resilience and equity.

Finally, this study contributes to the broader international literature by illustrating how HRM frameworks can be applied to analyze teacher motivation, workload, and retention in centralized education systems. Future research could build on this analysis by incorporating primary survey data, longitudinal workforce statistics, or comparative studies across similar governance contexts. Nonetheless, the evidence presented here clearly indicates that addressing teacher-related challenges through strategic HRM reform is a prerequisite for sustainable education development in Azerbaijan.

References

- Boxall, P., & Purcell, J. (2016). *Strategy and human resource management* (4th ed.). Palgrave.
- Deci, E. L., & Ryan, R. M. (2000). Intrinsic and extrinsic motivation. *Contemporary Educational Psychology*, 25(1), 54–67.
- Ingersoll, R. (2001). Teacher turnover and shortages. *American Educational Research Journal*, 38(3), 499–534.
- International Labour Organization. (2021). *Working conditions of teachers in public education*.
- Johnson, S. M., et al. (2012). *Teaching careers and retention*. Harvard University Press.
- OECD. (2019). *TALIS 2018 results*.
- OECD. (2020). *Education policy outlook*.
- OECD. (2021). *Teachers at the centre of education recovery*.
- UNESCO. (2023). *Global education monitoring report*.
- World Bank. (2020). *Teacher policy and management in Europe and Central Asia*.
- World Bank. (2022). *Improving human capital through education workforce reform*.

ORGANIZATIONAL AND EDUCATIONAL CONDITIONS FOR THE FORMATION OF EFFECTIVE MANAGEMENT IN PROFESSIONAL BOXING

Kazankapov Aman

Abai Kazakh National Pedagogical University, Almaty, Kazakhstan

Telakhynov Yerkin

Abai Kazakh National Pedagogical University, Almaty, Kazakhstan

Umirzakov Yedige

Abai Kazakh National Pedagogical University, Almaty, Kazakhstan

Abstract. The article analyzes the organizational and pedagogical conditions for the development of management in professional boxing. Professional boxing is considered as a specific segment of the modern sports industry characterized by commercialization, high media involvement, and complex contractual relations. The structure of management in professional boxing, the role of the manager, and the content of managerial activity are examined. Special attention is paid to the functions of a professional boxing manager, including goal setting, planning, organization of bouts, motivation, control, and information support. The study substantiates key organizational and pedagogical conditions that ensure effective management development, as well as the importance of specialized education and practical training of sports managers. The findings may be applied in sports management education and professional boxing practice.

Keywords: professional boxing, sports management, organizational and pedagogical conditions, managerial activity.

Introduction. Professional boxing occupies a significant place in the contemporary sports industry, functioning not only as a competitive sport but also as an integral component of the global entertainment and commercial market. Over the past decades, professional boxing has undergone substantial transformation, becoming closely intertwined with mass media, sponsorship networks, broadcasting corporations, and promotional organizations. This commercialization has significantly expanded the economic scale of professional boxing, while simultaneously increasing the complexity of its organizational and managerial processes (Smith & Stewart, 2015).

In contrast to amateur sport, where institutional regulation and state-supported structures prevail, professional boxing is predominantly governed by market mechanisms and contractual labor relations. Boxers, promoters, managers, trainers, and sponsors interact within a competitive environment based on contractual obligations, financial interests, and performance outcomes. As noted by Houlihan and Green (2011), such conditions require a fundamentally different management approach, emphasizing strategic planning, legal literacy, communication skills, and long-term athlete development.

The effectiveness of professional boxing largely depends on the quality of management, which encompasses organizational coordination, financial planning, athlete career management, marketing, and media relations. At the same time, modern sport management theory increasingly

recognizes the importance of pedagogical competence in the professional preparation and support of athletes. Managers in professional boxing are not merely administrators but also key actors influencing athletes' motivation, ethical behavior, psychological stability, and professional longevity (Chelladurai, 2014).

Pedagogical aspects of management become especially relevant in professional boxing due to the high physical and psychological demands placed on athletes, the risks associated with competitive performance, and the necessity of continuous professional development. Effective managers must be capable of creating educational and developmental environments that foster athletes' tactical thinking, self-regulation, and responsible decision-making both inside and outside the ring (Lyle, 2018). This highlights the need to integrate pedagogical principles into the organizational structure of professional boxing management.

Despite the growing body of research on sport management, the organizational and pedagogical conditions for the formation of effective management in professional boxing remain insufficiently explored. Existing studies often focus on general sport management models without considering the specific characteristics of professional boxing, such as individualized career trajectories, promoter-manager dynamics, and the dual commercial-pedagogical nature of managerial activity (Slack & Parent, 2006).

Therefore, the problem of developing management in professional boxing through scientifically grounded organizational and pedagogical conditions is particularly relevant. Addressing this issue contributes not only to improving management efficiency but also to ensuring sustainable athlete development, ethical standards, and the long-term stability of professional boxing as a socio-cultural and economic phenomenon.

Materials and Methods. The purpose of this study is to substantiate the organizational and pedagogical conditions that ensure the effective formation and development of management in professional boxing under contemporary socio-economic and sports-industry conditions. The research aims to identify key organizational mechanisms and pedagogical principles that contribute to improving managerial efficiency, optimizing athlete development, and enhancing the sustainability of professional boxing organizations.

In achieving this purpose, the study seeks to address several interrelated objectives: (1) to analyze the theoretical foundations of sports management and pedagogical support in professional sport; (2) to examine the specific characteristics of managerial activity in professional boxing, including its contractual, commercial, and educational dimensions; (3) to systematize organizational and pedagogical conditions that influence the quality of management; and (4) to develop a conceptual framework that integrates management theory with pedagogical approaches relevant to professional boxing.

To achieve the stated purpose, a комплекс of general scientific and special research methods was employed. The methodological basis of the study is grounded in systems theory, competence-based approach, and pedagogical modeling, which allow management in professional boxing to be considered as a multidimensional phenomenon combining organizational, economic, and educational components.

Theoretical analysis, synthesis, and generalization of scientific literature were used to examine classical and contemporary studies in sports management, professional sport, and pedagogical theory. This method enabled the identification of conceptual approaches to management effectiveness, leadership, and educational support in elite and professional sports. Comparative analysis was applied to distinguish between management models in amateur and professional sport and to highlight the specific managerial requirements of professional boxing.

Document analysis was employed to examine regulatory and normative materials governing professional boxing, including international federation regulations, contractual frameworks, ethical codes, and professional standards related to managerial and promotional activities. This

method allowed for the identification of structural and organizational constraints affecting management practices in professional boxing.

Additionally, a structural-functional analysis was used to examine the roles and responsibilities of key stakeholders in professional boxing management, such as managers, promoters, trainers, and athletes. This approach facilitated the identification of pedagogical interactions and communication mechanisms that influence athlete development and career management.

The method of conceptual modeling was applied to develop a generalized model of organizational and pedagogical conditions for effective management in professional boxing. This model integrates organizational structures, pedagogical support mechanisms, and managerial competencies, providing a holistic framework for understanding management development in this sport.

The use of these methods ensured the validity and reliability of the study’s conclusions and allowed for a comprehensive examination of management development in professional boxing from an organizational and pedagogical perspective.

Results. The results of the study are based on a comprehensive analysis of scientific literature, regulatory documents, and conceptual approaches to sports management. The findings allowed for the identification and systematization of key organizational and pedagogical conditions that ensure the formation of effective management in professional boxing. The obtained results confirm that management effectiveness in professional boxing is determined by the interaction of organizational structures, managerial competencies, and pedagogical support mechanisms.

Organizational Conditions for Effective Management in Professional Boxing

The analysis revealed that professional boxing management operates within a complex and multi-actor organizational environment. Effective management requires clear structural coordination between managers, promoters, coaches, medical staff, and media representatives. One of the main results of the study is the identification of core organizational conditions that directly influence management quality.

Table 1 presents the main organizational conditions and their functional significance in professional boxing management.

Table 1. Key Organizational Conditions for Effective Management in Professional Boxing

Organizational condition	Functional significance
Clearly defined management structure	Ensures role distribution, accountability, and coordination
Strategic career planning	Supports long-term athlete development and performance stability
Legal and regulatory competence	Prevents contractual conflicts and protects athletes’ rights
Financial and resource management	Optimizes sponsorship, budgeting, and economic sustainability
Communication and coordination mechanisms	Enhances interaction among stakeholders

The results indicate that the absence of a clearly structured management system leads to fragmented decision-making and reduced organizational efficiency. Strategic planning was identified as a critical condition, allowing managers to balance sporting objectives with commercial interests while reducing physical and psychological risks for athletes.

Pedagogical Conditions in Professional Boxing Management

In addition to organizational factors, the study revealed that pedagogical conditions play a decisive role in management effectiveness. Professional boxing management involves continuous interaction with athletes, which requires pedagogical competence, ethical awareness, and communication skills.

Table 2. Pedagogical Conditions for the Formation of Effective Management in Professional Boxing

Pedagogical condition	Educational and managerial impact
Developmental educational environment	Promotes motivation, discipline, and self-regulation
Competence-based approach to management	Integrates organizational, pedagogical, and psychological skills
Pedagogical communication	Strengthens trust and cooperation between managers and athletes
Reflective managerial practice	Enhances adaptability and decision-making quality
Ethical and value-oriented education	Supports fair play and responsible behavior

The results show that managers who demonstrate pedagogical awareness are more effective in supporting athletes' professional growth and psychological stability. Pedagogical communication and reflective practices were found to be especially important in managing high-performance athletes under competitive pressure.

Integration of Organizational and Pedagogical Conditions

A key result of the study is the substantiation of the integrated nature of organizational and pedagogical conditions in professional boxing management. The findings indicate that organizational mechanisms alone are insufficient without pedagogical support, and vice versa.

Table 3 illustrates the integrative relationship between organizational and pedagogical conditions.

Table 3. Integration of Organizational and Pedagogical Conditions in Professional Boxing Management

Organizational component	Pedagogical component	Resulting effect
Management structure	Educational interaction	Coordinated and athlete-centered management
Strategic planning	Career guidance and mentoring	Sustainable athlete development
Legal regulation	Ethical education	Protection of rights and professional integrity
Resource management	Motivation and support	Increased performance efficiency

The integration of these components contributes to the formation of a holistic management model that emphasizes both efficiency and human-centered development. The results confirm that the highest level of management effectiveness is achieved when organizational regulation is complemented by pedagogical interaction.

Overall, the findings demonstrate that effective management in professional boxing is a multidimensional phenomenon that requires the simultaneous implementation of organizational and pedagogical conditions. The results substantiate the necessity of a systematic approach to management development, aimed at improving managerial quality, supporting athlete well-being, and ensuring the long-term sustainability of professional boxing organizations.

Discussion. The findings of this study confirm that the development of effective management in professional boxing is a complex process determined by the interaction of organizational and pedagogical conditions. The results align with contemporary sport management theories, which emphasize that management effectiveness in professional sport cannot be reduced solely to administrative or economic functions but must incorporate educational, psychological, and ethical dimensions.

The identified organizational conditions correspond with the structural-functional models of sport organizations described by Slack and Parent (2006), who argue that clearly defined management structures and role differentiation are fundamental to organizational efficiency. In professional boxing, however, this requirement is complicated by the decentralized nature of management and the presence of multiple independent stakeholders. The present study expands existing theoretical models by demonstrating that coordination mechanisms in professional boxing must be more flexible and adaptive, reflecting the individualized career paths of professional athletes.

The importance of strategic planning identified in the Results section supports the conclusions of Chelladurai (2014), who emphasizes long-term planning as a key determinant of sustainable performance in elite sport. In professional boxing, strategic planning extends beyond competition scheduling to include career longevity, health preservation, and post-career transition. This finding highlights a distinctive feature of professional boxing management, where sporting and commercial objectives are inseparable and must be balanced through informed managerial decisions.

Legal and regulatory competence emerged as a critical organizational condition in this study, reinforcing previous research on professional sport management that underscores the role of legal literacy in contract-based sports systems (Houlihan & Green, 2011). Unlike team sports with centralized governance, professional boxing relies heavily on individual contracts, making managers' legal awareness essential for protecting athletes' rights and ensuring ethical conduct. The discussion of this aspect contributes to the literature by emphasizing the pedagogical role of managers in educating athletes about contractual responsibilities and professional ethics.

From a pedagogical perspective, the study's findings are consistent with Lyle's (2018) assertion that coaching and management in high-performance sport involve continuous educational interaction. The identified pedagogical conditions—such as the creation of a developmental educational environment, competence-based management, and reflective practice—underscore the human-centered nature of effective management in professional boxing. These results extend existing pedagogical theories by applying them to the specific context of professional boxing, where athletes are exposed to high levels of physical, psychological, and social pressure.

The integration of organizational and pedagogical conditions represents a key theoretical contribution of this study. While previous research often treats management and pedagogy as separate domains, the present findings demonstrate their interdependence in professional boxing management. This integrative perspective supports the systemic approach advocated in modern sport pedagogy, which views athlete development as a holistic process involving organizational support, educational guidance, and ethical regulation.

Furthermore, the emphasis on reflective managerial practice aligns with contemporary professional development models, which highlight lifelong learning and self-assessment as

essential components of managerial competence. In professional boxing, reflective management enables adaptation to dynamic competitive environments and individual athlete needs, thereby enhancing both performance outcomes and athlete well-being.

The discussion also reveals that insufficient pedagogical competence among managers may undermine organizational effectiveness, even when structural and financial resources are adequate. This finding suggests that management education programs in professional sport should incorporate pedagogical training alongside organizational and legal instruction. Such an approach would contribute to the formation of a new generation of sport managers capable of addressing both performance and developmental objectives.

Overall, the results of this study support the view that effective management in professional boxing requires a balanced integration of organizational efficiency and pedagogical responsibility. This conclusion not only enriches theoretical discourse in sport management and pedagogy but also provides practical implications for the design of management training programs and organizational policies in professional boxing.

Conclusion. The present study substantiates the significance of organizational and pedagogical conditions as key determinants of effective management development in professional boxing. The findings confirm that professional boxing, as a highly commercialized and contract-based sport, requires a management model that goes beyond traditional administrative functions and incorporates pedagogical, ethical, and developmental components.

The results demonstrate that organizational conditions such as clearly defined management structures, strategic career planning, legal and regulatory competence, and effective communication mechanisms form the structural foundation of professional boxing management. These conditions ensure coordination among stakeholders, protect athletes' rights, and support the economic sustainability of professional boxing organizations. However, the study reveals that organizational mechanisms alone are insufficient to guarantee management effectiveness without corresponding pedagogical support.

Pedagogical conditions, including the creation of a developmental educational environment, competence-based managerial training, pedagogical communication, and reflective practice, play a decisive role in enhancing management quality. The integration of pedagogical principles into managerial activity enables managers to support athletes' motivation, psychological stability, ethical behavior, and long-term professional development. This human-centered approach contributes to improved performance outcomes and career longevity in professional boxing.

One of the key conclusions of the study is that the highest level of management effectiveness is achieved through the integration of organizational and pedagogical conditions. The proposed integrative framework highlights the interdependence of structural regulation and educational interaction, emphasizing the necessity of a systematic approach to management development in professional boxing. This approach aligns with contemporary theories of sport management and pedagogy, which view athlete development as a holistic and multi-dimensional process.

The theoretical significance of this study lies in expanding the understanding of professional boxing management as a socio-pedagogical phenomenon that combines organizational efficiency with educational responsibility. Practically, the findings provide a basis for improving management training programs, developing professional standards for boxing managers, and designing organizational policies that prioritize athlete well-being and ethical conduct.

In conclusion, the study confirms that the development of effective management in professional boxing requires scientifically grounded organizational and pedagogical conditions. The implementation of these conditions contributes to the sustainable development of professional boxing, the protection of athletes' professional interests, and the long-term stability of the sport within the global sports industry. Future research may focus on empirical validation

of the proposed framework and the development of applied models for management education in professional boxing.

References

1. Chelladurai P. Managing organizations for sport and physical activity. – London: Routledge, 2014. – 360 p.
2. Houlihan B., Green M. Routledge handbook of sports development. – London: Routledge, 2011. – 624 p.
3. Lyle J. Sports coaching concepts: A framework for coaching practice. – London: Routledge, 2018. – 312 p.
4. Slack T., Parent M.M. Understanding sport organizations: The application of organization theory. – Champaign: Human Kinetics, 2006. – 296 p.
5. Smith A., Stewart B. Introduction to sport marketing. – London: Routledge, 2015. – 356 p.
6. Chelladurai P. Managing organizations for sport and physical activity: A systems perspective. – London: Routledge, 2014. – 380 p.
7. Houlihan B., Green M. Routledge handbook of sports development. – London: Routledge, 2011. – 624 p.
8. Lyle J. Sports coaching concepts: A framework for coaching practice. – London: Routledge, 2018. – 312 p.
9. Slack T., Parent M.M. Understanding sport organizations: The application of organization theory. – 2nd ed. – Champaign: Human Kinetics, 2006. – 310 p.
10. Smith A., Stewart B. Introduction to sport marketing. – London: Routledge, 2015. – 356 p.
11. Taylor T., Doherty A., McGraw P. Managing people in sport organizations: A strategic human resource management perspective. – Oxford: Butterworth-Heinemann, 2008. – 295 p.
12. Shilbury D., Westerbeek H., Quick S., Funk D. Strategic sport marketing. – 4th ed. – Crows Nest: Allen & Unwin, 2014. – 410 p.
13. Green M., Houlihan B. Elite sport development: Policy learning and political priorities. – London: Routledge, 2005. – 246 p.
14. Hoyer R., Smith A., Nicholson M., Stewart B. Sport management: Principles and applications. – 5th ed. – London: Routledge, 2018. – 432 p.
15. International Boxing Association (IBA). Technical and competition rules. – Lausanne: IBA, 2023. – 198 p.
16. UNESCO. Quality physical education guidelines for policy-makers. – Paris: UNESCO, 2015. – 120 p.

THE TYPOLOGICAL STRUCTURES OF AZERBAIJANI AND ENGLISH

Nuran Murshudzada

"Languages and teaching technologies" department, of Azerbaijan State Pedagogical University, Sheki branch, ORCID:0000-0002-3194-3250

ABSTRACT

We learn foreign languages because we are part of the society that speaks it, because we want to understand that culture, or because we want to be understood by that speech community. If a language is not used in any community, it dies. Language is therefore a social activity. Only when we are aware of every facet of the people involved—their personalities, worldviews, attitudes, interpersonal relationships, social status, the activities they engage in, the subjects they discuss, linguistic and nonlinguistic precedents, what comes next, who they are, and a host of other details about them and the situations they find themselves in—can it be fully described. The English and Azerbaijani languages belong to different language families based on their typological structures and genesis. The earliest forms of English, a West Germanic language of the Indo-European language family, were spoken by individuals in early mediaeval England. Azerbaijani is an agglutinative language that is part of the Oghuz group of Turkic languages. It is named after the Angles, a group of historic Germanic settlers in Great Britain.

Keywords: Language, Attitudes, Genesis, Linguistic and Nonlinguistic Precedents, Typological Structures

1. INTRODUCTION

Language is a collection of common communication signs that people use to communicate with one another in social settings. In this view, language is a social institution that belongs to a social group and consists of a necessary set of rules that allow its members to relate to one another, communicate with one another, and work together. Language is a tool used in society for fostering cultural growth and generating interpersonal connections. A human only learns a language after becoming a part of a culture.

Many academics have been intrigued by specific morpho-syntactic traits that are shared by English and Celtic but not always by other Germanic languages. However, the notion of a potential "Celtic" (or Brittonic substratum in English) has typically been discounted for linguistic and historical grounds, or it has been simply dismissed as typological universals. The historical accounts of the "Anglo-Saxon conquest" that served as the foundation for this conclusion in the 19th century, according to which the Britons were "extirpated" or driven out of England (Freeman 1867: 18) entirely by the invading "Anglo-Saxon" conquerors and the "tolerated remnant of their predecessors" (the Britons) were sold into slavery, have also largely gone uncontested until recently (Stubbs 1870: 1). The lack of Celtic loanwords in English can be attributed to the fact that intermarriage would have been prohibited (Freeman *ibid.*; Stubbs *ibid.*). Therefore, there was no basis for thinking that the two populations had combined in any way. Furthermore, these results appeared to be supported by literal readings of the oldest historical records from the time, Gildas and Bede.

Even today, this is the prevailing viewpoint (Burchfield 1986; Algeo and Pyle 1993). If the Britons were slain or expelled from the kingdom, how could there still be a Brittonic substratum

in England? Of course, the reasoning is circular. The majority of the Brittonic-speaking population was swiftly assimilated without leaving any linguistic traces, according to even the most forgiving sources that claim the Britons survived the colonization (Jespersen 1938).

Languages similarities are not always present everywhere, all the time, in all languages. Therefore, it is possible to argue that the root morphemes' clear parallelism in all places is false. It is true that the typological structures of many groupings of languages and their genetic make-up are similar, which has implications for how remaining languages developed and the presence of related languages. This demonstrates how the language environment in a particular region underwent a spreading process as a result of intermittent areal expansions, and throughout the course of history, they differentiated and established their own standards. However, these languages' genetic similarity and typological organization remain to protect their cultural heritage. The internal structures of the Turkic language family and the Indo-European language family both maintain genealogical and typological heritage. However, it cannot be argued that in all languages, geographical expansion and relocating have been historically necessary. It is clear from the investigations done so far that both languages, regardless of their typological and genealogical makeup, share a same genetic ancestor. The presence of a common root, however, does not prove that all languages developed simultaneously and that the commonality resulted from this. The lack of simultaneity and linearity in the development of many languages is suggested by the genetic similarity between them and their failure to cover their roots.

As human civilizations evolved, grew, multiplied, and spread, the basic components' diversity, distinction, and change also grew. Additionally, there was a change in the word's meaning as well as its structure. Here, metaphor, obsolescence, expansion, and contraction all played a significant role. This has made it challenging to understand the interlinguistic commonalities. (8 s.5)

2. TYPOLOGY OF AZERBAIJANI AND ENGLISH LANGUAGES

According to the volume of speech activity, structural changes in the Azerbaijani and English languages take place over time, and since changes in the structure result in changes in the system, the structure of modern languages exhibits the existence of many systems. According to the results of the investigations, the Azerbaijani language belongs to the Agglutinative group of languages, whereas the Inflective group of languages includes English. The inflectional (analytical) language family comprises the Indo-European language family. Sometimes, linguistic literature looks for characteristics that set inflectional and analytic languages apart from one another. The word "inflective" has Latin roots. It denotes bending or altering. In linguistics, the term "ending" refers to both internal and final word changes that result from classification. Analysis plays a significant role in the internal organization of inflectional languages. Latin is the word's original language of origin. It denotes correspondence or equality. The term "analytism" in linguistics refers to the joining of components with equal rights (word rights) to form a single unit. The use of prefixes and suffixes at the beginning of words that can serve the same word-building purpose is another definition of analytical writing. Analyticism is usually opposed to synthesizing. The word synthetism as a term is derived from the word synthesis. It means joining. In linguistics, it is understood in the sense of end-imagery. Synthetism and analyticism are compared on the basis of the fact that adequate units are attached to the beginning or the end in languages. For example, the word *masa* (table) in Azerbaijani takes the form *masaya* (in the table) when it becomes possessive. In English, the adequate element comes first: to table. When the word "*ölka*" (country) in the Azerbaijani language changes according to the case of the noun, it falls into forms such as *ölkənin*, *ölkəyə*, *ölkəni*, *ölkədə*, *ölkədən*. That is, not the beginning of the word, but the end

changes. In English, the beginning of the word changes: *the country, of the country to the country, with the country*, etc. The Azerbaijani language belongs to the family of inflectional-synthetic or inflectional languages as a result of this characteristic. Analytical languages include English and Germanic.

Synthesis in languages presented as analytic type has a sign: *organ–organization, abbreviate - abbreviation, abnormal– abnormality, sister– sister`s, door–door`s and etc.* All Indo-European languages share analytic and inflectional features. These languages have simultaneously shown evidence of synthesis. Therefore, rather than classifying these languages into analytic-synthetic and inflectional-synthetic groupings, it is more reasonable to define these languages according to the characteristics of analytically-inflection.

Due to the analytical and inflectional nature of these languages' primary leading factors. The term agglutination is of Latin origin and means sticking together. This phrase refers to the process of adding suffixes to the end of words as they are formed and their grammatical forms change in linguistics. The meanings of the suffixes attaching the end of the word to form a row, sequence with each other, or putting one behind the other to make a row, tandem are also included under the term "agglutination."

The Azerbaijani language is an agglutinative language, which means that modifying and changing suffixes are typically added to the end of words. Word-modifying and word-correcting suffixes both have grammatical significance. According to agglutination, every word's last suffix has a distinct grammatical meaning. As a result, it is impossible to move them or separate them from one another. The subsequent member fills in for any absent tandem members. For instance, the suffixes for number and case have different grammatical meanings in the Azerbaijani language: ***ev-evlər-evlərdə***.

The transitions between related structures (inflectional and agglutinative) can be seen in the earliest stages of languages with various grammatical systems, which shows that language elements emerged from related processes in the prehistoric era. Inter-linguistic differences grew and distinguishing factors kept growing in the latter stages. Within a single language, numerous dialectal divisions have developed. Despite this, it is still possible to uncover numerous facts and instances of inter-linguistic commonality by widening the network of typological studies. Regardless of where people lived, the typology of thinking caused the production of good and bad mythical representations based on comparable imitations and in line with the current occurrences.

For instance, vile conceptions like the Simurgh bird, Zumrud (Emerald) bird, Pigeon, and Angel were associated with pictures of giants, dragons, demons, and devils. Later, in Western literature, semi-mythical characters like Hercules, Amazons, and Prometheus took the place of these representations. Real personality representations of people like Dede Gorgud and Koroglu have been made in Azerbaijan, preserving some aspects of mythical imagination.

One of the theoretical theories on the existence of inter-linguistic commonality is the idea of cognitive typologies. However, this obviously isn't the end product. It cannot be ruled out that as linguistics and the typology of languages research advances, new theoretical viewpoints will do as well. A real guarantee for reasoning about the origin of languages with more solid arguments can instead be provided by new research and theoretical concepts. Language development is influenced by both man and nature. Consciousness, cognitive function, and the shift from this to thinking are at the core of their relationships, which cannot be disputed. Because it is impossible to discuss the development of the thinking process without an understanding of nature and the human being as an element of nature. Thinking results in the production of speech.

Conclusion

The presence of signs does not necessarily mean that they all come from the same origin, from one "great root language," even when they are similar and frequent in typologically disparate languages. Because it is illogical to assert that people first spoke a language in one location on the wide planet, then periodically spread across vast distances. The idea that the historical mixing of languages, contact, and migrations is the cause (or one of the causes) of the genetic similarity is unable to support by sufficient data. Primitive man must be considered if we are discussing primitive language. If the earliest forms of language were composed of sounds, imitations, call elements, and finally monosyllabic roots, it indicates that the earliest forms of human thought also existed. Although all of the theories that now exist have positive ideas about how languages first developed, none of them have been able to come up with a convincing defense for why there are common features in the first place. The basis for the similarities between languages with various systems is the typology of thought. Regardless of where people live, the typology of thinking creates analogous linkages between people and natural events. Interlanguage similarities result from this. The typology of thinking, however, is unable to guarantee the production of entirely equivalent elements across their languages because people are born and raised in various locations. Not all words can be generated at the same time and in the same way since human civilizations' levels of links to nature are not exactly the same.

REFERENCES

1. Freeman, E.A., 1867. *The History of the Norman Conquest, Its Causes and Failures*, Vol. 1, Oxford: Clarendon Press.
2. Gachelin, J.M., 1990. "Aspects of Non-Standard English". *L'Auxiliaire en Question (Travaux Linguistiques du Cerlico II)* Rennes: Presses Universitaires de Rennes II, pp. 221-240.
3. George, C., 1990. *Community and Coal: an Investigation of the English Dialect of the Rhondda Valleys, Mid Glamorgan*, unpublished Ph.D. thesis, University College of Wales, Swansea.
4. German, G., 1984. *Etude linguistique du Breton de St. Yvi*, unpublished Ph.D. thesis, University of Brest.
5. Gumperz, J. & R. Wilson, 1971. "Convergence and Creolization: A Case from the Indo-Aryan/Dravidian Border of India", in: Hymes, D. ed., *Pidginization and Creolization of Languages. Proceedings of a Conference held at the University of the West Indies, Jamaica, April 1968*, Cambridge: Cambridge University Press, pp. 151-167.
6. Hamp, E.P., 1975-1976. "Miscellanea Celtica I, II, III, IV" SC10-11: 54-73.
7. Hardie, D. A A, 1948. *Handbook of Modern Breton (Armorican)*, Cardiff: University of Wales Press.
8. Mübariz Yusifov. Linqvistik tipologiya (dillər arası müştərəklik və təfəkkür topologiyası). Bakı, «Elm və təşkil», 2017, 184 səh.
9. Härke, H., 1995. "Immigrants and Natives: A Provisional Model of Anglo-Saxon Ethnogenesis" unpublished typescript: 1-18.
10. —, (forthcoming 2001) "Population Replacement or Acculturation? An Archaeological Perspective on Population and Migration in Post-Roman Britain" in: Tristram, H. ed. *Celtic-Englises II*. Heidelberg: Carl Winter.
11. Hemon, R., 1975. *A Historical Morphology and Syntax of Breton*, Dublin: Dublin Institute for Advanced Studies.
12. Hewitt, S., 1986. "Le progressif en breton à la lumière de du progressif anglais", in: Le Dû, J & Y. Le Berre, eds. *La Bretagne Linguistique*. Vol.2, Brest: CRBC, pp. 133-147.
13. Higham, N., 1992. *Rome, Britain and the Anglo-Saxons*, London: Seaby.

ARTIFICIAL INTELLIGENCE AS A TOOL FOR FORMING INTEREST IN MATHEMATICS AMONG STUDENTS WITH LOW MOTIVATION TO LEARN

Y.S. Karyakin

Master's student in the specialty 7M01507 Mathematics, NAO "Kostanay Regional University named after A. Baitursynov"

Abstract. This article explores the possibilities of applying artificial intelligence (AI) technologies to increase interest in mathematics among students with low learning motivation. The author analyzes the limitations of traditional teaching methods and proposes alternative approaches based on personalized learning, visualization of abstract concepts, interactive communication, and instant feedback. Examples of AI tools are provided, a model of the teaching methodology is described, and directions for further research are outlined. The work is practical in nature and may be useful to teachers, methodologists, and developers of digital educational solutions.

Keywords: artificial intelligence, interest, motivation, mathematics, digital learning, visualization, feedback, educational technologies, school education.

Introduction

The modern educational paradigm focuses not only on transmitting knowledge but also on developing students' sustainable learning motivation, independent thinking skills, and meaningful perception of educational material. In the context of the rapid development of digital technologies and the integration of artificial intelligence (AI) into educational practices, schools face the task of adapting traditional teaching methods to new realities, especially in disciplines like mathematics.

Mathematics, despite its foundational nature, is often perceived by students as a difficult and abstract subject. This is particularly true for students with low learning motivation, who struggle to understand the material, do not see its practical value, and, as a result, demonstrate low engagement and performance levels. In such conditions, traditional teaching methods — such as frontal explanations, monotonous tasks, and the lack of feedback—prove to be ineffective.

The problem is most acute in the following aspects:

1. **Decreased interest in the subject:** Monotony of tasks, lack of visualization, and individualized approaches lead to fatigue and loss of academic initiative.
2. **Inability to adapt to the student's level:** A unified pace and format of material presentation fail to account for individual perception characteristics, which reduces learning effectiveness.
3. Thus, the relevance of this study is determined by the need to search for modern, technologically-supported solutions that can increase interest in mathematics among low-motivated students. The use of AI tools—chatbots, adaptive platforms, visualizers—opens up prospects for fostering sustainable learning motivation and improving the quality of mathematics education.

The purpose of the article is to define the scientific and methodological foundations for applying artificial intelligence technologies to foster interest in studying mathematics among students with low learning motivation, justify the need for creating, and describe the conceptual

model of a new teaching methodology aimed at increasing student engagement, cognitive activity, and the effectiveness of mastering mathematical concepts.

Object of the study: The process of teaching mathematics in secondary school.

Subject of the study: The use of artificial intelligence tools (chatbots, learning platforms, visualizers, adaptive services) to increase interest in mathematics among students with low learning motivation.

Review of pedagogical research.

In recent years, the potential of digital technologies, specifically artificial intelligence (AI), has been actively studied in pedagogy and psychology as a means to enhance motivation and learning effectiveness. Research shows that AI can have a significant impact on academic motivation, particularly among students struggling with traditional educational material.

The works of S. Papert and his followers on the constructivist approach emphasize the importance of the student's active involvement in the learning process. AI, integrated into the educational environment, can act not only as an information source but also as a partner in learning, capable of engaging in dialogue, asking prompting questions, and offering alternative strategies for problem-solving.

Research in cognitive psychology (Bransford, Brown, Cocking, 2000) suggests that learning becomes more effective when students receive timely and understandable feedback. AI platforms such as Photomath, Symbolab, and MathGPT implement this principle by providing step-by-step explanations, visualizing solutions, and analyzing errors, which fosters a conscious approach to learning.

Moreover, according to the research of Zhou & Li (2024), the visualization of abstract mathematical concepts using AI tools (e.g., Desmos, GeoGebra with AI support) helps reduce cognitive load and increases interest in the subject, especially for students with low motivation.

Thus, the integration of AI into the educational process allows for a transition from reproductive learning to a more flexible, adaptive, and motivating model, in which the student becomes an active participant rather than a passive consumer of knowledge. This is particularly important for fostering a sustainable interest in mathematics among students who struggle with learning.

Experiment

Research methodology

The study included both theoretical and empirical methods:

- **Theoretical:** Literature review, modeling, generalization of pedagogical experience.
- **Empirical:** Observation, surveys, interviews, testing, pedagogical experiment, analysis of student activity products.

Design and stages of the experiment

The experiment was conducted over 8–10 weeks in two parallel classes (grades 6–7) selected based on low motivation. Control (CG) and experimental (EG) groups were formed.

Stages:

1. **Diagnostic stage:** Diagnosis of interest, motivation, and knowledge level.
2. **Formative stage:** Implementation of the methodology using AI (adaptive tasks, chatbots, visualization, reflection).
3. **Control stage:** Repeated diagnosis.
4. **Delayed control:** Assessment of the stability of the effect 4–6 weeks later.

Methodology for AI implementation

In the lessons for the experimental group (EG), the following elements were used:

- Motivational tasks from AI (puzzles, visualizations).
- Personalized tasks with instant feedback.

- Pair work with chatbot support.
- Reflection through digital forms.

The following platforms were used: ChatGPT, MathGPT, Photomath, Kampus, Desmos, Symbolab.

Criteria for assessing effectiveness in EG

Criteria	Indicators of effectiveness in EG
Cognitive interest	Growth in the proportion of students with high interest ($\geq 25\%$)
Learning motivation	Increase in internal motivation, decrease in demotivation
Behavioral engagement	Growth in initiative, focus time, activity in dialogue
Subject results	Improvement in success, reduction of typical errors ($\geq 30\%$)
Reflective component	Growth in conscious use of AI as an educational tool

Results and Discussion

Based on the results of the experiment in the experimental group (EG), the following changes were observed:

- The average increase in interest in mathematics was $\Delta \approx +0.7$.
- The proportion of students voluntarily participating in tasks reached 60%.
- The number of queries to AI for explanations, rather than just receiving ready-made answers, increased.
- Subject results improved, particularly in algebraic transformations.
- The effect was partially retained 4–6 weeks after the experiment.

Conclusion

The conducted research confirmed that artificial intelligence technologies have high potential in fostering interest in mathematics among students with low learning motivation. The implementation of AI tools—such as chatbots, adaptive platforms, and visualizers—enabled a shift from traditional reproductive learning to a more flexible, interactive, and personalized model, which contributed to an increase in cognitive activity, engagement, and academic performance.

The developed methodology, based on the use of AI for creating motivational tasks, instant feedback, visualization, and reflection, demonstrated its effectiveness in school practice. Experimental data indicate significant improvements in academic performance, an increase in interest in the subject, and a conscious use of digital tools in learning.

Thus, AI can serve not only as a technological novelty but also as a full-fledged pedagogical resource capable of transforming the approach to teaching mathematics. It is important to emphasize that successful AI integration requires methodological planning, pedagogical support, and ethical responsibility.

Perspectives for further research include:

- Expanding the age and motivation groups of students.
- Developing specialized AI modules for school mathematics.
- Studying the long-term impact of AI on learning motivation and cognitive development.
- Creating methodological recommendations for teachers on integrating AI into the educational process.

The integration of AI into school mathematics education opens new horizons for improving the quality of learning, especially for students facing difficulties in mastering the subject. This makes further development of the scientific-methodological base and practical solutions in this area particularly relevant.

References

1. Zhou, Y., & Li, H. (2024). AI-enhanced visualization in mathematics education. *Journal of Digital Pedagogy*.
2. Kasymova, G.K., & Xu, W. (2024). Adaptive learning technologies in secondary education. *International Review of Education*.
3. Shlykova, S.S. (2025). Dialogic interaction with AI in the classroom. *Pedagogical Innovations*.
4. Kampylis, P., et al. (2023). Personalization through AI: A framework for schools. *European Journal of Educational Technology*

EXPLORING THE IMPACT OF DIGITAL MEDIA ON READING SKILLS

A.S.Ospan

Master degree student of Kazakh National Women's Teacher Training University
(Almaty, Kazakhstan)

Аңдатпа

Бұл мақалада ағылшын тілін оқытуда сандық технологияның оқу дағдыларына әсері қарастырылады. Қазіргі таңда осы тақырыптың ғылыми жаңалығы қазіргі қоғамда ағылшын тілін үйрену қажеттілігін анықтауында. Бұл зерттеуде ағылшын тілін оқытуда цифрлық технологияны қолданудың ең тиімді әдістері мен тәсілдері талданды, соның ішінде теледидар, радио, интернет ресурстары, ауызша коммуникация, тыңдау, оқу және жазу сияқты сөйлеу әрекеттерінің әртүрлі түрлерінде дағдыларды дамытуға арналған арнайы білім беру бағдарламалары, сондай-ақ ағылшын тілінің әртүрлі оқу мәнерлеріне егжей-тегжейлі талдау жасалды. Және де мақалада бастауыш сыныптағы ағылшын тілі сабақтарында медиа-технологияларды қолдану арқылы эксперименттік енгізуді қарастыратын практикалық бөлім қарастырылады.

Кілт сөздер: ағылшын тілін оқыту, түпнұсқалық материалдар, цифрлық технологиялар, интернет ресурстары, оқу стильдері, медиа технологиялар.

Аннотация

В данной статье рассматривается влияние использования цифровых технологий на навыки чтения в процессе обучения английскому языку. Научная новизна заключается в раскрытии необходимости изучения английского языка в современном обществе. В ходе изучения данной темы были проанализированы наиболее эффективные методы и подходы использования средств цифровых технологий в обучении английскому языку, такие как телевидение, радио, интернет-ресурсы, специализированные образовательные программы, предназначенные для развития навыков различных видов речевой деятельности таких как устного общения, аудирования, чтения, письма, а также навыков подробный анализ различных стилей чтения английского языка. Далее в статье рассматривается практическая часть, в которой проводится экспериментальное внедрение медиа технологий на уроках английского языка в младшей школе.

Ключевые слова: обучение английскому языку, аутентичные материалы, цифровые технологии, интернет-ресурсы, стили чтения, медиа технологии.

Annotation

This article examines the impact of digital technology on reading skills in English language learning. Its novelty lies in its identification of the need for English language learning in modern society. This study analyzed the most effective methods and approaches for using digital technology in English language teaching, including television, radio, internet resources, specialized educational programs designed to develop skills in various types of language activities such as oral communication, listening, reading, and writing, as well as a detailed analysis of various English reading styles. The article then discusses the practical part, which involves the experimental implementation of media technologies in English language lessons in primary school.

Keywords: English language teaching, authentic materials, digital technology, internet resources, reading styles, media technologies.

Text

In the modern world, learning English is essential because it is the international mode of communication for all of society. International languages allow for the exchange of information, regardless of nationality or place of residence. English is designated as the official working language of the United Nations (UN), and therefore, most international meetings are conducted in this language.

The development of innovative digital learning technologies has led to increased interest among researchers in adaptive approaches to the educational process in schools. This includes not only the emergence of training courses, but also intelligent systems and personalization of learning, as well as issues of increasing the effectiveness of the educational process [1, p. 115], [2, p. 710].

English also allows us to consume a vast amount of information: read the most outstanding works in the original, listen to world-famous musical compositions, and understand their meaning. It's difficult to imagine the modern world without English. It's firmly ingrained in our daily lives and completely changes our perspective on communication.

Digital technologies create a unique opportunity for foreign language learners to use authentic tools to put their acquired knowledge into practice through interaction with native speakers.

The issue of developing students' reading skills in senior secondary schools is becoming increasingly important, as reading, as a learning goal, serves as a means of understanding the subject matter. Reading, as a productive process, takes a significant amount of time and effort from students, as it also requires the integration of linguistic, speech, and cognitive competencies. As a form of communicative activity, it should be an integral part of every lesson. To facilitate students' reading, it is necessary to consider the specific characteristics of this type of cognitive activity, such as motivation, determination, students' mental abilities, independence, and perseverance.

The practical significance of reading lies in the fact that through it, students become familiar with the culture of the people speaking the target language, develop information retrieval skills, and instill respect for that foreign culture. Furthermore, reading success fully addresses the primary goal of foreign language learners: developing communicative competence.

Let's consider the problem of improving media literacy in English lessons using digital systems (tools) and their application to analyzing fake news.

Modern society, the media, and media networks are inseparable. Media literacy is the ability to critically consume and comprehend information, filter it appropriately, and prevent its uncontrolled dissemination and disinformation. It is important to be able to distinguish and filter web resources, fraudulent schemes, and malicious content.

Media literacy is the ability to identify and classify media resources and media messages, to analyze and to evaluate them, preventing their negative impact on users. This addresses a variety of tasks, such as:

1. Genre assessment;
2. Familiarization with structure and capabilities;
3. Creating a scenario or situation;
4. Argumentation and justification of what was observed;
5. Risk and threat assessment.

Threats – real or virtual, with sources in the real or virtual world.

Example. Examples of threats to students may include:

1. Fakes, fake pages (threats, for example, a publicly accessible photo posted on a social network or account);
2. Disinformation (deliberate misleading);
3. Cyberbullying (usually prolonged, intentional slander, threats, and compromise via SMS, email, or instant messaging);
4. Group pressure, trolling, and bullying (often involving insults, belittling the student in the eyes of others, including promoting suicide, romanticizing crime, etc.);
5. Extremism (involving a victim – a group member – in an extremist organization).

Students at school need to improve their media literacy, in particular, by implementing:

1. Personal safety management (self-awareness online, protection from media tricks, ability to navigate media networks);
2. Information retrieval (relevant selection of information);
3. Information perception (recognizing context, hidden meaning, forming a well-reasoned personal opinion);
4. Content creation (ability to create valuable content);
5. Media ethics (correct online communication).

Media education is based on the concept of encouraging people to engage in purposeful dialogue.

The benefits of media literacy for students are obvious, for example, critical thinking, recognizing hidden thoughts and goals ("the devil is in the details"), cultivating resilience to tricks, etc.

Media literacy also means self-education in the media sphere, reaching school children and their parents. Media literacy reflects literacy in obtaining, analyzing, evaluating, and transmitting information through various media channels and resources – from traditional to mainstream media. Media literacy enables one to analyze media, identify fakes and propaganda, censor news and public programs, and identify key structural elements, such as the true source of a fake, its purpose, etc.

The goal of media literacy is not only to develop media competencies but also heuristic procedures, identifying their advantages and limitations, stakeholders, and formulating effective opinions and decisions.

Example: If, for example, a user is asked to vote for "their" opinion or product, this is not mandatory; a media-literate user will critically evaluate such a proposal.

Media literacy offers additional and powerful opportunities for developing critical, comparative, and systemic thinking, creating and evolving one's own media resources and messages, assessing one's own and competitors' behavior, and using heuristics. Media learning is a form of information education, integrated with biblioliteracy, reading-writing-listening culture, and the use of relevant IT infrastructures (ecosystems).

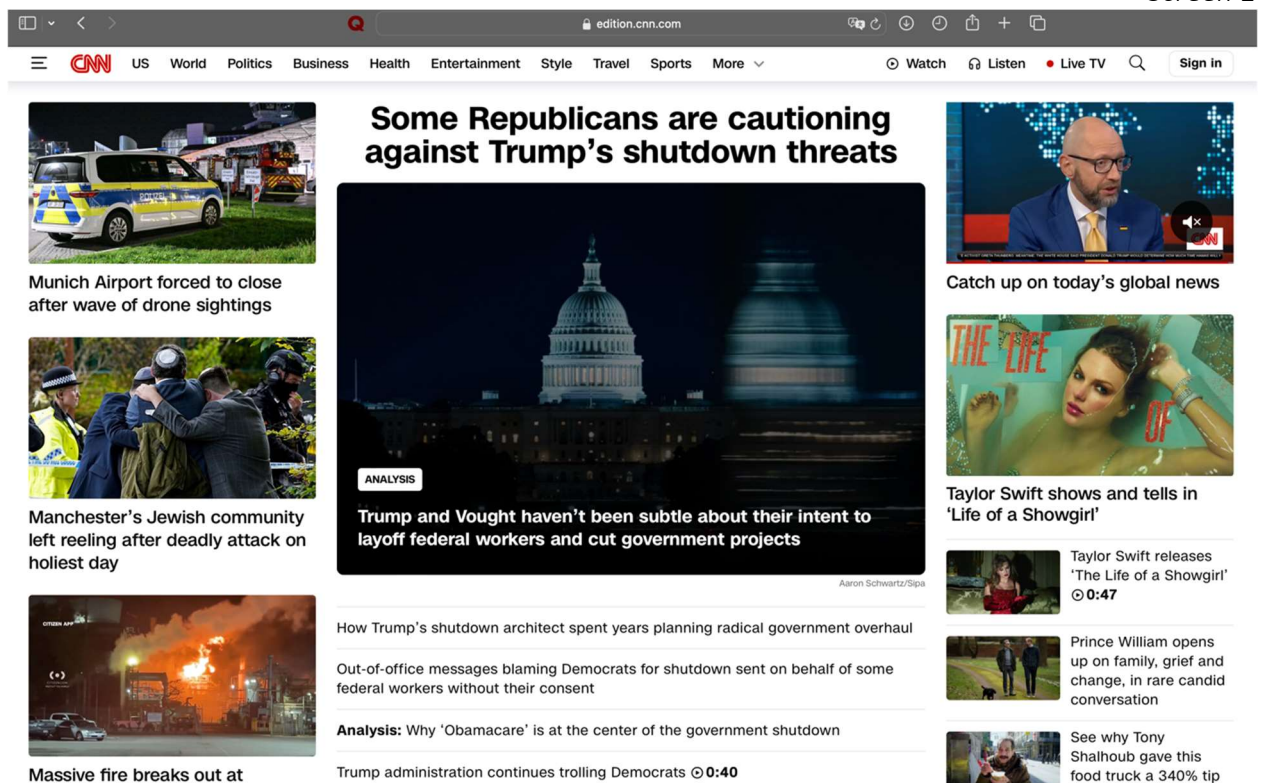
English lessons have their own specific characteristics. Along with the study of language and the country's history, basic speech and grammar skills are developed. The practical acquisition of this knowledge depends on the teacher's understanding, the visual and media support of the lesson, an adaptive learning and assessment mechanism, and infographics [6, p. 69], which have didactic advantages (compared to text).

The teacher must maintain students' attention, and infographics are an effective tool for this purpose. Creating infographics on a given topic can be an engaging activity for students.

Methodology

Homepage of CNN channel is presented on screen 1.

Screen 1



Methodology: Using the CNN Homepage to Develop Reading Skills and Discuss the Impact of Digital Media

1. Lesson Objective

- Develop reading skills in English (skimming, scanning, detailed reading).
- Develop media literacy: a critical approach to online news.
- Discuss the impact of digital media on reading habits and skills.

2. Materialsneeded: CNN Homepage (current version at the time of the lesson). Projector/screen (or students' smartphones). Worksheets with tasks (comprehension questions, comparison exercises).

3. Lesson Procedure

Stage 1. Lead-in – 5–7 min. The teacher asks questions:Where do you usually read the news: online or in print? Do you read the entire text or just the headlines? Brief discussion: How has digital media influenced reading habits?

Stage 2. Skimming – 10 min.

Students open the CNN homepage.

Assignment: In 2 minutes, determine:What are the three most common topics on the page (e.g., politics, technology, sports)? Which headlines seem most attention-grabbing?

Discussion: Why are these headlines so catchy?

Stage 3. Scanning&Detailed Reading – 15 min.

Divide students into groups, each group selecting one article.

Assignments: Find key facts (who, what, when, where, why). Define new words, create a mini-dictionary. Compare the use of short paragraphs and multimedia (photos, videos, hyperlinks).

Stage 4. Media Format Analysis – 10 min.

Discussion Questions: How does reading an article on CNN differ from reading a printed article? Is it easier or harder to concentrate? How do images, videos, and hyperlinks affect text comprehension? What develops reading skills better: long printed texts or digital media?

Stage 5. Speaking Practice (Speaking / Discussion) – 10 min.

Students discuss in pairs/groups: "Digital media makes our reading skills weaker/stronger. Do you agree?". Provide a short mini-essay/oral conclusion (2-3 sentences).

Stage 6. Reflection and Consolidation – 5 min.

Each student formulates: One new English word learned today. One conclusion about how digital media affects their reading.

4. Homework (options)

Find another online newspaper (e.g., BBC, The Guardian) and compare the presentation with CNN.

Write a mini-essay (100-150 words): "How digital media have changed my reading habits."

Thus, the lesson is built around real, authentic material (CNN), trains reading skills in English, and helps students understand the role of digital media in developing reading skills.

References:

1. V. P. Glukhov. Developing Reading Fluency in Primary School Students / V. P. Glukhov, A. V. Petrova.- Moscow: Prosveshchenie, 2019.

2. A. A. Safonov. Digital Pedagogy. Practical Course: Textbook and Workshop for Secondary Vocational Education / A. A. Safonov, M. A. Safonova.- Moscow: Yurait, 2024.

3. N. N. Svetlovskaya. Methods of Teaching Creative Reading: A Textbook for Universities / N. N. Svetlovskaya, T. S. Piche-ool.- 2nd ed., corrected and enlarged.- Moscow: Yurait, 2024.

4. E. V. Chizhikova. Developing Reading Accuracy and Fluency in Primary School Students Using Digital Technologies / E. V. Chizhikova [Electronic resource]. – Access mode: <https://clck.ru/3NbLeZ>

ЦИФРОВЫЕ ИНСТРУМЕНТЫ КАК СРЕДСТВО ПРОВЕРКИ ТЕОРЕТИЧЕСКИХ ГИПОТЕЗ В ОБУЧЕНИИ МАТЕМАТИКЕ

Алдибаева Турагалды Абилакимовна

к.п.н., ассоциированный профессор Алматинского гуманитарно-экономического университета, Республика Казахстан

Аннотация: В статье представлен подробный анализ использования цифровых образовательных сред как эффективного инструментария для практической проверки и критической оценки математических предположений. Автор рассматривает последовательный путь познания: от формирования первичной интуитивной догадки до выстраивания строгого аналитического доказательства, которое опирается на результаты предварительных цифровых экспериментов и интерактивных вычислений. Особое внимание в работе уделено методике формирования исследовательских компетенций у студентов. Этот процесс реализуется через создание и последующее разрешение когнитивных конфликтов — ситуаций, в которых обнаруживается явное несоответствие между абстрактной теоретической моделью и её реальным отображением на экране монитора. Именно в моменты такого сопоставления теории с практическими данными происходит глубокое осмысление предмета и развитие навыков научного поиска.

1. Введение: Гносеологический статус цифрового эксперимента.

Классическая образовательная модель, на протяжении десятилетий определявшая вектор преподавания математики в высшей школе, базировалась на строгом аксиоматико-дедуктивном методе, где приоритетом являлось транслирование готовых доказательств. Однако в условиях глобальной цифровой трансформации образовательного пространства этот консервативный подход дополняется и обогащается методами **экспериментальной математики**. Данное направление переосмысливает роль студента: из пассивного слушателя он превращается в активного исследователя, который использует возможности современных цифровых сред для первичного обнаружения закономерностей. Таким образом, цифровая среда становится платформой для живого математического эксперимента, предваряющего глубокое теоретическое осмысление.

Согласно концепции Дж.Борвейна, цифровой инструмент позволяет исследователю обнаруживать скрытые закономерности и проверять их устойчивость на массивах данных до момента формального вывода.

В образовательном процессе это создает условия для формирования исследовательских навыков: студент перестает быть пассивным потребителем готовых алгоритмов и становится активным субъектом познания. Использование информационных технологий позволяет трансформировать обучение в итерационный процесс выдвижения, проверки и уточнения гипотез, что максимально приближает учебную деятельность к реальному научному поиску.

2. Теоретико-методологические основания исследования.

2.1. Концепция фальсифицируемости и когнитивный конфликт

Процесс проверки гипотез в цифровой среде опирается на эпистемологический подход И. Лакатоса, описывающий развитие математики как динамическую цепочку

«догадок и опровержений» [2]. Цифровой инструмент (будь то система компьютерной алгебры или среда динамической геометрии) обеспечивает мгновенную обратную связь. Если выдвинутая студентом гипотеза ошибочна, система позволяет визуализировать или рассчитать контрпример.

В этот момент возникает **когнитивный конфликт** — состояние, описанное А. М. Матюшкиным как ключевой стимул к познавательной активности [5]. Противоречие между «ожидаемым» (теоретическим предположением) и «наблюдаемым» (результатом моделирования) побуждает студента к рефлексии и поиску логической ошибки, что является необходимым этапом глубокого усвоения материала.

2.2. Инструментальный генез и дидактические инварианты

Согласно теории П. Рабарделя, интеграция цифровых средств в сознание обучающегося проходит стадию «инструментального генеза» [4]. Артефакт (программное обеспечение) становится психологическим инструментом только тогда, когда субъект осознает границы его применимости. При проверке гипотез критически важным становится понимание разницы между «идеальным» математическим объектом и его дискретной цифровой аппроксимацией. Таким образом, цифровая среда выполняет не только иллюстративную, но и методологическую функцию, обучая студентов верификации данных и оценке погрешностей вычислений.

3. Практическая реализация.

3.1. Дифференциальное и интегральное исчисление.

3.1.1. Постановка проблемы и формирование гипотезы.

Центральной методологической задачей в рамках курса «Дифференциальное исчисление функции одной переменной» выступает детальное изучение локального поведения функции в бесконечно малой окрестности выбранной точки. На начальном этапе освоения материала у обучающихся зачастую формируется устойчивая, но упрощенная интуитивная гипотеза. Суть её заключается в убеждении, что любая непрерывная функция априори обладает свойством «визуальной гладкости». Студенты склонны полагать, что непрерывность линии на графике автоматически гарантирует возможность построения единственной касательной в любой произвольно взятой точке области определения.

3.1.2. Содержание и методика проверки в цифровой среде

Для верификации данного предположения организуется исследовательская работа в интерактивной среде динамической геометрии. Студентам предлагается выйти за рамки привычных гладких кривых (таких как парабола или синусоида) и проанализировать функции с особыми точками, например, функцию модуля $f(x) = |x|$ или более сложную осциллирующую функцию $f(x) = x \sin(1/x)$.

Основным инструментом исследования становится функция бесконечного масштабирования («zoom»). Обучающийся выбирает «критическую» точку (в данном случае — начало координат) и начинает многократно увеличивать масштаб графического изображения. Цель этого действия — найти так называемый «линейный участок», то есть такое состояние графика, при котором кривая под воздействием увеличения визуально выпрямляется и становится неотличимой от прямой линии (касательной).

3.1.3. Анализ полученных результатов и их научная интерпретация

В ходе выполнения этого цифрового эксперимента студенты фиксируют результаты, которые прямо указывают на несостоятельность их исходной интуитивной гипотезы.

В случае функции модуля $f(x) = |x|$ обнаруживается, что при любом, сколь угодно мощном увеличении, график сохраняет характерный «излом» (острый угол) в точке $x = 0$. Процесс масштабирования не приводит к визуальному выпрямлению линии, что наглядно доказывает отсутствие единственной касательной в данной точке.

При исследовании функции $f(x) = x \sin(1/x)$ ситуация усложняется: вместо выпрямления график демонстрирует незатухающие, бесконечно повторяющиеся осцилляции. Студент видит, что при приближении к нулю частота колебаний возрастает, и график «дребезжит», не позволяя зафиксировать определенное направление для касательной.

3.1.4. Итоговый вывод и преодоление формализма

Таким образом, практическое сопоставление визуальных данных с теоретическим определением производной позволяет студенту сделать глубокий аналитический вывод: этот визуальный и расчетный опыт подготавливает почву для введения строгого определения производной через пределы, демонстрируя, что непрерывность функции является лишь необходимым, но не достаточным условием её дифференцируемости [7]. Этот опыт превращает сухую формулировку учебника в осознанное знание, основанное на личном исследовательском опыте и критическом анализе увиденных феноменов.

3.2. Исследование сходимости рядов и интегралов.

Проверка гипотез о суммируемости бесконечных последовательностей — область, где цифровая эмпирика вступает в прямое противоречие с обыденным восприятием. Студенты склонны полагать, что если слагаемые ряда стремятся к нулю, то общая сумма обязательно будет конечной.

Метод проверки: Использование систем компьютерной алгебры (например, Maple или WolframAlpha) для вычисления частичных сумм гармонического ряда $\sum_{n=1}^N \frac{1}{n}$. Студент задает расчет для $N = 10^3, 10^6, 10^9$.

Наблюдение: Обнаруживается крайне медленный, но логарифмически неуклонный рост суммы, что опровергает первоначальное ожидание стабилизации.

Вывод: Полученные данные служат эмпирическим основанием для изучения интегрального признака Коши и деликатных условий сходимости [8].

3.3. Приближенные вычисления и предельные переходы.

Цифровые инструменты позволяют проверить гипотезу о точности численного дифференцирования. Студент предполагает, что уменьшение шага h в формуле $\frac{f(x+h)-f(x)}{h}$ всегда ведет к увеличению точности.

Эксперимент: С помощью скрипта на языке Python или табличного процессора вычисляется производная функции e^x при h , стремящемся от 10^{-1} до 10^{-20} .

Данные: Студент обнаруживает, что после определенного порога ($h \approx 10^{-16}$) происходит резкое увеличение ошибки аппроксимации, обусловленное спецификой машинной арифметики, т.е. ошибка начинает стремительно расти.

Анализ: Данное несоответствие теории и практики позволяет обсудить вопросы машинной точности и специфику представления вещественных чисел в памяти ЭВМ, что критически важно для современного инженера и математика.

4. Методический алгоритм предотвращения эффекта «черного ящика»

Для обеспечения высокого качества математического образования и предотвращения превращения программного обеспечения в «черный ящик» — ситуацию, при которой результат выдается системой без осознания студентом внутренних механизмов и логики процесса — необходимо строгое соблюдение исследовательского алгоритма. Данный путь трансформирует механическое использование цифровых инструментов в осознанную познавательную деятельность, где технология выступает катализатором мышления, а не его заменой.

Ниже представлено расширенное научное описание этапов данного алгоритма:

4.1. Априорное суждение: Формирование теоретического ожидания.

На первом этапе определяющую роль играет предварительный логический анализ. До непосредственного обращения к программной среде обучающийся обязан сформулировать четкое теоретическое предположение (гипотезу) в вербальной или символической форме.

- **Научная значимость:** Данный шаг исключает метод бессистемного перебора («угадывания») и заставляет студента опираться на уже имеющийся понятийный аппарат.
- **Процесс:** Формулировка априорного суждения (например, о сходимости ряда или дифференцируемости функции) создает ментальную модель, которую в дальнейшем предстоит верифицировать или фальсифицировать в ходе эксперимента.

4.2. Сценирование цифрового исследования: Проектирование условий верификации.

Второй этап предполагает осознанное конструирование условий цифрового испытания. Вместо стандартного применения алгоритмов студенту необходимо подобрать такие параметры и объекты, которые способны максимально эффективно протестировать выдвинутую гипотезу на устойчивость.

Научная значимость: Здесь проявляется исследовательская инициатива обучающегося. Он самостоятельно выбирает инструменты (масштабирование, изменение шага вычислений, варьирование числовых массивов), которые могут выступить в роли критических фильтров для его догадки.

Процесс: Подбор критических условий (например, исследование поведения функции в «точках излома» или анализ сумм при экстремально больших значениях N), где теоретическая модель сталкивается с вычислительной реальностью цифровой среды.

4.3. Интерпретация и гносеологическое сопоставление: Синтез теории и эмпирики.

Заключительный и наиболее значимый этап заключается в критическом анализе полученных результатов и их глубоком соотнесении с фундаментальными математическими теоремами.

Научная значимость: Согласно концепции И. В. Роберт, именно в момент интеллектуального сопоставления «наблюдаемого» (цифровой эмпирики) и «доказанного» (теоретического знания) происходит органичная интеграция информационных технологий в структуру математического знания обучающегося [6].

Процесс: Разрешение возникшего когнитивного конфликта приводит к тому, что цифровые данные (графики, численные массивы, визуальные модели) перестают быть просто иллюстрацией и становятся весомым аргументом в строгом аналитическом рассуждении.

Такой системный подход гарантирует, что цифровой инструмент выступает не как упрощение учебной задачи, а как мощное средство преодоления формализма в знаниях и развития интеллектуальной независимости будущего специалиста.

Для предотвращения превращения цифрового инструмента в «черный ящик» необходимо соблюдение следующего алгоритма:

1. **Априорное суждение:** Четкая вербальная или символическая формулировка гипотезы до начала компьютерного эксперимента.
2. **Сценирование эксперимента:** Выбор параметров моделирования, способных подтвердить или опровергнуть предположение.
3. **Интерпретация и сопоставление:** Критический анализ полученных результатов и их соотнесение с фундаментальными теоремами. Согласно И.В.Роберт, именно в этот момент происходит интеграция информационных технологий в структуру математического знания [6].

5. Заключение

Интеграция цифровых инструментов в образовательный процесс меняет саму природу изучения дисциплины, превращая математику из набора алгоритмов в междисциплинарное поле для активных изысканий. Организация учебной деятельности, основанная на проверке гипотез в интерактивных средах, дает студентам возможность выйти за рамки репродуктивного освоения материала. В ходе такой работы формируется критически важный навык соотнесения идеализированной теории с практическими результатами вычислений. Такое глубокое сопоставление аналитических методов и цифровых данных является мощным инструментом против формального заучивания предмета. Подобный подход не только укрепляет логическое мышление, но и стимулирует интеллектуальную автономность обучающихся, подготавливая их к решению нестандартных задач в профессиональной деятельности, где требуется умение проверять теорию реальными фактами.

Использованная литература

1. **Борвейн, Дж., Бейли, Д.** Математика в эксперименте: пути познания XXI века / Дж. Борвейн, Д. Бейли. — М.: Ижевск: РХД, 2012. — 416 с.
2. **Лакатос, И.** Доказательства и опровержения. Как доказываются теоремы / И. Лакатос. — М.: Наука, 1967. — 152 с.
3. **Ларин, С. В.** Компьютерная анимация в обучении математике / С. В. Ларин. — Красноярск: КГПУ, 2014. — 132 с.
4. **Рабардель, П.** Люди и технологии: когнитивный подход к анализу современных инструментов / П. Рабардель. — М.: Ин-т психологии РАН, 1999. — 264 с.
5. **Матюшкин, А. М.** Проблемные ситуации в мышлении и обучении / А. М. Матюшкин. — М.: Директ-Медиа, 2008. — 392 с.
6. **Роберт, И. В.** Теория и методика информатизации образования (психолого-педагогический и технологический аспекты) / И. В. Роберт. — М.: БИНОМ. Лаборатория знаний, 2014. — 398 с.
7. **Tall, D.** Visualizing Differentials in Calculus / D. Tall // Mathematics Teaching. — 1991. — № 137. — С. 29–39.
8. **Heid, M. K.** Reskilling Mathematics: The Theory and Practice of Using CAS / M. K. Heid // Journal for Research in Mathematics Education. — 1988. — Vol. 19. — № 1. — С. 3–25.
9. **Арнольд, В. И.** Математическое понимание природы / В. И. Арнольд. — М.: МЦНМО, 2011. — 144 с.

INTERACTIVE METHODS FOR IMPROVING LEARNERS' READING SKILLS AT THE ENGLISH LESSONS

Halima Mammadova Elmar

A teacher, Azerbaijan State Pedagogical University, Sheki branch

Abstract: Reading is an essential element in cultural transmission and language acquisition. This study integrates theoretical and practical insights into teaching reading in the English language, contrasting it with native language reading instruction. It evaluates major instructional methodologies and provides evidence-based recommendations for educators and learners. The objective is to enhance curriculum development, teacher training, and classroom practices for English language learners. Language serves as a cultural cornerstone, and engaging with written texts is often the initial step toward cultural understanding. Reading is fundamental to literacy, offering insights into varied cultures, expanding vocabulary, and broadening perspectives. With the growing interest in foreign language acquisition, educators are challenged to identify effective instructional strategies. Reading, a crucial component of language instruction, necessitates diverse approaches. Unlike native language reading, learning to read in a foreign language involves mastering new lexical and phonetic systems. This complexity demands the integration of multiple teaching methods to ensure effective learning.

Key words: reading, interactive methods, extensive reading, intensive reading

Introduction

Language serves as a foundational element in the construction of any culture. To gain insights into a different culture, engaging with the language through its words, sentences, and texts is essential. In essence, reading is a primary means of acquiring knowledge. The extent of one's reading directly correlates with the breadth of learning. Reading, a fundamental component of literacy, exposes individuals to diverse worlds, terminologies, and perspectives. Empirical studies indicate that extensive reading is associated with an expansive vocabulary.

The increasing interest in foreign language acquisition presents a critical challenge for methodologists to identify the most effective instructional approaches. Consequently, selecting appropriate methods for teaching reading is of paramount importance. Reading in English language instruction is integral to the broader process of foreign language education. Currently, a variety of methods exist for teaching reading; however, these methods are typically employed in conjunction, rather than in isolation, to enhance learning outcomes.

The processes of learning to read in one's native language versus a foreign language differ significantly. In native language acquisition, students have already mastered the lexical and phonetic systems. Conversely, reading in a foreign language requires learners to navigate an entirely new set of letters and sounds.

The importance of reading skill

Reading is the most popular type of speech activity in secondary schools. Reading skills that can be used in everyday life are developed faster and easier than speaking, writing and listening

skills. According to (Carr, 2010) reading and writing are unnatural acts, made possible by the purposeful development of the alphabet and many other technologies. Our minds have to be taught how to translate the symbolic characters we see into the language we understand. Reading and writing require schooling and practice, the deliberate shaping of the brain.

Reading in the history of mankind arose later than oral speech and on its basis and became an autonomous means of communication and cognition. Complex integrated ability to understand what is read does not mean simple decoding of information graphically recorded in the text, but implies active mental activity of a person, including imagination, emotions, existing experience and knowledge. The active role of the reader with his unique individuality contributes to the recreation of the meaning of what is read, determines the personal interpretation of the content. The idea of reading as a process of interaction between the text and the reader distinguishes the modern direction in the study of reading, the so-called interactive reading.

Reading has two sides. On the one hand, it is the perception of what is read, on the other hand, it is comprehension. Often, such errors in perception as comparing words which are similar in form, incorrect reading of words leads to distortion of meaning. In turn, incorrect understanding of meaning leads to false guessing of the word form. According to Tufts University developmental psychologist (Wolf, 2007) in her book on the neuroscience of reading, Proust and the Squid, although all reading makes use of some portions of the frontal and temporal lobes for planning and for analysing sounds and meanings in words, logographic systems appear to activate very distinctive parts of those areas, particularly regions involved in motoric memory skills. Differences in brain activity have even been documented among readers of different alphabetic languages. Readers of English, for instance, have been found to draw more heavily on areas of the brain associated with deciphering visual shapes than do readers of Italian. The difference stems, it's believed, from the fact that English words often look very different from the way they sound, whereas in Italian words tend to be spelled exactly as they are spoken.

The reading process involves analysis, synthesis, generalization, inference and forecasting. The following analysers are involved in reading: the main one is visual; the auxiliary ones are speech motor and auditory.

A child begins reading in his native language after he has developed the skills and abilities of oral speech, and reading thus turns into a process of recognizing in graphics the linguistic material already known from oral speech. It is important to emphasize the following: the ability to read is formed once. A child who has seamlessly synthesized letters and syllables and learned the meaning of the resulting word has forever overcome the reading barrier, since he has made a discovery of how to read. Everything that happens later is an improvement of this initial skill due to the inclusion of specific skills related to both the perception of the graphic side of texts and their understanding.

Reading, like listening, is a receptive, reactive and, in its form of flow, unexpressed internal type of speech activity. Reading can also be a partially external, expressed type of speech activity, for example, reading aloud, as if for others. Therefore, much of what is said about listening also applies to reading. But even the same mechanisms as perception, internal pronunciation, mechanisms of operational and long-term memory, forecasting, comprehension work in a specific way in reading, since they rely on visual, and not on auditory perception of speech.

Interactive methods for improving reading skills

There are different approaches to determining when and how to begin teaching reading at the initial stage. The concept of "reading technique" includes, firstly, students' mastery of letter-sound relationships; secondly, the ability to combine perceived material into semantic groups, i.e.

syntagmas, and to correctly formulate them intonationally. If it is not formed sufficiently, if this skill is not automated, then all these technologies or types of reading will be at risk.

There are two opposite, complementary approaches to teaching foreign language reading: “bottom-up” and “top-down”. The reader gets a general view of the reading passage, absorbing the overall picture while top-down approach. This is useful if the readers have schemata which allow them to have appropriate expectation of what they are going to come across. On the other hand, in bottom-up processing the reader focuses on individual patterns and achieves understanding by stringing these detailed elements together to build up a whole (Harmer, 2001).

Reading is carried out in different ways, depending on what we want to ‘do with the text’. Intensive reading usually involves focusing on linguistic and content accuracy. It has to do with drawing our attention to the different aspects of the lexical, syntactic and discourse systems with the objective of gaining a full understanding of the literal meaning presented in the written passage. Texts used for intensive reading are usually short and they are studied in depth.

Extensive reading is oriented towards grasping a general understanding of the text for the purpose of enjoyment or learning. This activity is frequently carried out in silence. Texts used for extensive reading are usually long texts such as books or articles; reading them takes extended periods of time. Teaching extensive reading implies encouraging a reading habit and reading for pleasure. According to (Davis, 1995) any classroom will be poorer for the lack of an extensive reading programme, and will be “unable to promote its pupils’ language development in all aspects as effectively as if such a programme were present”. Such a programme will make students more positive about reading, improve their overall comprehension skills, and give them a wider passive and active vocabulary.

At the heart of any speech skill are certain skills – actions that a person performs automatically, without thinking about how and what he is doing. Speech reading skills include mastering various technologies for extracting information from text, their adequate use depending on the task at hand. At the heart of these skills is reading technique. Since skills are primary and abilities are secondary, it is clear that at the initial stage of learning to read it is necessary to develop reading technique. Reading for gist or skimming means running one’s eyes over a text to get general comprehension. This is not easy options but quick way to get general top-down view of what is going on. Reading for specific information, on the contrary, is looking for specific detail ignoring others. When reading for detailed information a reader is concentrated on everything that is written.

The teacher's tasks in developing reading technique are to:

- bypass the intermediate stage of pronunciation as quickly as possible and establish a direct correspondence between the graphic image of a speech unit and its meaning;
- consistently increase the unit, i.e. the word, syntagma or paragraph of the perceived text and bring it to at least a syntagma by the end of the first year of study;
- Develop normative reading with observance of an acceptable tempo, stress norms, pauses and intonation.

When reading, a person not only sees the text, but also pronounces it to oneself and at the same time, as it were, hears the reflection from the outside. It is thanks to the mechanism of internal pronunciation that a comparison of graphic and auditory-motor images occurs. The action of this mechanism is most clearly observed in novice readers, the so-called whispered reading. Gradually, with the accumulation of experience, internal pronunciation acquires a more condensed character and finally disappears completely. An important psychological component of the reading process is the mechanism of probabilistic forecasting, which manifests itself at the semantic and verbal levels. Semantic forecasting is the ability to predict the content of the text and make the correct assumption about the further development of events based on the title, the

first sentence and other text signals. Verbal forecasting is the ability to guess a word based on the initial letters, guess the syntactic structure of a sentence based on the first words, and guess the further structure of a paragraph based on the first sentence. According to (Tribble, 1997) readers recognize a rejection letter or a job offering letter within the first couple of lines.

The methodology distinguishes two forms of reading: silently, i.e. internal reading, and aloud, i.e. external reading. Silent reading is the main form of reading; it aims to extract information, it is “monologue”, and is done alone. Reading aloud is a secondary form; it is “dialogue”, and its purpose is mainly to convey information to another person. Depending on the stage of learning, the individual characteristics of the students, and the actual learning conditions, the percentage of reading aloud and silently in class and at home may change. According to (Brown, 2001) Reading aloud is useful in the first years of Primary, to check bottom-up processing skills or simply pronunciation. Unfortunately, it tends to be boring for children, not very authentic and not very interactive. At the initial stage, reading aloud is preferable to silent reading. Reading aloud ensures not only consistent skill development, but also a sufficient degree of self and mutual control.

The initial stage of training plays the role of a foundation in the formation of the communicative core and is simultaneously a preparatory stage, during which students acquire a set of fundamental reading skills and abilities. Based on known sounds, students master the drawing of letters, the technique of reading aloud and silently with a full understanding of the text, containing 2-4% of unfamiliar words. By the end of this stage, reading acquires a relatively independent meaning as a method of foreign language communication.

The middle stage of learning is characterized by reading with a full understanding of the main content, which involves the use of all reading skills in a complex: the ability to achieve understanding, overcoming interference in all available ways, as well as the ability to achieve ignoring interference, extracting from the text only essential information, the ability to read silently texts presented for the first time with the purpose of fully understanding the information, with the purpose of extracting basic information and partial information.

At the senior stage, the skills and abilities acquired earlier are improved. Reading at this stage is aimed at teaching reading with full and precise understanding. Teaching this reading skill is discussed by practical necessity: a high school graduate must understand original and slightly adapted texts from socio-political and popular science literature that he may encounter in his professional activities, in further language studies or for self-education purposes. There are such parameters for assessing reading technique as reading speed, compliance with semantic and logical norms, compliance with pause norms, and use of correct intonation patterns and understanding of the text read.

The formation of reading aloud technique to strengthen grapheme-phoneme connections is facilitated by such exercises as naming letters, finding given letters in the alphabet, naming letters in a specific word, identifying letters and sounds in a word, grouping words by a specific sound, letter and description - recording - reading words in accordance with certain features

The formation of reading aloud technique to correlate form with meaning is facilitated by such exercises as finding cognate words, finding adjectives in a comparative degree in a row of words, and finding verbs in the past tense, etc.

The formation of reading aloud technique to develop linguistic guesswork is facilitated by such exercises as finding internationalism words, translating words by their structure.

The formation of the technique of reading aloud to develop probabilistic forecasting is facilitated by restoring words in parts, choosing a noun for these adjectives and filling in gaps with articles, prepositions, etc.

The formation of the technique of reading aloud to group words into a semantic whole is facilitated by reading by syntagmas, being in a series of phrases denoting time, place to practice intonation, reading after the speaker, expressive reading and reading with intonation markings.

The following exercises can be used to develop reading technique at the initial stage:

- reading aloud proverbs, sayings, tongue twisters, poems, short dialogues learned by heart;
- filling in the gaps with missing letters;
- finding a word in each row that contains the specified sound;
- combining words of the text into thematic groups;
- finding synonyms or antonyms in the text and recording them in writing;
- filling in gaps in a sentence or text with words that fit the meaning;
- selecting equivalents in the native language for words in a foreign language;
- reading the text at a set time;
- repeating the text after the teacher sentence by sentence;
- finding a sentence in the text that contains the answer to the teacher's question;
- supplementing the specified sentences, etc.;

In short, reading begins with reading longer plot texts. In addition to the formation of reading techniques at the initial stage, various reading technologies, compensatory skills, and independent work skills are already beginning to form. At this stage, it is already possible to teach ignoring the unknown, if it does not interfere with the completion of the assigned task, working with a dictionary, using footnotes and comments offered in the text, as well as interpreting and transforming the text.

There are three stages of work on the text:

1. Pre-text – awakening and stimulating motivation to work with the text; actualization of students' personal experience by drawing on knowledge from other educational areas of school subjects; forecasting the content of the text based on students' knowledge, their life experience, headings and pictures, etc. Here it is necessary to follow one important rule: all preliminary work on the text should not concern its content, otherwise schoolchildren will not be interested in reading it, since they will not find anything new for themselves in this text.

The following exercises of student centred activities which may help teachers introduce and identify the topic of reading and activate previous knowledge:

- Identify the topic of the text with some pre-questions and/or with the help of visual aids.
- Explore key vocabulary that will come up in the text.
- Anticipate and predict possible information through brainstorming or true-false activities.
- Check previous assumptions with group discussions.

2. Textual – reading of the text of its individual parts with the purpose of solving a specific communicative task formulated in the assignment to the text and set by the student before reading the text itself. The object of reading control should be its comprehension. At the same time, control of comprehension of the read text should be connected both with the communicative tasks set before the students and with the type of reading.

The following exercises guide the reader through the text:

- General comprehension questions,
- True/false activities,
- Give-the-right-order activities,
- Fill-in-the-blank activities,
- Multiple choice activities,
- Problem solving activities,
- Information transfer activities i.e. maps, diagrams, drawings, tables, etc.

3. Post-text – using the content of the text to develop students' skills in expressing their thoughts in oral and written speech.

Examples of possible post-reading activities are: summaries and other types of writing tasks, discussions, role-plays and other oral interaction activities...

Educational materials are also of particular importance when teaching reading, since their nature determines whether reading will proceed as a student's speech activity or as an exercise.

1. The educational value of texts, their moral potential – to what extent do texts contribute to the education of students in the broad sense of the word and the formation of moral and ethical standards.

2. The cognitive value of texts and the scientific nature of their content. Texts should include factual material about the country and people whose language is being studied, as well as information from a wide variety of areas of human knowledge, such as popular science texts.

3. The content of texts should correspond to the age and interests of students. The content of texts should be significant in the eyes of students of a particular age group, should correspond to the level of their intellectual development and meet their cognitive and emotional interests.

4. Correctness of the ratio of the new and the known. According to (Cook, 1989) in order to make sense of any text we need to have "pre-existent knowledge of the world". Such knowledge is referred to as schema. We carry in our heads mental representation of typical situations that we come across. Such schematic knowledge is activated when we are stimulated by particular words, expressions or contexts.

It is known from psychology that one of the conditions for attracting attention to an object is such a degree of its novelty, at which, along with new elements, there are also elements that are somewhat familiar to students. The presence of known information in reading texts significantly facilitates its perception and understanding by students. In methodological literature, texts are recommended that specify and expand on information already known to students.

5. Degree of accessibility of texts. An interesting text that contains insurmountable difficulties loses all its appeal in the eyes of students. At the initial stage and especially in the first year of studying a foreign language, it is advisable to teach reading using lexical and grammatical material previously learned orally. This allows you to remove difficulties associated with understanding what is being read and pay more attention to the technique and expressiveness of reading. Gradually, texts may also contain unfamiliar words, the meaning of which can be guessed or which are given in footnotes. Texts which are accessible in terms of language help to create and maintain motivation for reading. According to (Day, R and Bamford, J 1998) specially written materials for extensive reading what are called "language learner literature" are often referred to as "simplified readers". Such materials can take form of original fiction and non-fiction books as well as simplifications of established works of literature. Such books succeed because the writers or adaptors work within specific lists of allowed words and grammar. That is why students at the appropriate level can read them with comfort and self-confidence. At their best, such books despite the language limitations, can speak to the reader through the creation of atmosphere and compelling plot lines. According to (Carter, 1998) the language may be simplified, but it must not be unnatural. As he and his colleagues suggest "concocted, made-up language can be perfectly viable but it should be modelled on naturalistic samples." On the other hand, according to (Farrell, 1998) authentic material can be used by students at fairly low levels, however, if the tasks that go with it are well designed and help students understand it better, rather than showing them how little they know.

6. Systematic increase in the volume of text. According to (Wallace, 1992) texts with longer words and sentences will be more difficult to understand than those with shorter ones. But on the

other hand, according to (Paran, 1996) to be successful students have to recognize a high proportion of the vocabulary without consciously thinking about it.

Educational texts can be of different lengths: from one word to several dozen pages in a home-reading book. Both are important and should be included in the educational process. Short texts convey specific, sometimes extremely important information. Therefore, students should be taught to read correctly and extract the necessary information from such texts. However, it is impossible to limit oneself to teaching reading only short texts due to the following circumstances. Firstly, motivation, as is known, is directly dependent on the awareness of the success of the activity performed. Students should feel their progress, which consists not only in their understanding of increasingly complex texts, but also in the desire to read large texts. Secondly, it is possible to develop a complex reading skill, including all the specific skills that ensure it, only on expanded texts.

An important issue is the suitability of the text for a particular type of reading. The decisive factors in this case are, firstly, the ratio of primary and secondary information and, secondly, the location of new words and their meanings.

Conclusion

Reading is one of the four types of speech activity that involves understanding and evaluating information contained in a text. Reading in English is crucial for learning English, as it helps expand vocabulary, strengthen grammar skills, and improve spelling by introducing new words and constructions to context. This skill also contributes to the development of writing and critical thinking skills, enabling learners to analyse information and better understand the structure of language.

When reading, learners encounter new words and phrases in a natural context, which helps them better understand and remember their meaning and correct usage. Reading texts with correct grammar helps to intuitively grasp grammar rules without having to memorize complex theories. Constantly interacting with texts helps to memorize the correct spelling of words and phrases, improving your spelling.

Reading good texts serves as a model for constructing logical and grammatically correct sentences, which helps learners write their own texts. Reading trains comprehension skills, which are important for extracting main ideas, finding details, and analysing information. Reading aloud improves pronunciation, intonation, and fluency. In addition, discussing what have been read or completing tasks based on the text develops oral communication skills.

Effective foreign language reading instruction for professional learners requires an integrated approach: systematic support for decoding and vocabulary, abundant meaningful reading opportunities, explicit strategy instruction, and careful alignment to workplace genres. Teachers should design curricula that combine extensive reading with targeted lessons and on-going assessment to promote both comprehension and real world reading competence.

Carefully chosen methods and strategies, beside their associated techniques, enable educators to effectively and efficiently teach reading skills to students.

References

1. Brown, H. D. Teaching by Principles: An Interactive Approach to Language Pedagogy. Englewood Cliffs, New Jersey: Prentice Hall Regents. 2001.
2. Carter, R. 1998. Orders of Reality: CANCODE, communication, and culture. *ELT Journal* 51/1
3. Cook, G. 1989. *Discourse*. Oxford University Press.
4. Davis, C. 1995. Extensive reading: an expensive extravagance? *ELT Journal* 49/4
5. Day, R. and Bamford, J. 1998. *Extensive Reading in the Second Language Classroom*. Cambridge University Press.
6. Farrell, T. 1998. Using TV “soaps” for listening comprehension. *Modern English Teacher* 7/2
7. Harmer, J. 2001. *The practice of English language teaching*. 3rd edition. London. Longman.
8. Nicholas Carr, *The Shallows: How the Internet is changing the way we think, read and remember*, Atlantic Books, 2010.
9. Paran, A. 1996. Reading in EFL: facts and fictions. *ELT journal* 50/1.
10. Tribble, C. 1997. *Writing*. Oxford University Press.
11. Wallace, C. 1992. *Reading*. Oxford University Press.
12. Wolf, Maryanne. *Proust and the Squid: The Story and Science of the Reading Brain*. Harper, 2007.

PEDAGOGICAL POTENTIAL OF 3D MODELING FOR DEVELOPING VISUAL LITERACY IN ART EDUCATION

Yesmagambetova L.O.

Master's student, Artistic work, graphics and design, Kazakh National Women's Teacher Training University, Almaty, Kazakhstan

Krykbayeva S.M.

Candidate of Arts Study, Leader of educational programm, Kazakh National Women's Teacher Training University, Almaty, Kazakhstan

Abstract

This study explores the pedagogical potential of 3D modeling for developing visual literacy in art education, addressing the growing need for digital competencies in contemporary learning environments. Using a systematic and bibliometric review methodology based on PRISMA 2020 guidelines, the research analyzes 13 Scopus-indexed studies published between 2015 and 2025. The findings reveal a significant increase in scholarly interest in 3D modeling, particularly after 2020, reflecting global technological advancements and the expansion of digital instructional practices. The results demonstrate that 3D modeling enhances key components of visual literacy, including spatial reasoning, visual interpretation, structural analysis, and creative thinking. Keyword co-occurrence analysis shows that research in this field is structured around four major thematic clusters: pedagogy and digital learning, artistic and creative applications, e-learning and virtual reality, and creativity-centered approaches. Despite its strong potential, the integration of 3D technologies faces challenges such as limited technical infrastructure, insufficient instructor preparedness, and a lack of methodological frameworks. The study contributes to the theoretical and practical understanding of 3D modeling as a transformative tool in art education and highlights future directions for instructional design, empirical research, and digital literacy development.

Keywords: 3D modeling; visual literacy; art education; digital pedagogy; computer graphics; spatial thinking; virtual reality; creativity; bibliometric analysis.

Introduction

Research relevance. In an era of rapidly evolving technologies, the field of art education is undergoing profound transformations and entering a period of fundamental change. In recent years, 3D modeling has emerged not only as a visualization tool but also as a key direction that is reshaping instructional approaches in visual arts, design, and architecture. Integrating three-dimensional modeling technologies into the educational process significantly contributes to the development of spatial thinking skills. It enables learners to understand the form, structure, proportions, and spatial relations of objects at a fundamentally new level. All of these aspects promote the development of visual literacy an essential competency in the current era of globalization (Lee & Chen, 2024). Visual literacy refers to the ability to understand, construct, and interpret visual representations, as well as to critically evaluate visual messages within the media environment. In the field of art education, this concept is of particular importance because it fosters not only aesthetic perception but also analytical, logical, and creative thinking (Bamford, 2022). Traditional art education methods such as drawing and painting no longer fully meet the visual communication needs of contemporary learners living in a digital environment. This gives

rise to a new challenge: introducing 3D modeling into the learning process as an important pedagogical tool that combines creative thinking with technical literacy. In art education, 3D modeling enhances students' spatial imagination, accuracy of visual visualization, ability to analyze objects from different perspectives, and understanding of the interrelation between form and composition (Rodriguez, 2023). Additionally, during practical classes, it develops students' research skills and allows them to experiment with materials, forms, and object textures. As a result, learners become more engaged, and the learning process becomes interactive and closer to professional practice. However, despite the advantages of 3D modeling in art education, several challenges persist. These include the lack of adequate technical infrastructure in educational institutions, insufficient digital competency among instructors, and the absence of systematic methodological resources for integrating 3D modeling into the curriculum. In some cases, students perceive three-dimensional modeling purely as a technical activity, failing to grasp its artistic significance. Therefore, there is a need to develop methodological frameworks that promote conscious and purposeful use of 3D technologies.

The purpose of this study is to theoretically substantiate the pedagogical potential of 3D modeling technologies in art education and to identify ways to enhance learners' visual literacy. The study aims to:

1. Conceptualize the structure and components of visual literacy based on theories of art education and digital literacy;
2. Explore the pedagogical and methodological potential of 3D modeling in developing visual literacy;
3. Develop and pilot a model for integrating 3D modeling into the art education process;
4. Assess the effectiveness of 3D modeling and determine the level of visual culture formation based on a pedagogical experiment and result analysis.

Research question: How does the use of 3D modeling technologies in the art education process contribute to the development of learners' visual literacy?

Theoretical and Methodological Framework. The study examines the development of visual literacy through the application of 3D modeling technologies in art education, emphasizing the importance of innovative methods and digital tools in modern educational systems. The research is grounded in the principles of digital pedagogy, which highlight the active role of learners in constructing new knowledge and understanding through personal experience. Rather than simply receiving ready-made information, learners explore artistic objects independently through 3D modeling, mastering texture, form, tone, and spatial relations through experiential learning. This approach significantly enhances visual thinking and creative abilities. Methodologically, the study employs systematic and bibliometric review techniques. Articles indexed in Scopus were selected using PRISMA guidelines based on relevant keywords. The collected data were categorized, visualized, and analyzed using Bibliometrix and VOSviewer software.

Research Significance. This study is significant in its focus on enhancing learners' visual literacy through the integration of 3D modeling in art education. By combining the principles of digital pedagogy and constructivism, the findings contribute to the development of students' creative and spatial thinking skills. Furthermore, the study supports the modernization of art education through contemporary digital technologies and offers practical insights for improving teaching effectiveness.

Literature Review

Although the concept of visual literacy first entered educational theory in the 1960s, its meaning has evolved significantly with the development of digital technologies. Bamford (2022) defines visual literacy as «the ability to understand, analyze, and create new visual content». This competency has become essential not only in the arts but also in fields such as engineering, design,

media, and communication. 3D modeling directly contributes to several core components of visual literacy, including:

- spatial thinking,
- visual interpretation,
- structural analysis of objects,
- recognition of visual codes and symbols,
- creative visual thinking.

According to Rodriguez (2023), working with 3D objects strengthens the «see–construct–explain» cognitive cycle among children and university students. That is, learners do not merely observe an object; they reconstruct its structure in a digital environment, thereby deepening their understanding of visual information. The development of visual literacy depends not only on technical skills but also on aesthetic perception and creative thinking. Benham, Burroughs, and Osland (2024) demonstrate that working with computer graphics significantly enhances visual culture and helps learners develop a new artistic language. Over the last decade, 3D modeling technologies have become widely integrated into educational systems around the world. Scholars have extensively examined the positive impact of these technologies on students' innovative thinking, creative decision-making, and understanding of complex visual systems (Chemerys, 2020). Their studies highlight the role of 3D modeling as a key tool in developing professional competencies among design students. Three-dimensional environments enable learners to analyze form, compare compositional solutions, and conduct visual experiments. 3D modeling is particularly important within the STEM + ART → STEAM framework. According to Ford and Minshall (2018), integrating 3D modeling into STEM and art classes is an effective way to foster creativity and engineering thinking. Priavolou and Pantazis (2017) describe 3D modeling as a new form of educational communication, emphasizing that the collaborative creation of digital objects strengthens students' roles within the group and develops skills such as self-assessment and critical thinking. In recent years, art education has been increasingly enriched by project-based learning, interdisciplinary approaches, and peer learning methods. Otto and Mandorli (2015) argue that 3D modeling allows students to combine theoretical knowledge with practical skills through the creation of real products.

The interdisciplinary approach connects art with informatics, engineering graphics, architecture, and media technologies. Knochel (2021) terms this model «multimodal inquiry» and shows that 3D modeling becomes a core component of creative research in mobile makerspace environments. Peer learning has also demonstrated high effectiveness in 3D modeling courses. Gladovic et al. (2024) emphasize that qualitative self-assessment and group discussions improve the quality of visual projects. By analyzing each other's models, students gain a deeper understanding of visual articulation and aesthetic choices. Beyond artistic expression, 3D modeling strengthens several cognitive functions, including:

- spatial visualization,
- mental rotation,
- visual memory,
- constructive reasoning.

Suzuki (2014) shows that computer graphics courses significantly enhance students' spatial transformation skills, which are relevant not only in art but also in engineering, robotics, and medicine. Yoon (2010) finds that working in virtual and 3D environments expands students' creative freedom, enabling them to think beyond the constraints of the physical world. However, several challenges have been identified in the integration of 3D modeling into art education systems:

- insufficient technical infrastructure and equipment (Irwin et al., 2014; Lazarakou, 2024),
- low digital skills among instructors (Schmidt, 2021),

- lack of methodological resources (Svobodova, Benesova & Cernochova, 2016),
- students' tendency to perceive 3D modeling as a purely technical skill (Patera, 2009).

To address these issues, researchers recommend implementing blended learning, flipped classroom approaches, and workshop-based instructional models.

Methods

A systematic review methodology was adopted, following the PRISMA 2020 guidelines. The step-by-step selection procedure is illustrated in Figure 1, which presents the flow diagram detailing identification, screening, eligibility assessment, and final inclusion of studies. The database search was carried out in Scopus, using a structured Boolean query to ensure the precision and completeness of the results. The final search string was:

TITLE-ABS-KEY ("3D graphics" "modeling") AND PUBYEAR > 2014 AND PUBYEAR < 2026 AND (LIMIT-TO (LANGUAGE , "English")) AND (LIMIT-TO (SUBJAREA , "SOC") OR LIMIT-TO (SUBJAREA , "ARTS") OR LIMIT-TO (SUBJAREA , "COMP")) AND (LIMIT-TO (EXACTKEYWORD , "3d Modeling") OR LIMIT-TO (EXACTKEYWORD , "3d Graphics") OR LIMIT-TO (EXACTKEYWORD , "Virtual Reality"))

This query made it possible to focus on English-language research published between 2015 and 2025, specifically within the subject areas of Social Sciences, Arts, and Computer Science, and indexed under keywords directly related to 3D technologies. The initial search produced 119 records, and at the identification stage automated tools flagged 3 records as ineligible, while no duplicate entries were detected; therefore, 116 records proceeded to the screening stage. During screening, titles and abstracts were reviewed for thematic relevance, and as shown in Figure 1, a total of 13 records were excluded for not meeting the initial criteria, leaving 103 records sought for full-text retrieval. However, the full texts of 52 studies were not accessible, which reduced the set to 51 records eligible for content analysis.

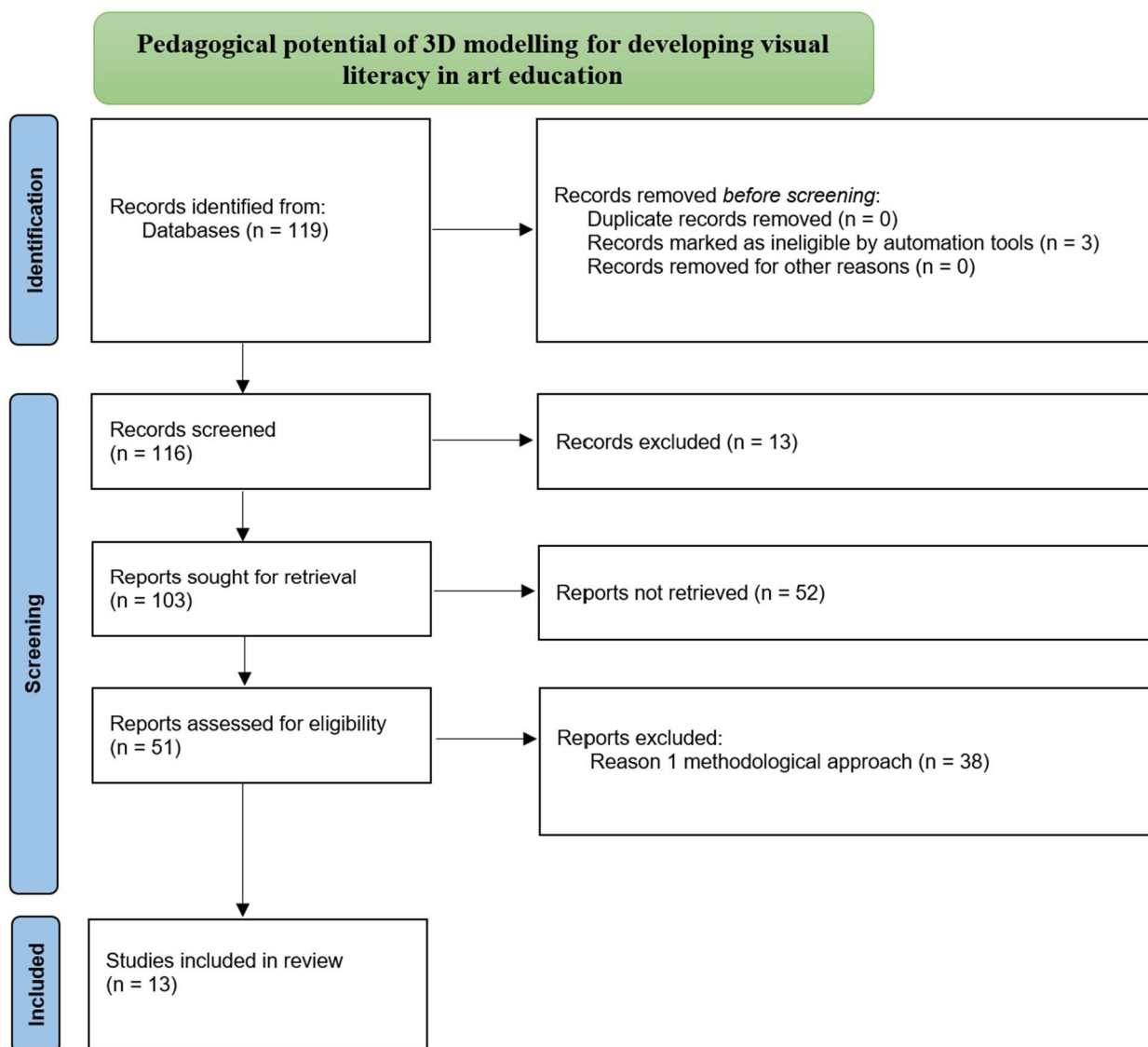


Figure 1. - PRISMA diagram for identifying studies on 3d modelling and visual literacy in art education

At the eligibility stage, all 51 studies were examined in detail, resulting in the exclusion of 29 studies that did not align with the topic of 3D modelling in art education, 5 studies that lacked relevance to artificial intelligence or academic writing, and 4 studies that fell outside the specified publication timeframe; in total, 38 studies were excluded. Ultimately, 13 studies fully met the inclusion criteria and were incorporated into the final systematic synthesis. These selected studies constitute the empirical and theoretical foundation for assessing the pedagogical potential of 3D modelling in developing visual literacy, and the complete flow of identification, screening, and eligibility assessment procedures is presented in Figure 1.

Results

In accordance with the topic *“Enhancing Visual Literacy Through 3D Modelling in Art Education,”* the analysis provides a quantitative overview of publication activity over the past decade. The dynamics of publications and citations reveal several distinct developmental phases. During the initial phase (2015–2021), the overall activity in this field remained very low. As illustrated in Figure 2, only 2 to 4 publications appeared annually, indicating that the field had not yet fully emerged as an independent research direction. This trend suggests that scholarly interest in the pedagogical application of 3D modelling and its role in visual literacy development was still

forming during this period. A noticeable shift occurred in the rapid growth phase (2020–2025). The increasing availability and accessibility of 3D modelling tools led to a significant rise in research output. Beginning in 2020, both publication counts and citation rates grew sharply, demonstrating heightened global interest in integrating 3D technologies into art and design education. This surge reflects broader technological trends as well as the expansion of digital practices in educational settings. The stabilisation phase (from 2025 onward) shows a marked increase compared to earlier periods, indicating that 3D modelling has become a well-established research topic. During this stage, the field matured into a wide-ranging thematic area with strong academic positioning. Studies began to focus not only on the technical aspects of 3D modelling but also on its methodological, pedagogical, and cognitive dimensions, highlighting its importance as a powerful instructional tool. The findings demonstrate that over the past 15 years, 3D modelling has evolved from a marginal topic into a rapidly expanding and influential domain within art education. While earlier research was limited, recent years show a clear upward trajectory, confirming the growing relevance of 3D modelling in contemporary educational and creative practices.

Geographical analysis of publications and transition to conceptual trends. The geographical distribution of publications demonstrates that research on the pedagogical use of 3D modelling in art education is developing unevenly across regions but shows clear patterns of global expansion. The most active contributors are China (4 publications) and the United States (4 publications), which lead due to their strong digital infrastructure, established technological innovation ecosystems, and long-standing integration of computer graphics into educational frameworks. Their significant output also reflects national strategies aimed at advancing STEAM education and strengthening connections between art, technology, and engineering. The Russian Federation (2 publications) represents a growing research segment, reflecting an increasing emphasis on digital literacy and the adoption of 3D technologies in both art and engineering education, driven by curricular modernization and interdisciplinary collaboration. A wide group of countries including Australia, Brazil, Colombia, Ethiopia, Germany, Grenada, India, Malaysia, Nigeria, Thailand, and Turkey contributed one publication each, signaling early but promising stages of engagement with 3D modelling in pedagogical contexts. These isolated contributions often emerge from universities experimenting with digital tools, pilot projects, or national initiatives to integrate technology into creative disciplines. Although individually modest, these publications collectively indicate the global relevance of the topic and reveal how diverse educational systems explore 3D technologies for visual literacy development. The presence of countries from multiple continents Asia, Africa, Europe, and Latin America highlights the universal applicability of 3D modelling as both an educational and professional skill. This international distribution suggests that the field is transitioning from localized experimentation toward broader, globally coordinated research interests, where shared technological challenges and pedagogical goals create opportunities for future collaboration and comparative studies.

As the geographic patterns confirm the worldwide spread of 3D modelling practices, a deeper understanding of the thematic and conceptual connections within this research area becomes essential. These conceptual relationships are visualized in Figure 2, which presents the keyword co-occurrence map and highlights the core clusters shaping the scientific landscape of 3D modelling in art education. The keyword co-occurrence map (Figure 2) illustrates the main conceptual clusters shaping the research landscape on 3D modelling in art education. The visual structure demonstrates how different thematic areas intersect, indicating interdisciplinary connections and emerging research priorities.

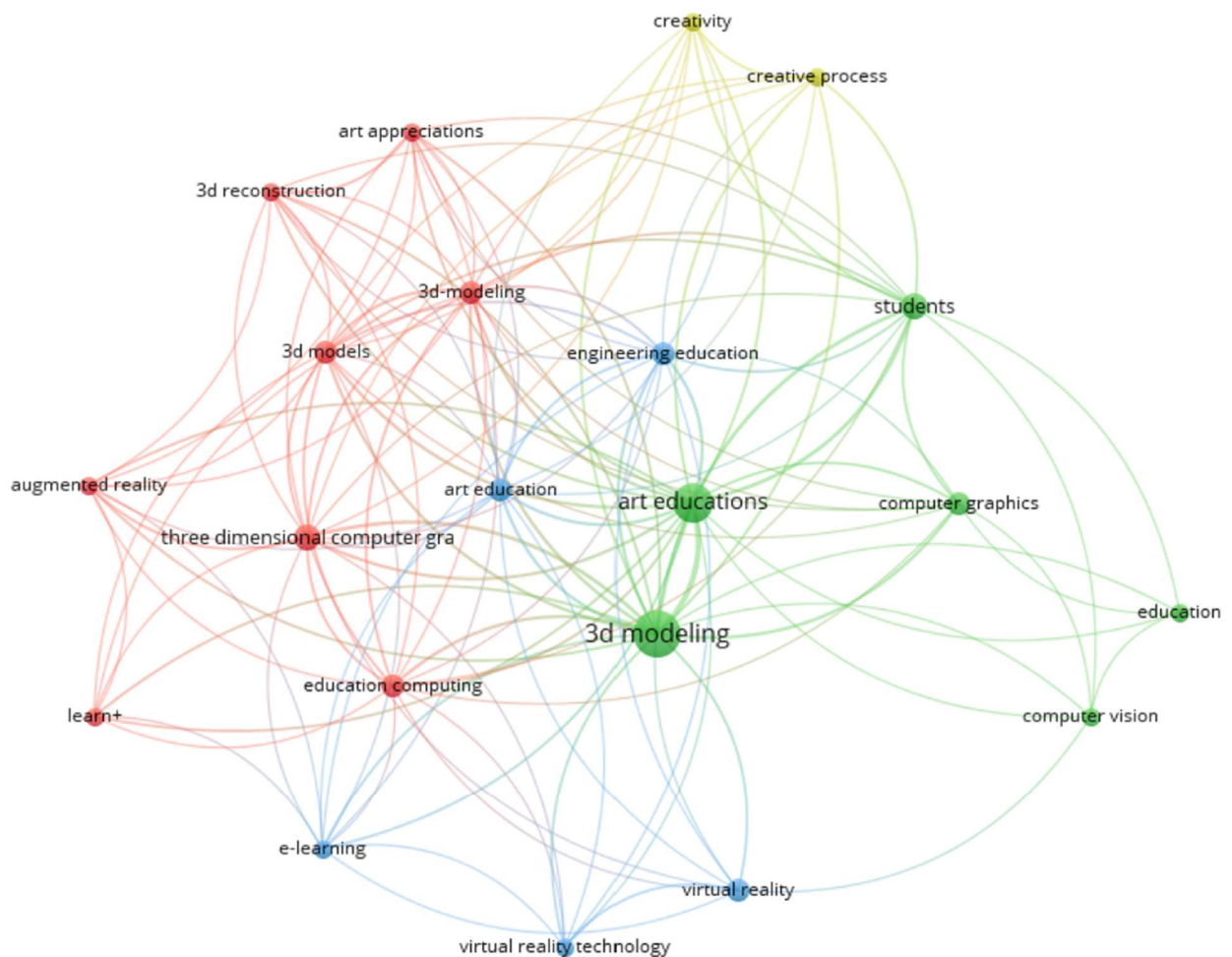


Figure 2. - Keyword co-occurrence network of studies on 3D modelling in art education

The keyword co-occurrence analysis reveals several interconnected thematic clusters that collectively define the research landscape on 3D modelling in art education. The largest, green cluster centers around terms such as “students,” “art education,” “computer graphics,” “education,” and “computer vision,” reflecting a strong pedagogical orientation and demonstrating how 3D modelling is embedded within instructional practices, digital learning environments, and the development of students’ visual and spatial skills. The red cluster encompasses keywords like “3D models,” “3D reconstruction,” “augmented reality,” “three-dimensional computer graphics,” and “art appreciation,” highlighting the artistic and creative applications of 3D technologies, including digital reconstruction, the use of augmented reality in visual arts, and the expansion of expressive and aesthetic possibilities. The blue cluster, associated with terms such as “e-learning,” “virtual reality,” “virtual reality technology,” and “education computing,” points to the growing relevance of immersive and remote learning environments, where VR tools support spatial conceptualization, digital platforms enable independent creative exploration, and e-learning systems broaden access to 3D modelling education. The yellow cluster, focused on “creativity” and “creative process,” shows that 3D modelling is increasingly studied as a catalyst for idea generation, innovative thinking, and problem-solving, with its close link to the pedagogical cluster underscoring creativity as a key educational outcome. At the center of the entire network lies the term “3D modeling,” serving as the primary integrative node that connects all clusters. Its central position confirms that 3D modelling bridges pedagogy, technology, and artistic practice, establishing the field as inherently interdisciplinary and characterized by research trends that consistently integrate creative, technological, and cognitive dimensions.

Discussion

The findings of this systematic and bibliometric review demonstrate that 3D modeling has become an increasingly influential tool in the development of visual literacy within art education. The identified publication trends, geographical distribution, and keyword clusters converge to reveal several important insights regarding the pedagogical role of 3D technologies. First, the steady growth of publications particularly after 2020 indicates that the integration of 3D modeling into art education is no longer an experimental or peripheral practice but a rapidly expanding research domain supported by technological advancements and the digital transformation of education. This pattern aligns with broader global shifts described in previous studies, which argue that digital tools reshape both artistic production and educational methods (Knochel, 2021; Rodriguez, 2023). The rising number of citations further reinforces the growing academic interest in the pedagogical benefits of 3D modeling.

Second, the geographical analysis reflects an uneven yet global adoption pattern. The dominance of China and the United States corresponds with their strong technological ecosystems and advanced digital education policies. Meanwhile, contributions from emerging countries demonstrate that 3D technologies are gaining traction in diverse educational contexts. This aligns with the argument of Ford and Minshall (2018), who emphasize that 3D technologies serve as a bridge between artistic education and engineering-driven innovation across different national systems. Third, the conceptual structure revealed by the keyword co-occurrence analysis highlights the multifaceted nature of 3D modeling in education. The pedagogical cluster emphasizes student-centered learning, spatial reasoning, and digital visualization skills, supporting theoretical claims about constructivist digital pedagogy (Bamford, 2022). The artistic cluster underscores the expressive and aesthetic potential of digital tools an area widely discussed by Benham, Burroughs, and Osland (2024), who note that computer graphics cultivate new artistic languages and visual cultures. The emergence of e-learning and virtual reality clusters confirms that immersive technologies play an increasingly important role in creative and design-oriented learning (Yoon, 2010). Finally, the creativity cluster further validates the perspective that 3D modeling serves not only as a technical tool but also as a catalyst for innovative thinking and idea generation (Suzuki, 2014). Fourth, the results also highlight challenges that persist across educational settings. Technical limitations, insufficient instructor training, and methodological gaps are consistent with earlier research identifying similar barriers to digital tool adoption (Schmidt, 2021; Irwin et al., 2014). These challenges reinforce the need for professional development, infrastructure improvements, and the creation of structured pedagogical models for integrating 3D modeling into curricula. The findings align closely with existing literature and contribute new empirical evidence supporting the theoretical argument that 3D modeling plays a significant role in developing visual literacy. The review confirms that 3D modeling enhances spatial awareness, visual interpretation, analytical skills, and creative expression core components of visual literacy recognized across contemporary scholarship.

Conclusion

This study examined the pedagogical potential of 3D modeling for developing visual literacy in art education through a systematic review of publications indexed in Scopus. The results demonstrate that 3D modeling has evolved into a powerful educational tool that supports both cognitive and creative development. By enabling learners to manipulate form, explore spatial relationships, and engage with digital visual environments, 3D modeling strengthens the key components of visual literacy, including spatial visualization, interpretation of visual information, structural analysis, and creative thinking. The findings show a clear upward trend in global research activity, particularly after 2020, reflecting the increasing accessibility of digital technologies and the growing recognition of their value in art education. The thematic clusters identified in the keyword analysis confirm that 3D modeling intersects with pedagogy, design, creative practice,

immersive technologies, and digital learning environments, positioning it as an inherently interdisciplinary tool. Additionally, the global distribution of studies suggests expanding international interest, although disparities in technological capacity and methodological resources remain. Despite these advancements, the review highlights several challenges, such as limited technical infrastructure, insufficient digital competencies among instructors, and the absence of systematic pedagogical frameworks. Addressing these obstacles is essential for maximizing the educational impact of 3D modeling. Future research should focus on developing evidence-based instructional models, conducting empirical classroom interventions, and exploring how 3D modeling can be aligned with emerging learning theories and digital literacy frameworks. In conclusion, 3D modeling offers significant pedagogical potential for enhancing visual literacy and modernizing art education. Its integration into the teaching and learning process not only enriches students' creative and analytical capabilities but also supports the development of essential competencies required in today's visually saturated and technologically advanced world.

Reference

1. Bamford, A. (2022). *Visual literacy and creative learning in art education*. *Journal of Arts Pedagogy*, 14(2), 45–59.
2. Benham, S. S., Burroughs, K., & Osland, L. (2024). *Teaching computer graphics visual literacy*. *Journal of Visual Art Practice*, 23(1), 40–57.
3. Bonorden, M., & Papenbrock, J. (2022). *Evidence-based optimization of classroom teaching units using 3D printers for designing models—from the 2D picture to the 3D flower model*. *Education Sciences*, 12(11), 831.
4. Chemerys, H., Novytskyi, O., & Marushevska, Z. (2020). *The use of 3D modeling technologies in the process of professional training of future design specialists*. *Journal of Education and Learning*, 9(3), 59–67.
5. Creswell, J. W., & Plano Clark, V. L. (2017). *Designing and conducting mixed methods research* (3rd ed.). Sage Publications.
6. Editorials. (2023). *Artificial intelligence and academic integrity*. *Journal of Ethics in Research*, 18(3), 145–150.
7. Eber, D. E., & Wolfe, R. (2000). *Teaching computer graphics: Visual literacy and aesthetics*. *IEEE Computer Graphics and Applications*, 20(5), 23–30.
8. Ford, S., & Minshall, T. (2018). *Where and how 3D printing is used in teaching and education*. *Additive Manufacturing*, 21, 524–534.
9. Gladovic, C., Tai, J. H. M., Nicola-Richmond, K., & Dawson, P. (2024). *How can learners practice evaluative judgment using qualitative self-assessment?* *Assessment & Evaluation in Higher Education*, 49(6), 755–766.
10. Green, L., & White, D. (2023). *Modern Artificial Intelligence in Art Education* [PDF].
11. Irwin, J. L., Pearce, J. M., Anzalone, G. C., & Oppliger, D. E. (2014). *The RepRap 3-D printer revolution in STEM education*. *360 of Engineering Education*, 3, 12–25.
12. Knochel, A. D. (2021). *MAKE 3D: Mobile Makerspaces for Multimodal Inquiry*. *Art Education*, 74(5), 6–12.
13. Lazarakou, E. (2024). *3D printing continuing education: Effects on students' skills and career orientation*. *International Journal of Educational Technology*, 15(2), 102–115.
14. Lee, A., & Chen, M. (2024). *Developing visual literacy through immersive 3D modeling*. *International Journal of Art & Design Education*, 43(1), 112–129.
15. Mardov, I. (2021). *The use of innovative technologies in the development of students' creative abilities in art education*. *Pedagogical Sciences*, 78(3), 45–52.
16. Murphy, S. (2024). *Primary school students' perspectives on 3D printing in education* [PDF].

17. Otto, P., & Mandorli, F. (2015). *Project-based learning and 3D modeling in technical education. Procedia – Social and Behavioral Sciences*, 191, 612–617.
18. Patera, M. (2009). *The potential of 3D visualisation technology in art & design education* (Doctoral thesis, The Glasgow School of Art).
19. Priavolou, C., & Pantazis, A. (2017). *3D printing as a means of learning and communication: The 3Ducation project revisited. Telematics and Informatics*, 34, 1465–1476.
20. Rash, E., et al. (2024). *Virtual 3D simulation technology for interprofessional team training. Advances in Simulation*, 9(2), 34–50.
21. Rodriguez, J. (2023). *Spatial thinking skills development through 3D modeling in arts education. Journal of Creative Technologies*, 11(4), 58–72.
22. Schmidt, C. (2021). *Project work and creative freedom in art education: The Danish experience. European Journal of Arts Education*, 13(1), 77–89.
23. Suzuki, K. (2014). *A trip to arts for computer graphics students: Enhancing creativity and spatial skills. Computer Graphics Education Journal*, 18(4), 85–92.
24. Suzuki, K., Saito, S., & Inoue, T. (2006). *Development of graphics literacy education using 3D-CAD/CG at universities in Japan. International Journal of Art & Design Education*, 25(1), 97–104.
25. Svobodova, I., Benesova, W., & Cernochova, M. (2016). *Development of graphics literacy education in visual arts. Education and Information Technologies*, 21(5), 1345–1359.
26. Xiao, L. (2013). *Animation trends in education. International Journal of Information and Education Technology*, 3(3), 286–291.
27. Yoon, S. A. (2010). *Virtual reality as a tool in creative arts education. Journal of Educational Computing Research*, 43(1), 5–21.
28. Zhang, H., Wang, Y., Yi, L., & Lee, S. (2021). *Sketch2Model: View-aware 3D modeling from single free-hand sketches. In Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR)*, 12113–12122.

The Impact of Artificial Intelligence on the Transformation of the Teacher's Role

Iskandirova Aizhan Baurzhanovna

Master's Student, Kostanay Regional University named after Akhmet Baitursynov, Kazakhstan

Abstract

The article analyzes the impact of artificial intelligence (AI) on the transformation of the teacher's role in the context of education digitalization. It reveals the changes in the professional activities of educators associated with the integration of intelligent technologies and identifies new functions and competencies emerging from human–AI interaction. Based on the analysis of international studies (UNESCO, OECD, PISA), a model of the teacher's new professional identity is proposed. The conclusions emphasize the preservation of the teacher's humanistic mission amid the digital transformation of the educational environment.

Keywords: artificial intelligence, digitalization, pedagogical activity, teacher's role, education of the future.

Introduction

The modern educational system is actively encountering processes of digital transformation, driven by the widespread implementation of artificial intelligence (AI) technologies. AI is becoming not just an auxiliary tool, but a key factor that contributes to the change in the structure of educational processes. The main challenge for educators lies in adapting to these changes and adjusting their roles within the educational system. The integration of AI into the educational process requires teachers to acquire new competencies and reconsider their roles, leading to the transformation of their professional identity and functions.

Contemporary Challenges in Education and the Role of AI

With the development of AI in education, teachers are no longer the sole source of knowledge. Instead of providing information, they become organizers of the learning process, where technology plays the role of an assistant. Students and teachers work in tandem with AI, which fosters personalized learning, creates individual learning paths, and enhances the effectiveness of material comprehension.

The relevance of this research is due to the need to study how AI technologies impact pedagogical activities, what new roles teachers are adopting, and how the humanistic aspect of education is preserved in the context of digitalization. According to OECD (2024), more than 65% of educators note that digital technologies have changed their views on teaching and methods of interaction with students. Thus, the field of pedagogy faces the challenge of developing new theoretical and practical foundations for the teacher's professional activity in the era of artificial intelligence. Research by UNESCO (2023) shows that 73% of educators believe that artificial intelligence is significantly changing their methods of work. Instead of traditional lectures, the focus is shifting to methods that allow AI to create interactive and adaptive learning environments.

In a philosophical context, the transformation of the teacher's role reflects the transition from an anthropocentric to a techno-humanistic model of education, where the educator becomes the link between technological progress and the humanistic values of society. The teacher of the new generation must not only be able to use AI but also meaningfully guide

students towards the responsible application of technologies, while preserving empathy, creativity, and a moral stance.

The methodological basis of the research consists of systemic, activity-based, and axiological approaches. The study uses methods of scientific literature analysis, pedagogical modeling, and generalization of practical experience of teachers applying AI in education. The author has developed a structural-functional model of the teacher's role transformation in the era of artificial intelligence [3].

The Changing Role of the Teacher in a Digital Society

In the context of digitalization, the teacher is no longer limited to transmitting information. They become a facilitator of the educational process, helping students learn to think critically, analyze, and create. This transformation occurs through interactive learning, project-based activities, and the integration of AI, which helps adapt the learning process to the needs of each student. Such changes undoubtedly require teachers to not only possess technical skills but also to develop psychological and ethical competencies.

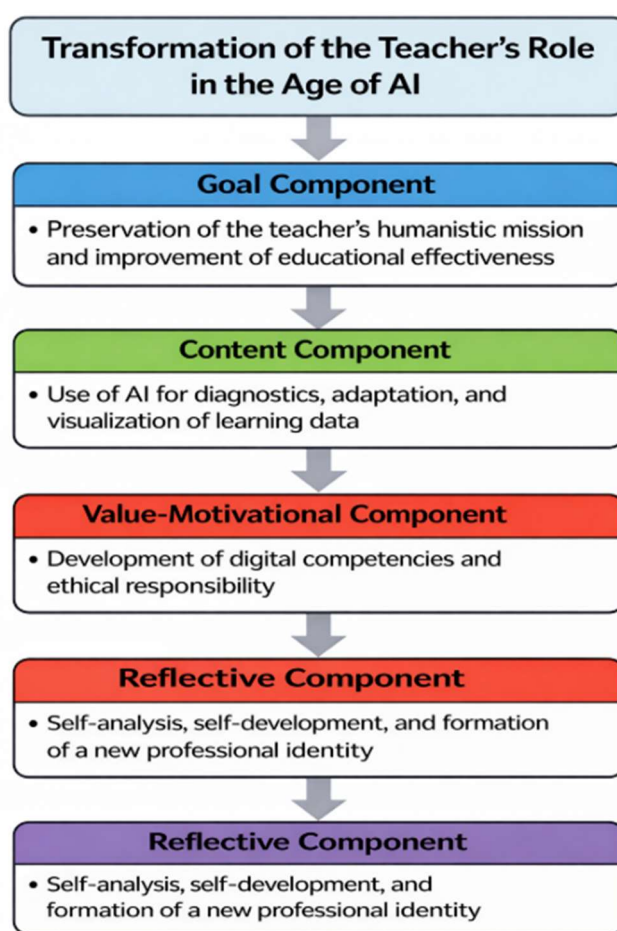


Figure 1. Transformation of the Teacher's Role in the Age of AI.

Each component reflects the key aspects of modern pedagogical activity and contributes to the formation of a comprehensive picture of the teacher's role in the future.

Integration of AI into Pedagogical Activity

The introduction of artificial intelligence (AI) into the educational process requires teachers not only to be proficient in using new technological tools but also to develop a strategic vision for how to integrate these technologies to enhance the effectiveness of learning and improve the quality of educational interactions. This means that educators need to adapt to new educational realities, where AI becomes an important partner, rather than just a tool for automation.

With the advent of AI, the teacher's role transforms: the educator is no longer the sole source of knowledge but becomes a facilitator of the learning process, helping students develop critical thinking, analysis, and independent decision-making. This shift from a reproductive model of education to a constructivist approach, where the student becomes an active participant in the learning process, requires teachers to develop new competencies, including digital literacy and ethical responsibility.

AI enables the creation of a more personalized educational space, where each student can learn at their own pace and according to their needs. This opens up new horizons for adaptive learning, where educational materials, assignments, and tests are tailored based on the student's progress and abilities. AI can track each student's progress in real time, providing instructors with up-to-date data to adjust the curriculum and teaching methods.

One of the prominent examples of AI usage is the case method, which is widely used in digital educational environments. In the case method, students analyze real or hypothetical situations, which helps develop critical thinking and provides students with the skills needed to analyze real-life situations, an essential component of their future professional activities. AI, in turn, can help create interactive case studies that automatically adapt to the student's level, offering more complex or simpler tasks depending on their progress. Furthermore, AI greatly expands the possibilities for personalized learning. For example, adaptive learning systems can analyze student responses and, based on the collected data, adjust the upcoming tasks and educational materials. This allows students to receive an optimal level of difficulty, which not only enhances the quality of material comprehension but also reduces stress and frustration during learning.

Digitalization of education, supported by AI, opens up vast possibilities for creating innovative content. With the help of AI, interactive courses can be developed that not only provide learning material but also actively engage students in the learning process. For example, interactive laboratories allow students to conduct experiments in a virtual environment, or simulations of professional situations help students acquire practical skills in a safe, controlled setting. Additionally, using AI, adaptive learning systems can be created that adjust the educational experience based on each student's pace of learning. This allows effective work with both highly motivated students and those who need additional support, providing everyone with an individualized approach.

While AI offers numerous advantages for education, it also brings about certain ethical challenges. One of the main concerns is the privacy of student data. To create a personalized learning experience, AI systems collect extensive data on students' actions and progress. These data can be used to improve learning further, but it is essential to ensure their proper protection to avoid any negative consequences. Another concern is the reduced personal interaction between teachers and students, which could negatively impact the quality of the educational experience. While AI can efficiently analyze and provide data on student progress, it cannot replace the emotional support and motivation that only humans can provide.

Moreover, as AI is integrated into educational practices, it is essential for teachers to develop skills like digital empathy—the ability to perceive and respond to students' behavior in virtual environments—and moral responsibility for using technology in education. These are important aspects that must be considered when developing and implementing AI in educational processes.

With the development of AI technologies, future education will see new learning formats, such as virtual teachers and smart educational platforms, which can personalize the learning process even further. This will provide real-time interaction between students and AI, helping to quickly respond to students' needs and providing adaptive learning materials. Thus, the integration of AI into pedagogical activity not only improves educational effectiveness but also

creates new challenges for educators, requiring continuous updating of competencies and pedagogical reflection.

The Role of the Teacher as a Facilitator

With the development of AI, according to the UNESCO model (2023), the role of the educator is shifting from the traditional role of the teacher as the transmitter of knowledge to the role of a facilitator - a helper in the learning process. The teacher helps students analyze data, interpret information, and work in teams. They guide students in the search for solutions but are no longer the sole source of knowledge. Thus, in the digital age, the educator must become the organizer of the educational process, capable of working with new technologies and managing the interaction between students and technologies.

Ethics and the Humanistic Mission of the Teacher

Although AI is changing the professional competencies of teachers, it is important to note that the humanistic mission of the educator remains unchanged. According to OECD (2024), teachers must retain their role as mentors who nurture rather than simply teach. This is especially crucial in the era of technology, where technology should not replace ethical values and the humanistic approach. Ethical guidelines such as empathy, respect for differences, and the creation of an inclusive environment should form the foundation for the interaction between humans and AI.

Development of New Competencies for Educators

With the development of technologies, teachers must acquire new competencies, such as:

- Digital literacy - the ability to effectively use AI and other digital technologies in the educational process.
- Critical thinking - the ability to evaluate and analyze data obtained through AI.
- Ethical responsibility - understanding the risks associated with the use of AI and the ability to make decisions while considering ethical norms.

These competencies will contribute to a more harmonious integration of the technological and humanistic components of the educational process.

Advantages and Challenges of Education Digitalization

Advantages:

- Personalized learning, where each student receives material tailored to their level of knowledge.
- Increased accessibility of education through online platforms and the use of AI to create adaptive courses.
- Enhanced learning effectiveness through the use of intelligent systems that can analyze student progress and suggest additional resources.

Challenges:

- Ethical risks associated with the use of AI, such as data privacy and dependency on technologies.
- Reduced personal interaction between teachers and students, which could lower the quality of the educational experience.
- The need for continuous knowledge updates for educators so they can effectively work with new technologies.

Model of the Teacher's New Professional Identity

Based on the analysis of international studies such as those by OECD and UNESCO, a model of the new professional identity of the teacher has been proposed, which includes several key aspects:

- Digital competence and the ability to integrate AI into the educational process.
- Teamwork with other educators and professionals in the field of technology.
- Ethical responsibility in the use of technologies in the educational environment.

- Humanistic thinking, which helps preserve the values of education despite the widespread adoption of AI.

Conclusion

The transformation of the teacher's role in the era of artificial intelligence is an inevitable process in the context of education digitalization. The teacher of the future is not only a specialist using new technologies but also an educator who maintains their humanistic mission, capable of working in collaboration with AI and ensuring high-quality education for all students.

Further research in this area should focus on studying the ethical aspects of human–AI interaction, as well as developing methodologies that will ensure a balance between technological efficiency and the humanistic approach in education.

References

1. UNESCO. *Artificial Intelligence in Education: Challenges and Opportunities*. – Paris, 2023.
2. OECD. *AI and the Future of Teaching*. – Paris, 2024.
3. Bates T. *Teaching in a Digital Age*. – Vancouver, 2022.
4. Bulatbaeva A.A. *Method of Modeling in Research Activities of Master's Students // Vestnik KazNU*. – 2013. – No. 2(39).
5. Kotlyarova I.O. *Method of Modeling in Pedagogical Research // Vestnik YuUrGU*. – 2019. – No. 1.

ӘОЖ 57:004.8

БИОЛОГИЯЛЫҚ BIG DATA ТАЛДАУДА ЖАСАНДЫ ИНТЕЛЛЕКТІНІҢ ИННОВАЦИЯЛЫҚ МҮМКІНДІКТЕРІ

Кыдырбаева Н.Х.

8D01503 – «Биология» білім беру бағдарламасының 1 курс докторанты, І.Жансүгіров атындағы Жетісу университеті, Қазақстан Республикасы, Талдықорған қ.

Мукашева Д.М.

PhD, І.Жансүгіров атындағы Жетісу университеті, Қазақстан Республикасы, Талдықорған қ.

Ауелбек М.А.

PhD, І.Жансүгіров атындағы Жетісу университеті, Қазақстан Республикасы, Талдықорған қ.

Аннотация

2010-жылдардың соңынан бастап жасанды интеллект (ЖИ), оның ішінде машиналық оқыту технологиялары өмір туралы ғылымдар саласындағы зерттеулерді түбегейлі өзгертіп келеді. ЖИ биологиялық үдерістерді есептік талдауда, табиғи қосылыстарды анықтауда және экожүйелер динамикасын зерттеуде маңызды құралдардың біріне айналды. Осы шолуда жоғары өнімді жүйелі молекулалық деректер деректерді жинаудың жедел өсуі өмір туралы ғылымдарда ЖИ-ге негізделген талдау әдістерінің қажеттілігін арттырғаны қарастырылады. Жүйелі молекулалық деректер (omics data) - бұл биологиялық жүйелерді толық әрі жан-жақты зерттеуге арналған *жоғары өнімді молекулалық деңгейдегі* деректер жиынтығы. Олар жасушадағы барлық молекулалардың (гендер, РНҚ, ақуыздар, метаболиттер және т.б.) тұтас жиынтығын қамтиды. Негізгі назар ботаника және микробиология салаларындағы қолданбалы мүмкіндіктерге аударылған. Біз жүйелік биологияда жүйелі молекулалық деректерге негізделген болжау модельдерінің рөлін және күрделі биологиялық жүйелерді тереңірек түсінуге мүмкіндік беретін ЖИ-ге негізделген инновациялық аналитикалық тәсілдерді атап өтеміз. Сонымен қатар, жүйелі молекулалық деректердің FAIR принциптеріне (деректерді оңай табу мүмкіндігі, қолжетімділік, үйлесімділік және қайта пайдалану мүмкіндігі) сәйкестігін қамтамасыз етудің маңыздылығы талқыланады.

Кілт сөздер: жасанды интеллект, геномика, феномика, протеомика, транскриптомика, Dendral жүйесі, Big Data, Omics Data, FAIR принциптері.

Dendral – 1960-1970 жылдары жасалған жасанды интеллекттің алғашқы эксперттік жүйелерінің бірі. Ол химиялық деректерді талдауға арналған және масс-спектрометриялық деректер негізінде органикалық қосылыстардың молекулалық құрылымын анықтау үшін қолданылған. Жүйе логикалық қорытындылау ережелері мен сарапшылардың білімін пайдалана отырып, күрделі ғылыми мәселелерді шешуге жасанды интеллекттің қабілетті екенін көрсетті. Dendral химия, биология және ғылыми деректерді талдау салаларындағы заманауи ЖИ жүйелерінің дамуына негіз қалады.

Биология саласындағы рөлі. Биология саласында Dendral маңызды әдіснамалық рөл атқарды. Алғашында химия үшін жасалғанымен, оның негізгі қағидалары - эксперттік білімді қолдану, логикалық шығару және гипотезаларды автоматты түрде құру - кейінірек

биоинформатикада кеңінен қолданылды. Бұл тәсілдер биологиялық құрылымдарды, молекулаларды, метаболизмдік жолдарды және генетикалық деректерді талдауда пайдаланылып, биологиялық Big Data-ны интеллектуалды өңдеудің дамуына ықпал етті.

Dendral жүйесінің жұмыс істеу принципі эксперттік тәсіл мен логикалық қорытындылауға негізделген:

Деректерді енгізу - жүйе эксперименттік деректерді (мысалы, масс-спектрлер) және бастапқы шектеулерді қабылдайды.

Білім қоры - сарапшылар (химиктер, биологтар) енгізген ережелер мен эвристикалардан тұрады.

Гипотезаларды генерациялау - берілген шектеулерге сәйкес келетін барлық ықтимал құрылымдар автоматты түрде құрылады.

Іріктеу және тексеру - логикалық ережелер арқылы мүмкін емес нұсқалар алынып тасталады.

Нәтижелерді бағалау - қалған гипотезалар эксперименттік деректерге сәйкестік деңгейі бойынша реттеледі.

Осылайша, Dendral сарапшының ғылыми ойлау процесін модельдейді, бұл кейінгі биология және биоинформатика саласындағы интеллектуалды жүйелердің дамуына негіз болды. Эксперттік жүйенің алғашқы үлгісі - 1965 жылы Эдвард Фейгенбаум (оны «эксперттік жүйелердің атасы» деп те атайды) және Калифорния штатындағы Стэнфорд университетінің өкілі Джошуа Ледерберг әзірлеген Dendral жүйесі болды (Сурет 1).



Сурет 1. – Эдвард Фейгенбаум мен Джошуа Ледербергің Dendral жүйесін сынақтан өткізуі

Dendral жүйесі жасанды интеллекттің ғылыми зерттеулердегі алғашқы қадамдарының бірі болып, эксперттік білімді пайдаланып күрделі химиялық деректерді талдауды автоматтандырған болатын. Оның жұмыс принциптері - деректерді енгізу, гипотезаларды генерациялау және логикалық қорытынды шығару - кейінгі биоинформатика мен молекулалық модельдеудегі көптеген шешімдердің негізін қалаған. Бүгінде биология мен биомедицина саласында Dendral сияқты принциптерді дамытқан көптеген заманауи бағдарламалар мен платформалар бар. Олар молекулалардың құрылымын болжау, дәрілік заттарды іздеу, ақуыз және нуклеин қышқылдарының өзара әрекеттесуін талдау сияқты күрделі мәселелерді шешуге арналған.

Жүйелі молекулалық (omics data) деректердің қарқынды өсуі өмір ғылымдарын зерттеуде жасанды интеллектіні қолдануды қажет етеді. Соңғы екі онжылдықта зерттеулер

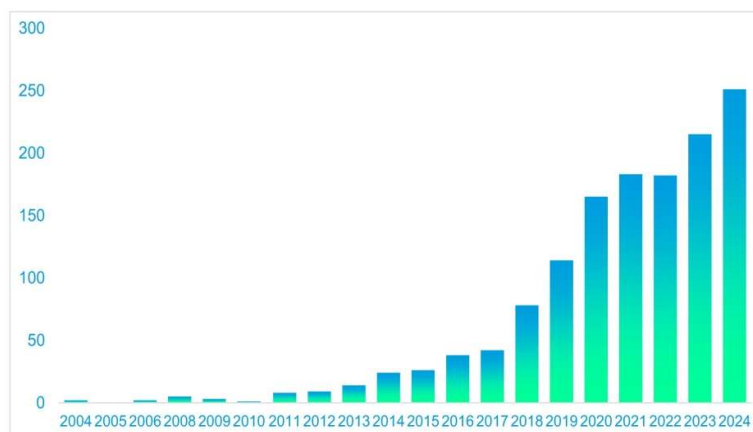
мен қоғам «өмір ғылымдарындағы үлкен деректер» дәуіріне аяқ басты. Технологиялық прогресс биологиялық молекулалардың (мысалы, ДНҚ, РНҚ, ақуыздар, метаболиттер) және фенотиптердің сапалық және сандық өзгергіштігін өлшеу мүмкіндіктерін кеңейтті, бұл бір эксперимент аясында ірі және күрделі omics data жиынтықтарын алу үрдісін кеңінен таралуына әкелді. Өмір ғылымдарында жүйелі молекулалық (omics data) деректердің қарқынды өсуі негізінен геномикадан басталды. Бұл процесс шамамен 20 жыл бұрын келесі буын ДНҚ секвенирлеу платформаларының (Next-Generation Sequencing, NGS) пайда болуымен байланысты. ДНҚ-ны секвенирлеудің Сэнгер әдісі 1970-жылдары ашылғанына қарамастан, қысқа оқылымдарға негізделген екінші буын NGS әдісінің енгізілуі үшін үш онжылдық қажет болды. Осы әдістің қолданылуы ДНҚ секвенирлеуде жаңа революция туғызып, оның қолжетімділігін және өнімділігін едәуір арттырды. Нәтижесінде жануарлар мен өсімдіктердің мыңдаған de novo геномдары жинақталып, бүкіл геном бойынша миллиондаған бір нуклеотидтік полиморфизмдер (Single Nucleotide Polymorphisms, SNP) анықталды. Сонымен қатар, бірнеше гендік транскриптерді жоғары өнімді талдау, яғни транскриптомика, 1990-жылдардың ортасында гибридизацияға негізделген микрочип технологияларының енгізілуімен басталды. Өмір ғылымдарында зерттелетін деректер өте үлкен және күрделі. Жиі бұл деректерді талдауға, түсінуге және болжау жасауға көмектеседі. Соңғы 20 жылда технологияның дамуы молекулалық деңгейде деректер жинауды әлдеқайда жеңілдетті және жылдамдатты [1].

2000-жылдардан бастап NGS (жаңа буын секвенирлеу) технологиясы РНҚ молекулаларының әртүрлілігін бұрынғыдан да дәл зерттеуге мүмкіндік берді. Бұл әдіс экспрессия деңгейлерінің кең диапазонын, сондай-ақ альтернативті сплайсинг сияқты күрделі процестерді анықтауға жол ашты. Мұндай зерттеу әдісі РНҚ-секвенирлеу (RNA-seq) деп аталады және РНҚ-дан алынған кДНҚ-ларды жаңа буын секвенирлеу құрылғылары арқылы оқу негізінде жүргізіледі [2]. Үшінші буын секвенирлеу технологиялары (PacBio, Oxford Nanopore Technologies) ДНҚ мен РНҚ-ны оқу ұзындығын ұзартты, деректерді тезірек алуға және нәтижелердің дәлдігін арттыруға мүмкіндік берді. Протеомика мен метаболомика ақуыздар мен метаболиттердің құрамын зерттеу үшін масс-спектрометрияға сүйенеді. Масс-спектрометрия 1940-жылдардан бері белгілі, бірақ оның газдық және сұйықтық хроматографиясымен біріктірілуі, сондай-ақ ESI (электрораспылдау ионизациясы) және MALDI сияқты жаңа ионизация әдістерінің пайда болуы бұл технологияның биологияда қолдану аясын ерекше кеңейтті [3]. Бұрын электрондық соққы арқылы ионизациялау кең қолданылған, бірақ ол молекулаларды қатты фрагментациялайтын. Қазіргі кезде оны жұмсақ ионизация әдістері - ESI және MALDI алмастырды. Бұл әдістер биомолекулалардың құрылымын бұзбай, оларды дәл анықтауға мүмкіндік береді. Соңғы 20 жылда жоғары айырымдылықтағы масс-спектрометрия (HR-MS) күшейіп, ақуыздар мен метаболиттерді өте дәл анықтауға жағдай жасады. Осылайша, протеомика мен метаболомика күрделі биологиялық үлгілерді зерттеуде кеңінен қолданылатын маңызды әдістерге айналды [4]. Соңғы жылдары визуализация технологиялары (яғни, түрлі құрылғылар арқылы объектілерді түсіру және бақылау әдістері) тез дамып, жаратылыстану ғылымдарына үлкен өзгеріс әкелді. Бұл жаңалықтар тек медицинаға ғана емес, өсімдіктерді зерттеу саласына да көп пайдасын тигізіп жатыр. Бүгінде өсімдіктердің және ауыл шаруашылығы дақылдарының сыртқы белгілерін (феномикасын) зерттеу қарқынды дамуда. Себебі жаңа сенсорлар, машиналық көру жүйелері (камералар мен арнайы программалар) және автоматтандыру технологиялары бұл саланың мүмкіндіктерін кеңейтіп отыр [5]. Қазір автоматтандырылған, өсімдікке зиян келтірмей жұмыс істейтін, көп мәлімет жинауға қабілетті құрылғылар өте үлкен көлемде суреттер мен датчик деректерін шығарады. Бұл деректер зерттеушілерге өсімдіктерді тереңірек түсінуге көмектеседі. Бірақ мәліметтің тым көп болуы - оларды өңдеу мен талдау кезінде қосымша қиындықтар туғызады. Алдыңғы қатарлы технологиялардың

дамуы биологияда өте көп және күрделі omics data- деректерді (геномика, транскриптомика, протеомика, метаболомика сияқты) үлкен көлемде алуға мүмкіндік берді. Мұндай деректер биологиялық жүйелердің қаншалықты күрделі екенін терең зерттеуге жол ашады. Бір эксперименттен бірнеше түрлі omics data- мәліметті біріктіре отырып, ғалымдар организмнің ішкі деңгейдегі молекулалық өзгерістері оның сыртқы белгілерімен қалай байланысты екенін толық түсіне алады. Алайда соңғы 20 жылда бір-бірімен тығыз байланысты мыңдаған, тіпті миллиондаған молекулалық көрсеткіштердің (мысалы, SNP, транскрипттер, ақуыздар, метаболиттер) фенотиппен байланысын анықтау өте қиын мәселе болып қалуда [6]. Бұл деректер соншалықты көп және күрделі болғандықтан, оларды адам миы өздігінен талдай алмайды. Осындай үлкен және көп өлшемді деректерді түсіну үшін қуатты компьютерлер қажет. Қазіргі уақытта жеке компьютерлерден бастап үлкен физикалық және бұлттық серверлерге дейін - барлығы деректерді тез әрі тиімді талдауға мүмкіндік береді. Сондықтан жасанды интеллект (ЖИ) өмір туралы ғылымдарда негізгі құралға айналды. ЖИ болашақта көптеген биологиялық жаңалықтардың ашылуына жетекші рөл атқарады деп күтіледі. Сурет 2 жасанды интеллекттің omics data деректерін талдауда қолданылуы жыл сайын қарқынды өсіп жатқанын көрсетеді. Соңғы он жылда бұл тақырыпқа қызығушылық бірнеше есе артқан.

Search query: ((artificial intelligence) AND (omics)) AND (life sciences)
Year Count

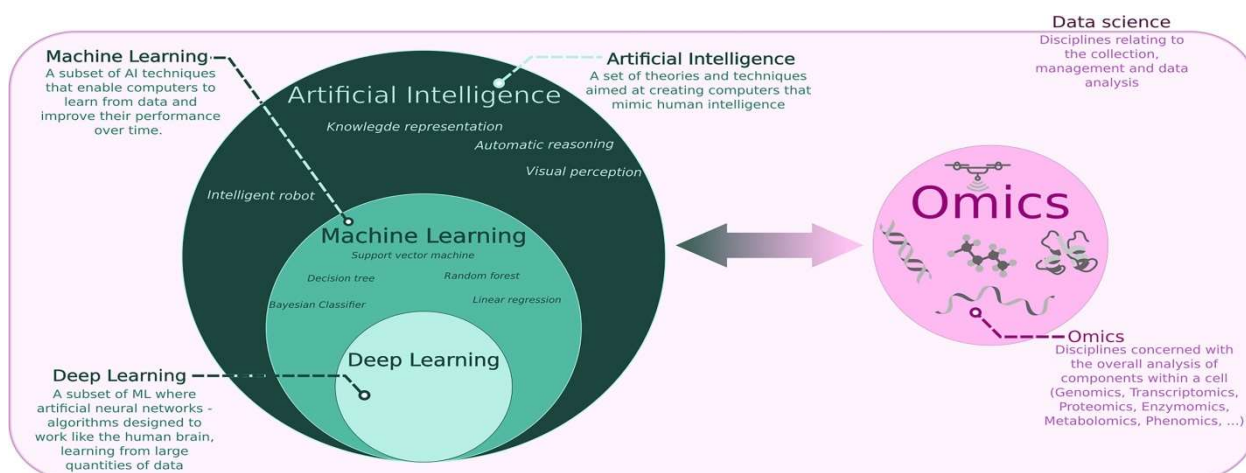
2004	2
2005	0
2006	2
2008	5
2009	3
2010	1
2011	8
2012	9
2013	14
2014	24
2015	26
2016	38
2017	42
2018	78
2019	114
2020	165
2021	183
2022	182
2023	215
2024	251



“Source: PubMed search results (as of 19 Sept 2024)”.

Сурет 2. Соңғы 20 жылдағы жасанды интеллект пен Omics зерттеулерінің жарияланым динамикасы

2024 жылдар аралығында PubMed деректер қорынан жасанды интеллект және Omics, өмір туралы ғылымдар бойынша барлығы 1362 жарияланым табылған (2024 жылдың 19 қыркүйегіндегі мәлімет). Соңғы 20 жылдағы осы кілт сөздермен жүргізілген әдебиеттерді талдау көрсеткендей, өмір туралы ғылымдар саласында жасанды интеллекттің қолданылуы өте жылдам дамып келе жатқан зерттеу бағыты болып табылады. Қарапайым түрде алғанда, жасанды интеллект (ЖИ) – бұл компьютерлік ғылымның бір саласы деп қарастыруға болады, ол машиналарды (әдетте бір немесе бірнеше компьютерді) белгілі тапсырмаларды орындауға үйретуге бағытталған, яғни алдын ала берілген мәліметтер жиынтығына негізделген оқыту арқылы жұмыс істейді [7] (сурет 3).



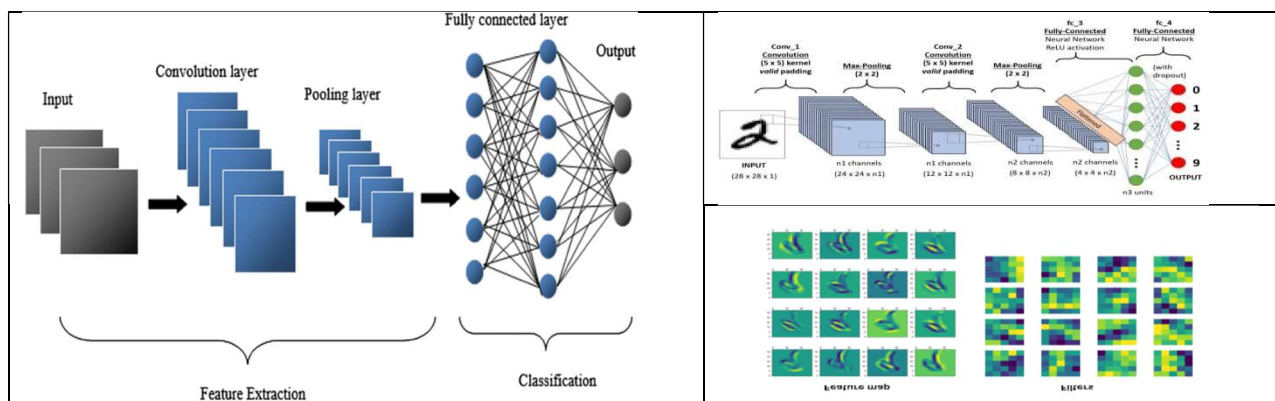
Сурет 3. Жасанды интеллект (ЖИ), машиналық оқыту (МО), Нейрондық желілер арқылы күрделі үлгілерді үйрену (НУ) және Omics ғылымдарының өзара байланысын көрсетеді.

Мұндай ЖИ күнделікті қолданылатын көптеген тапсырмаларды орындайды, мысалы: спамды сүзу, сөйлеуді тану, тілдік аударма, онлайн жарнама, суреттерге таңба қою және т.б. ЖИ әлі дамудың бастапқы кезеңінде. Мұндай ЖИ түрлері мәліметтерді адам интеллектімен салыстырмалы немесе одан да жоғары деңгейде үйреніп, түсінуге қабілетті машиналарды жасауға бағытталған [8].

1. **Artificial Intelligence - Жасанды интеллект.** Бұл адамдардың интеллектін имитациялайтын компьютерлерді жасауға бағытталған теориялар мен әдістер жиынтығы. Оның құрамына білімді көрсету, автоматты пайымдау, визуалды қабылдау, ақылды роботтар кіреді.
2. **Machine Learning -Машиналық оқыту.** Компьютерлерге мәліметтерден үйренуге және уақыт өте өнімділігін арттыруға мүмкіндік беретін әдістер жиынтығы. Мысалы: *Support Vector Machine, Decision Tree, Random Forest, Bayesian Classifier, Linear Regression*.
3. **Deep Learning - Нейрондық желілер арқылы күрделі үлгілерді үйрену.** Мұнда жасанды нейрондық желілер қолданылады, олар адамның миы сияқты жұмыс істейді және үлкен көлемдегі мәліметтен үйренеді.
4. **Data Science - Деректер ғылымы.** Бұл мәліметтерді жинау, басқару және талдау саласы. Omics-Data Science шеңберімен байланысты. Жасуша құрамын кешенді талдауға бағытталған ғылымдар: геномика, транскриптомика, протеомика, энзимомика, метаболомика, феномика.

Өсімдіктер ғылымында жасанды интеллект (AI) қолдану. Omics зерттеулерінің қарқынды дамуы өсімдіктер ғылымында зерттеулерді түбегейлі өзгертті. Сонымен бірге, бұл тәсіл жоғары күрделілігі мен үлкен көлемі бар деректерді өңдеу үшін машиналық оқытуды (МО) қолдануды қажет етті [9]. Феномика - өсімдіктердің сыртқы белгілері мен қасиеттерін зерттейтін сала, ол бастапқыда тек зерттеушілерге арналған перспективалы бағыт болса, қазір өсімдіктер мен ауыл шаруашылық мәдениеттерінде кең қолданылатын құралға айналды. Бұл прогресс заманауи сенсорлар мен визуализация технологияларының (RGB, мультиспектральды, гиперспектральды, жылулық және флуоресценттік камералар мен сенсорлар) дрондар мен жердегі роботтармен бірігуінің арқасында мүмкін болды. Олар жоғары өнімді фенотиптеу деректерін жинай алады. Машиналық оқыту алгоритмдері үлкен көлемдегі суреттер мен сенсорлық деректерден маңызды белгілер мен сипаттамаларды шығару үшін тиімді әдіс болып табылады. Мысалы, Аймақтық нейрондық желілер (CNN) өсімдіктердің суреттеріне негізделген фенотиптеу кезінде ең тиімді болып саналады. Олар биотикалық және абиотикалық стресс әсерлерін болжауда, сондай-ақ өсімдіктер ауруларын тез әрі дәл диагностикалауда аса пайдалы. Аймақтық нейрондық желілер (CNN,

Convolutional Neural Network) – бұл суреттер, видео немесе басқа көпөлшемді деректердегі үлгілерді тануға арналған нейрондық желі. Суреттегі жапырақтың пішінін немесе тамыр жолдарын анықтау керек делік. CNN кішкентай фильтрді сурет бойымен «сырғытып», әр аймақтағы маңызды белгілерді шығарады. Осылайша желі суреттегі күрделі үлгілерді автоматты түрде таниды. Қорыта айтқанда сурет немесе деректерді кішкентай аймақтарға бөліп, олардың ерекшеліктерін (features) шығару әдісін білдіреді, және бұл операция CNN-нің негізгі құрылымы болып табылады (сурет -4).



Сурет 4. Конволюция – сурет немесе сигналдағы автоматты түрде бөліп шығару әдісі, CNN-нің негізгі операциясы

Конволюция – CNN архитектурасындағы негізгі операция, ол суреттен маңызды белгілерді автоматты түрде бөліп алуға мүмкіндік береді. Сонымен қатар, тамыр жүйесінің құрылымын талдау үшін AI қолдану өсімдіктер физиологиясының аз зерттелген аймақтарын зерттеуге мүмкіндік береді және ауыл шаруашылығында «Екінші жасыл революцияны» жылдамдатуы мүмкін. Өсімдіктерді селекциялау да геномика жетістіктерінің арқасында түбегейлі өзгерді. Селекционерлер геномдық болжам (GP) әдісін пайдаланып, SNP маркерлері бойынша мақсатты белгілерді тезірек жақсартуға тырысады. Классикалық GP модельдері жақсы дәлдік берсе де, жаңа МО негізіндегі алгоритмдер күрделі белгілерді болжауды жақсартуға бағытталған. Күрделі белгілерді болжаудағы бір мәселе – генетикалық емес вариациялар мен гендердің өзара әсерлері. Бұл мәселені шешу үшін транскриптомика, протеомика, метаболомика сияқты басқа Omics деректерін GP модельдеріне қосу ұсынылады. Әсіресе, метаболомика фенотипке ең жақын қабат болып саналады және оның қолданылуы өсімдіктердің өнімділігін дәлірек болжауға мүмкіндік береді [10].

Қазіргі таңда өмір туралы ғылымдарда жүйелі молекулалық деректердің (omics data) қарқынды өсуі биологиялық зерттеулердің сипатын түбегейлі өзгертті. Геномика, транскриптомика, протеомика, метаболомика және феномика сияқты көпөлшемді деректердің үлкен көлемі биологиялық жүйелердің күрделілігін тереңірек түсінуге мүмкіндік бергенімен, оларды дәстүрлі статистикалық әдістермен талдау айтарлықтай шектеулерге ие. Осы тұрғыдан алғанда, жасанды интеллект пен машиналық оқыту әдістері биологиялық Big Data талдауда шешуші рөл атқаратын инновациялық құралдарға айналды. Мақалада omics деректерінің қалыптасу тарихы мен технологиялық дамуы, сондай-ақ олардың биологиядағы Big Data мәселесін қалай туындатқаны жан-жақты қарастырылды. Жаңа буын секвенирлеу технологиялары, жоғары айырымдылықтағы масс-спектрометрия және заманауи визуализация жүйелері бір эксперимент аясында көпқабатты деректерді жинауға жол ашты. Мұндай деректерді интеграциялау және олардың фенотиппен өзара байланысын анықтау үшін жасанды интеллектіге негізделген әдістердің қажеттілігі айқын көрсетілді. Жасанды интеллектінің, әсіресе машиналық оқыту мен нейрондық желілерге негізделген тәсілдердің, өсімдіктер ғылымындағы қолданбалы мүмкіндіктері ерекше атап өтілді. Жоғары

өнімді фенотиптеу, биотикалық және абиотикалық стресс факторларын болжау, өсімдік ауруларын диагностикалау және геномдық болжамды жетілдіру бағыттарында бұл технологиялар жоғары тиімділік көрсетуде. Сонымен қатар, метаболомика сияқты фенотипке жақын omics қабаттарын машиналық оқыту модельдеріне енгізу күрделі белгілерді болжаудың дәлдігін арттыруға мүмкіндік беретіні көрсетілді. Жасанды интеллект биологиялық Big Data талдауда тек көмекші құрал ғана емес, биологиялық жүйелерді кешенді түсінуге және жаңа ғылыми заңдылықтарды ашуға бағытталған негізгі қозғаушы күшке айналып отыр.

Пайдаланылған әдебиеттер тізімі

1. Stephens ZD, Lee SY, Faghri F, et al. Big data: astronomical or genomics? PLoS Biol. 2015;13:e1002195. 10.1371/journal.pbio.1002195.
2. Giani AM, Gallo GR, Gianfranceschi L, et al. Long walk to genomics: history and current approaches to genome sequencing and assembly. Comput Struct Biotechnol J. 2020;18:9–19. 10.1016/j.csbj.2019.11.002.
3. Wang Z, Gerstein M, Snyder M. RNA-seq: a revolutionary tool for transcriptomics. Nat Rev Genet. 2009;10:57–63. 10.1038/nrg2484.
4. Lowe R, Shirley N, Bleackley M, et al. Transcriptomics technologies. PLoS Comput Biol. 2017;13:e1005457. 10.1371/journal.pcbi.1005457.
5. Amarasinghe SL, Su S, Dong X, et al. Opportunities and challenges in long-read sequencing data analysis. Genome Biol. 2020;21:1–16. 10.1186/s13059-020-1935-5.
6. Marx V. Method of the year: long-read sequencing. Nat Methods. 2023;20:6–11. 10.1038/s41592-022-01730-w.
7. Griffiths J. A brief history of mass spectrometry. Anal Chem. 2008;80:5678–83. 10.1021/ac8013065.
8. McLafferty FW. A century of progress in molecular mass spectrometry. Annu Rev Anal Chem. 2011;4:1–22. 10.1146/annurev-anchem-061010-114018.
9. Mann M, Kelleher NL. Precision proteomics: the case for high resolution and high mass accuracy. Proc Natl Acad Sci USA. 2008;105:18132–38. 10.1073/pnas.0800788105.
10. Alseekh S, Fernie AR. Metabolomics 20 years on: what have we learned and what hurdles remain? Plant J. 2018;94:933–42. 10.1111/tpj.13950.

From Classical Texts to Digital Platforms

Sevinj Aliyeva

Senior lecturer, Azerbaijan State Pedagogical University, Sheki branch

Abstract

The field of English literary education has witnessed radical changes because of the rapid development of technology and innovations in learning. Even as traditional literary pieces continue to play an important part in literary education, the way in which these pieces are accessed, examined, and interpreted has changed dramatically. This paper explores how technology has impacted the teaching of English literary education in higher education institutions by examining the role of technology and innovation in learning. Through an analysis of traditional learning principles, technology integration, innovation in learning approaches, and challenges, it emerges that there should be a way forward that strikes a balance between literary studies and innovations in learning.

Keywords: English literature, higher education, digital pedagogy, literary studies, innovative teaching

Introduction

English literature as a field of study has served as a foundation of humanities studies, highlighting language developments, identity, philosophical trends, as well as changes related to society. The great works of literary classics have been utilized, not only for entertainment purposes, but also as a way to learn through these literary texts to foster interpretation, critical thinking, and moral awareness among students. Historically, until the end of the last century, teaching English literature in institutions of higher learning was practically print media and classroom discussions.

However, over the past decades, the emergence of digital technology has brought about a paradigm shift in the field of education. Learning spaces are no longer limited to the classroom and physical texts. Instead, technology and online resources have completely transformed the way in which literary knowledge can be accessed and produced. This has led teachers to rethink the goals and approaches of delivering lessons on English literature in the classroom. This article will explore this transition in teaching English literature in light of the current impact of technology on learning spaces.

Traditional pedagogy in English literature studies involved close reading, contextualization, and theoretical approaches. Students are trained in the analysis of language, symbolism, form, and themes through extensive reading. This encouraged intellectual training and textual awareness, further validating literature as an intellectual exercise.

However, with this, more traditional educational models seemed to place learners primarily within a passive position. The transfer of knowledge tended to occur in a straight line, prioritizing interpretation over meaning. As variations in student enrollment took place, along with changes in educational preference, limitations in strictly lecture-type instruction became more evident. In this manner, educational reimagination, and not outright rejection of classical literary traditions, followed.

The integration of digital technologies within higher education institutions has broadened the possibilities within literary studies. Digital resource bases as well as academic databases have increased accessibility to primary literary texts as well as critical research works, allowing literary research outside the boundaries within which literary studies occur within institutions. Public domain archives have additionally enabled the democratization of literary knowledge.

In addition to access, new ways of engaging with content are being created by the digital medium. Audiobooks, recorded versions, and annotated critical editions are providing new routes for engaging with literary texts. Dramatic literature is one area of literature that can benefit significantly from the addition of multimodal content. Performance-related resources can provide insight into aspects of text that are abstract when encountered in print.

Contemporary Pedagogical Innovations:

1) Learner-Centered Literary Pedagogy

There is an increasing trend in contemporary instructional theories that emphasize learner agency and participation in knowledge-building processes. In classrooms that teach literary works, this focus encourages learners to take responsibility for interpretation, engage in dialogic analysis, and position literary pieces within larger cultural contexts. Technology allows learner engagement by enabling collaboration and annotation.

2) Blended & Flipped Learning

Blended learning environments combine digital support with physical teaching, while flipped classroom teaching reverses the normal sequence of classroom instruction. In literary studies, these concepts can allow the analysis of literary texts to be prepared in class, leaving the classroom instructional time for discussion.

3) Digital Humanities & Analytical Expansion

The rise of the field of 'digital humanities' has brought about a methodological pluralization to literary studies. Technological capabilities have made available to literary scholars the macroscopic analysis of texts, which makes manifest the patterns on the level of language, and the themes on the level of large corpora. This analytical approach does not displace 'close reading'; on the contrary, it enriches the field of interpretation.

4) Project-Based and Collaborative Learning

The learning frameworks that focus on projects involve ongoing exploration and teamwork problem-solving techniques. Literature learners can conduct comparative research, digital theme exhibits, and interdisciplinary analysis that can incorporate literary interpretation, historical, philosophical, and/or sociocultural insights into their work.

5) Pedagogical and Ethical Challenges

Even as the educational advantages of digital integration are considerable, certain hurdles do require attention. With the growing trend of reading on screens potentially undermining sustained attention and immersion in the text, issues of equitable access to technological infrastructure might also intensify the gap between the educationally well-equipped and the disadvantaged. On the educational front, the use of digital technology demands both organizational and individual professional education. A very important balance therefore has to be maintained here. Such technology should instead supplement rather than subtract from literary scholarship.

There arises an urgent need to redefine the objectives and outcomes of teaching English literature in an educational setting in light of the shifting dynamics between literary studies and educational technology. In the present global digital change, literature classrooms in universities have become converged spaces that combine traditional intellectual practice in literature analysis and digital technology. This demands that teachers in literature classrooms change their methodological practices to not only be content-centered but also reflective.

Furthermore, today's students find themselves in a more complex and different digital environment, which is also impacted by the influence of social networking sites, audiovisual media, and the ability to access information instantaneously. It is, therefore, essential to make English literature teaching more interpretively rich while also taking into consideration the evolving thinking and learning behaviours of the new generation. Digital tools can also help in achieving the same goal by engaging the learner more actively.

Another aspect of equal importance is the role of the teacher acting as an intermediary between the classical literary tradition and the educational innovations of the modern age. The university teacher is called upon to maintain the demands of scholarship on the one hand and lead students through technology-enhanced learning contexts on the other. The role of the teacher is another aspect of the importance of pedagogical balance.

The integration of innovative teaching practices emphasizes the imperatives of ongoing evaluation in pedagogy. With the development of new teaching practices, the curriculum in literature should be adapted in ways that relate teaching practices to educational requirements at various levels. This fits within an overall framework that reaffirms the continued significance of English literature as an area that consistently adjusts to the reality of teaching practices within English studies.

Conclusion

This shift towards a digitally enriched literary pedagogy is part of the larger shifts that are happening in higher education institutions. This shift does not denote the irrelevance of classical literary studies but offers an opportunity for its renewal. By combining classical forms of interpretation with innovative approaches, it is possible to ensure that English literary studies remain both intellectually honest and relevant in their response to new realities. English literary studies remain an important living discipline within an integrated framework that combines innovation with technology, thereby remaining relevant within higher learning institutions.

References

- Abrams, M. H., & Harpham, G. (2015). *A Glossary of Literary Terms*. Cengage Learning.
- Baldick, C. (2015). *The Oxford Dictionary of Literary Terms*. Oxford University Press.
- Garrison, D. R., & Vaughan, N. D. (2008). *Blended Learning in Higher Education*. Jossey-Bass.

DEVELOPING INCLUSION IN EDUCATION

Qocayeva Nurana Mammad

ADPU nəzdində Azərbaycan Dövlət Pedoqoji kolleci

ABSTRACT :

Education, which is accepted as a fundamental human right according to the Universal Declaration of Human Rights, started to include the concepts of social justice and equality with the Salamanca Declaration (UNESCO, 1994). According to this statement, education should have a structure that focuses on the individual differences of students and the needs brought about by these differences. Today, the structure of schools becomes more diverse and more students with different needs take part in the education process. In this case, it is a universally accepted fact that education is offered equally for all. However, the issue of how to provide this education is still debated. The ecological model, on the other hand, examines individuals by including their political and socio- economic systems and responds to their needs. The ecology of inclusive education examines the effects of systems on the education process while evaluating students as valuable and participatory individuals. In this study, inclusive education is presented from an ecological model perspective. In this context, by explaining the features of inclusive education and ecological models, the systems of the ecological model are explained with an inclusive education perspective.

Keywords: Inclusive education ,Bronfenbrenner, Ecological model, Psychological counseling.

TƏHSİLDƏ İNKLÜZİVLİYİN İNKİŞAFI

Qocayeva Nuranə Məmməd

ADPU nəzdində Azərbaycan Dövlət Pedoqoji kolleci

Beynəlxalq qurumlar tərəfindən verilən tərifə görə, inklüziv təhsil uşaqların cinsi, etnik, dini və mədəni mənşəyindən, sosial-iqtisadi statusundan, əlilliyi olub-olmamasından, qabiliyyətindən və ehtiyaclarından asılı olmayaraq, həmyaşıdları ilə birlikdə yaxınlıqdakı ümumi təhsil müəssisələrində eyni sinifdə təhsilə cəlb olunmasıdır. Başqa sözlə desək, inklüziv təhsil hər bir uşağın təhsil almaq hüququna əsaslanaraq, əlilliyi olmayan və olan bütün uşaqların keyfiyyətli təhsilə çıxışını və seqreqasiya, ayrı-seçkiliyin olmadığı mühitdə bərabər inkişafını təşviq edən təhsil modelidir.

İnklüziv təhsil uşaqların fiziki, psixi, intellektual və digər xüsusiyyətlərindən asılı olmayaraq, onların as həmyaşıdları ilə məktəbdə eyni sinifdə təhsilə cəlb edilməsidir. Inklüziv təhsil əlilliyi olan uşaqların əlilliyi olmayan həmyaşıdları ilə birlikdə təhsil alması hər kəs üçün səmərəli tədris formasıdır. Belə ki, bütün uşaqların eyni sinifdə həyata keçirilən tədris prosesində iştirakı təhsilverənləri şagirdlərə fərdi yanaşmağa sövq edir. Əlavə olaraq, müxtəlif araşdırmaların nəticələri göstərir ki, əlilliyi olan uşaqlarla əlilliyi olmayan uşaqların birgə inklüziv sinifdə oxuması fərqliliyə münasibəti dəyişməyə, özünə hörmətin və həmyaşıdların qəbulunun yaxşılaşdırılmasına səbəb olur ki, bu, sosial yöndən ədalətli və ayrı-seçkiliyə yol verməyən cəmiyyətin qurulmasına töhfə verir. Cəmiyyətin əksi olan məktəblərdə müxtəlifliyin olması qaçılmazdır.

Birləşmiş Millətlər Təşkilatının (BMT) “Əlillərin hüquqları haqqında” Konvensiyası əlilliyi olan şəxslərin təhsil hüquqlarının bir çox tərəflərini əhatə edir və inklüziv təhsilin hər kəs üçün ən yaxşı təhsil mühiti olduğunu təşviq edir. Eynilə, BMT-nin “Uşaq Hüquqları Konvensiyası”nın 28-ci maddəsi hər bir uşağın təhsil hüququnu tanıyır və bərabər imkanlar əsasında bu hüququn həyata keçirilməsi dəstəkləyir. Adıçəkilən maddə bildirir ki, təhsil uşağın şəxsiyyətinin, istedadının, əqli və fiziki bacarığının inkişaf etdirilməsi, insan hüquqlarına və əsas azadlıqlara, azad cəmiyyətdə sülh, dostluq, anlaşma, tolerantlıq və bərabərlik içində həyata, ətraf mühitə hörmət tərbiyə edilməsinə yönəldilməlidir. Bu müxtəlif əlilliyi olan tələbələrə mane ola biləcək bütün digər şərtləri əhatə edir. UNICEF (2005) hesab edir ki, dünyada 18 yaşdan kiçik 150 milyon uşaq əlilliyə

malikdir. Əlilliyi olan uşaqların yalnız 14%-i təhsilini davam etdirir. (NCES, 2020). Birləşmiş Millətlər Təşkilatının Qaçqınlar üzrə Ali Komissarlığı (UNHCR, 2020a) Hesabata görə, dünyada 7,4 milyon məktəb yaşlı uşaq qaçqındır. Azərbaycanda əlil uşaqların bütün təhsil pillələri üzrə maneəsiz təhsil ala bilməsi üçün müxtəlif addımlar atılıb. 2019-2020-ci illərin statistikasına görə, ölkədə sağlamlıq imkanları məhdud uşaqlar üçün 5496 xüsusi məktəb və internat məktəbi var. Hazırda Azərbaycanda 60 mindən çox əlil uşaq var ki, onların yalnız 12 minə yaxını təhsilə cəlb olunur və beləliklə böyük əksəriyyəti təhsildən kənarda qalır. Bir sıra problem inklüziv cəmiyyətin yaranmasına və ümumiyyətlə təhsilli əhəlinin yetişməsinə ciddi əngəllər törədir. Azərbaycan Respublikasında təhsilin inkişafı üzrə Dövlət Strategiyasının Fəaliyyət Planında yaxın gələcəkdə məktəbəqədər və ümumi təhsil müəssisələrinin inklüziv təhsil üzrə məqsədli əlavə təhsil proqramlarının hazırlanması və həyata keçirilməsi nəzərdə tutulsa da, bu proqram hələ ki, pilot layihəsi səviyyəsindədir”

Türkiyədəki 3,9 milyon qaçqının yarısı məktəb yaşlı uşaqlardır və yalnız 35,58%-i məktəblərə yazıla bildi. Uşaq bağçalarında 35 553, ibtidai məktəbdə 338 807, orta məktəbdə 222 703, liseyədə 89 518 nəfər var. Qaçqın və qaçqın olan uşaqların çoxu ya heç məktəbə başlamır, ya da təhsilini davam etdirə bilmir. Əlil və qaçqın şagird qruplarından başqa, miqrasiya və terrorizmdən, zorakılıqdan və travmaya məruz qalan və müxtəlif ehtiyacları olan bir çox şaird qruplarına əlavə olaraq, hamısı inklüziv təhsilin ümumi çətiri altında qiymətləndirilir. Məktəblərdə şagird profillərinin müxtəlifliyi artsa da, bu şagirdlərin təhsili artır. Proseslərdə fərqli ehtiyaclar da ortaya çıxır (Qonski, 2011; Özel, 2018; Rəşid və Tikli, 2010). Bununla əlaqədar olaraq, iqtisadi səbəblərə və sosial-iqtisadi struktura görə istisna baş verir.

Son illərdə məktəbi tərk etmə nisbətləri sürətlə artmışdır (OECD, 2020; Zorbaz və Özer, 2020). Təhsilə resurslarının bərabər şəkildə bölüşdürülməsinə çalışılsa da, məktəbdən kənarda iqtisadi və sosial vəziyyətlə bağlı problemlər var. Faktorlar təhsil imkanlarının fərqli olmasına səbəb olur. Bütün tələbələr üçün təhsil imkanının və təhsil keyfiyyətinin təmin edilməsi (real və virtual) hamı üçün eynidir. Onun zərurəti hamı tərəfindən qəbul edilir. Bəs bütün bu tənzimləmələr necə həyata keçiriləcək? Bütün dünyada inklüziv təhsilin məqsədinə nail olmaq üçün hələ də müzakirə olunur və layihələr hazırlanır.

Son illərdə Azərbaycanda

- Təhsil Nazirliyi ilə UNICEF-in birgə əməkdaşlığı çərçivəsində 2015-2016-cı tədris ilindən ölkəmizdə “İbtidai təhsil səviyyəsi üzrə inklüziv təhsilin tətbiqi” layihəsinin icrasına başlanılıb. Layihə hazırda Bakı şəhərində yerləşən 220 nömrəli məktəb-lisey, 138, 252 və 202 nömrəli tam orta məktəblərdə icra olunur. Ümumilikdə 66 sağlamlıq imkanları məhdud şəxs inklüziv təhsilə cəlb olunub.
- Ölkəmizdə inklüziv təhsillə bağlı Avropa İttifaqının maliyyə dəstəyi ilə Heydər Əliyev Fondunun “Regional İnkişaf” İctimai Birliyi (RİİB) tərəfindən “Müəllimlərin inklüziv təhsil sahəsində bacarıqlarının artırılması” layihəsi də həyata keçirilir. Layihə Bakı, Şəki, Ağcabədi, Quba, Şamaxı və Cəlilabad bölgələrini əhatə edir.
- Həmçinin UNICEF tərəfindən “Azərbaycanda əlilliyi olan uşaqlar üçün inklüziv keyfiyyətli təhsilin genişləndirilməsi” layihəsi icra olunur. Layihə “2018-2024-cü illərdə Azərbaycan Respublikasında əlilliyi olan şəxslər üçün inklüziv təhsilin inkişafı üzrə Dövlət Proqramı” çərçivəsində Avropa İttifaqının maliyyə dəstəyi əsasında Təhsil Nazirliyi ilə əməkdaşlıq şəklində həyata keçirilir. Layihənin məqsədi əlilliyi olan uşaqların ümumtəhsil məktəblərində keyfiyyətli inklüziv təhsil alması üçün əlverişli mühitin yaradılması, o cümlədən kadr hazırlığı və əlilliyi olan uşaqların inklüziv təhsilə cəlb olunması üçün cəmiyyətdə müsbət münasibətlərin dəstəklənməsidir. Layihə Bakı, Sumqayıt, Quba, Şəki, Ağcabədi, Gəncə və Qazaxda icra edilir.

Türkiyədə də inklüziv təhsillə bağlı bəzi layihələr həyata keçirilir

“Suriya Müəllimlərinin Hazırlığı Layihəsi”, “Siniflərində Xarici Tələbələrle Layihələr”.

“Müəllimlərinin Hazırlığı Layihəsi”, “Suriyalı Uşaqların Türkiyə Təhsil Sistemində İntegrasiyası”

Dəstək Layihəsi (PICTES)", "Əlilliyi olan Uşaqlar üçün İnküziv Erkən Uşaqlıq Təhsili Layihəsi" və "İnküziv təhsil: Müəllim hazırlığı modulları layihəsinin hazırlanması". 2018-ci ildə İnküziv Təhsildə: Müəllim Hazırlığı Modullarının Hazırlanması Layihəsi, 10 fərqli mövzu (İnküziv təhsilə giriş: nəzəri və konseptual mühit, inküziv tədris və qiymətləndirmə, İnküziv Tədris Mühitləri, Fiziki və Psixososial, Məktəb, Ailə və İcma Tərəfdaşlığı, Əlilliyi olan İnsanlar Uşaqlarla İş Türkcənin İkinci Dil kimi Tədrisi, Zorakılığa məruz qalan uşaqlar Müvəqqəti müdafiədə olan uşaqlarla iş, miqrasiya və terrordan zərər çəkmiş uşaqlarla iş "Təbii fəlakətlərdən zərər çəkmiş uşaqlarla iş" mövzusunda modul hazırlanmış və bu təlimlərdə çoxlu sayda müəllim iştirak etmişdir. Təhsil resurslarını bərabər paylamaq və hər bir tələbəyə bərabər şəkildə necə yanaşmaq olar? Suallar bütün dünyanı əhatə etsə də, bu, inküziv təhsillə bağlı araşdırmalara istiqamət verə biləcək bir perspektivdir. İnküziv Təhsil uşaqların təhsil hüquqlarını qorumaq üçün təhsil prosesi dövlətlər tərəfindən maliyyə dəstəyi ilə həyata keçirilir. Konvensiyada (CEDAW), təhsildə kişi və qadınlar arasında bərabərliyi təmin etmək məqsədi ilə məktəb kurikulumların və dərslərin nəzərdən keçirilməsi və kişilər və qadınlar arasında bərabərlik əsasında tənzimlənməsi ilə bağlı qərarlar qəbul etmişdir. Baxmayaraq ki, təhsilin bütün insanların hüququ olduğu vurğulanması müxtəlif müqavilələrdə təkrarlanır Yenidən qurulsa da, yalnız əsrin sonlarında inküzivlik konsepsiyasına həqiqətən müraciət edildi. alınmağa başlandı. İnküziv təhsil ilk dəfə Salamanka Bəyannaməsi (UNESCO, 1994) ilə tətbiq edilmişdir. dünyaya tanındı. Birləşmiş Millətlər Təşkilatının Elm və Mədəniyyət Təşkilatının məlumatına görə (UNESCO, 2017) İnküziv təhsil alanların müxtəlif ehtiyaclarına diqqət yetirir və onlara cavab verir bu proses kimi müəyyən edilir. İnküziv təhsilin məqsədi kursantların öyrənmələrini təmin etməkdir Onların təhsil fəaliyyətlərində iştirakını artırmaq və təhsildə təcrid və ayrı-seçkiliyi azaltmaq. Müəllimləri və tələbələrini cəlb etməklə bütün təhsil sistemində öyrənmənin asanlaşdırılması və Müxtəlifliyin faydalarını əhatə etmək məqsədi daşıyır. Ainscow (2002) iddia edir ki, yalnız inküziv təhsil üçün Fiziki şəraitin təşkili kifayət deyil, əlavə olaraq, təhsilin bütün komponentləri və onun maraqlı tərəflərinin inküzivlik, təlim proqramları və fəlsəfəsini başa düşməsinə və dəstəkləməsinə təmin edir kurikulumun hər bir uşağı əhatə etməsi üçün yenidən təşkil etmək lazımdır. Nəticədə, Slee və Alan (2001) tərəfindən ifadə edildiyi kimi, inküziv təhsil yalnız xüsusi təhsildir. Bu, təhsillə bağlı bir anlayış deyil. İnküziv təhsil öyrənmə və iştirakla bağlı problemləri olan hər kəs üçündür. Özel, D. & Yıldız, E., Ç. (2020). Tədqiqat və Təcrübədə İnküziv Təhsil Jurnalı, 1 (2), 16-28 Buraya tələbələr və bütün digər tələbələr daxildir. Çünki təhsil sisteminin vəzifəsi ondan ibarətdir Şagirdlərin müxtəlif cəmiyyətdə öyrənməsi və yaşaması üçün uyğun mühitin yaradılması öyrətməkdir (Black-Hawking, 2010). Əslində inküziv təhsilin əsas məqsədi qurulacaq inküziv təhsil vasitəsilə cəmiyyəti dəyişdirmək.

İnküziv Təhsilin Ekologiyası

Bronfenbrenner (1970) tələbələrin ekoloji mühitin onların müvəffəqiyyətində təsirli olduğunu ifadə etdi. Bronfenbrennerə görə fərdlərin inkişafını bir proses və bu inkişaf kimi görmək lazımdır (Anderson, Boyle və Deppeler, 2014). Şagirdlərin təhsil prosesləri təkcə onların məktəb daxilindəki vəziyyətindən deyil, həm də evdə danışılan dil və dil bilikləri, məktəbdə və ya məktəb ətrafında təhlükəsizlik və gigiyena vəziyyəti, təhsil almaq imkanı, ailənin təhsilə necə və nə dərəcədə cəlb olunması, tələbənin maddi imkanları, Müəllimin və məktəbin maliyyə vəsaiti məktəbin yerləşdiyi mühitdən , ayrı-seçkilik və nifrət nitqi kimi bir çox vəziyyətlə bağlıdır (Stubbs, 2008). İnküziv təhsilin ekologiyasını nəzərdən keçirərkən (Anderson, Boyle və Deppeler, 2014) Bronfenbrennerin (1970) ekoloji modelini nəzərə alaraq, tələbələrin mikro sistemlər (təhsil proqramı, sinifdəki vəziyyət kimi), mezo sistemlər (tələbənin mikro sistemlə əlaqə), ekosistemlər (resurslar, məktəb siyasəti, məktəb mədəniyyəti və ideologiyaları kimi) və makro sistemləri nəzərə alaraq (təhsil sistemi, siyasət konteksti, sosial kontekst və milli kontekst kimi) Bizdə olacaq. Başqa sözlə, inküziv təhsilin ekologiyası şagirdlərə təsir edən bütün aspektləri özündə birləşdirir. Proses şagirdi təhsilin mərkəzinə qoyur və bu sistemləri bir-birinə integrasiya edir. əlaqəsi və təsirləri haqqında məlumat əldə etməyə çalışır. Ekoloji inküziv təhsil, onun prosesləri və Bu, fərdlərə vəziyyətləri araşdırmaq

üçün bir çərçivə təmin edir. Bu çərçivə ilə pedaqoqlar, tələbələr Onlar üçün həqiqətən inklüziv təhsil yaratmaq məqsədi ilə prosesi nəzərdən keçirə bilərlər (Anderson və Boyle, 2014). Bir sözlə, təhsilin ekologiyası konsepsiyasında deyildiyi kimi, şagird uğurlu, dəyərli və iştirakçı bir fərd kimi qiymətləndirilməli və fərdin ətrafındakı sistemlər qiymətləndirilməlidir.

Bunun fərdin təhsilinə necə təsir etdiyi nəzərə alınmalıdır. Inklüziv təhsilin məqsədi bütün tələbələrin müxtəlif öyrənmə ehtiyaclarını ödəməkdir. (YUNESKO, 1994).

Bu məsələ ilə bağlı maarifləndirmə gücləndirilməlidir. Inklüziv təhsil təcrübələri bütün sistemlərə tətbiq oluna bilər. Inklüziv təhsil inkişaf etdikdə, yəni ümumən cəmiyyətə təsir etdikdə daimilik qazanar.

Ədəbiyyat:

1. Ainscow, M. (2002). Inklüziv məktəblərin inkişafının başa izahı. London: Falmer Press.
2. Ainscow, M., Dyson, A., Goldrick, S., and West, M. (2012). Bərabər təhsil sistemlərinin inkişafı.
3. Abington, Oxon: Routledge.
4. Anderson, J., Boyle, C. və Deppeler, J. (2014). Inklüziv təhsilin ekologiyası:
5. Bronfenbrenner. H. Zhang və P. Chan (Red.), Təhsildə Bərabərlik: Ədalət və Daxiletmə (səh. 24-38). Avstraliya: Brill və Sense
6. Birləşmiş Millətlər Təşkilatı (1948). Ümumdünya İnsan Hüquqları Bəyannaməsi.
7. http://www.unicankara.org.tr/doc_pdf/h_rigths_turkce.pdf saytıdan götürülüb.
8. Black- Hawkings, K. (2010). İştirak üçün Çərçivə: Tədqiqat üçün tədqiqat aləti nailiyyət və məktəbə daxil olma arasında əlaqə. Beynəlxalq Araşdırmalar Jurnalı & Təhsildə Metod, 33(1), 21-40. doi: 10.1080/17437271003597907
9. Boyle, C., Topping, K., Jindal-Snape, D., and Norwich, B. (2012). üçün həmyaşd dəstəyinin əhəmiyyəti
10. xüsusi təhsilə ehtiyacı olan uşaqları daxil edərkən pedaqoji heyət. Beynəlxalq Məktəb psixologiyası, 33(2), 167–184.
11. Bronfenbrenner, U. (1970). Uşaqlar və valideynlər (səh. 241–255). Vaşinqton, DC: ABŞ Hökumət Çap Ofisi.

Müəllimin peşə ustalığı və nüfuzu

Rəfiyeva Xuraman Əli qızı

Baş müəllim, Azərbaycan Dövlət Pedaqoji Universitetinin, Şəki filialı, Fransız dili müəllimi Orcid 0000-0001- 9887-4619

Müəllimin dünyagörüşü, onun davranışı, həyatı, hadisələrə münasibəti bu və ya digər şəkildə bütün şagirdlərə təsir edir

M.İ.Kalinin

"Müəllim bir çıraqdır" ifadəsi müəllimin işıq saçan, yol göstərən, bilik və dəyərləri nəsil-dən-nəslə ötürən bir mənbə olduğunu bildirən metaforik bir fikirdir. Müəllim şagirdin həyatına işıq gətirir, cəhalətdən xilas edir və onların gələcəyinə "çıraq" tutur. Bu işıq müəllimdən şagirdə, şagirddən isə yeni nəsillərə keçərək davam edir. Müəllim tək bir fərd deyil, bir çox şagirdin həyatına təsir edən və onların "çağdaş" olmasında mühüm rol oynayan bir insandır. Bu işığın heç vaxt sönməyəcəyinə dair ümid yaradır. Müəllimindən şagirdə, şagirddən də öz yetirmələrinə ötürülən bu işıq daim davam edir. Ona görə də müəllim fənninə aid dərin bilik sahibi olmalıdır. Bunsuz ən mütərəqqi metodika belə onun işində irəliləyişə səbəb ola bilməz. Müəllim öyrədici olmalıdır – bu vəzifə müəllim fəaliyyətinin əsasını təşkil edir. Belə ki, müəllim öyrətməklə bərabər, öyrədə-öyrədə özü də öyrənir. Şagirdlər müəllimin biliyinə və öyrətmə tərzinə xüsusi diqqətlə yanaşdığı üçün, müəllimdə hər hansısa bir qüsurları zaman bu səhvə qarşı reaksiya verirlər. Ona görə də pedaqoji fəaliyyətə başlayan hər bir gənc müəllim buna diqqət yetirməlidirlər. Müəllim özünün tədris etdiyi fənni yaxşı bilməlidir, əks halda dərs zamanı istifadə edilən hər hansısa metod və üsul onun üçün yararlı və əlverişli şərait yaratmayacaqdır. Müəllim peşə ustalığı zamanı müəllim adına və nüfuzuna, habelə təhsil müəssisəsinin işgüzar nüfuzuna xələl gətirə biləcək hərəkətlərə yol verməməlidir. Mədəni davranış – müəllim təhsilalanlarla, rəhbərlik və həmkarları ilə davranışında nəzakətli, xeyirxah, diqqətli və təmkinli olmalıdır. Şagirdlər müəllimlərinin hansı bilik sahibi olduğunu çox tez hiss edirlər və onların zəif (necə deyirlər zəif damarını) tərəflərindən tutmağa çalışırlar. Hətta onlar „proqram“ dairəcindən kənara çıxan suallara da cavab axtarırlar. Elə hallar da olur ki, müəllim şagirdlərin suallarına cavab verə bilmir. Bəziləri bu halda çıxılmaz vəziyyətdə qalıb, bəziləri də hazırda bu suala cavab verə bilməyəm, bir qədər sonra bu suala qayıdaraq deyə cavab verib. Bu, müəllimin nüfuzunu aşağı salmır, əksinə şagirdlər onlara verilən səhv cavabı tez hiss edir və müəllimə inanırlar.

Müəllim özünün pedaqoji təcrübəsini günbəgün artırmalı və təkmilləşdirməlidir. "Müəllimin pedaqoji təcrübəsi onun pedaqoji statusundan asılıdır, fikrini qəti şəkildə demək olmaz. "Pedaqoji təcrübə,, anlayışı illərin sayından asılı deyil. Hamımızın çalışdığı məktəblərdə uzun illər işləməsinə baxmayaraq öz dərslərini yüksək səviyyədə qura bilməyən, şagirdlərin hörmətini qazanmayan müəllimlərlə yanaşı, qısa vaxtda əsl pedaqog səviyyəsinə yüksələn müəllimlərimiz də vardır. Hətta çoxdur desək daha düz olar.

Pedaqoji ustalığın ilkin şərtləri biliyin toplanması, qabaqcıl təcrübənin öz işində yaradıcılıqla tətbiq edilməsi və özünün iş təcrübəsini ümumiləşdirərək yoldaşlarına çatdırmasıdır.

Müəllim nüfuzuna təsir edən ən başlıca amillərdən biri də onun şəxsi nümunəsi, özünə və şagirdlərinə qarşı yüksək tələbkardlılığıdır. Şagirdlər öz ixtisasını dərinlən bilən tələbkər müəllimlərə hörmət edirlər. Təcrübə göstərir ki, müəllimin nüfuzunu qoruyub saxlaması çox çətinidir, ona görə ki, bu proses özünə nəzarətin bir an da zəifləməməsinə, əksinə, gücləndirilməsinə tələb edir.

Gənclərlə açıq söhbət etmək, onlarla birlikdə çətin suallara cavab tapmaq, özünün işindəki zəif cəhətləri şagirdlərdən öyrənmək müəllimlərin iş təcrübəsinə daxil olmalıdır. Biz şagirdləri deyilənlərə passiv surətdə qulaq asmağa məcbur etməklə onların yaradıcılıq imkanlarını məhdudlaşdırmış oluruq. Ən başlıcası odur ki, şagirdlərin real imkanlarını nəzərə almaqla onların hər birinin bilik səviyyəsinə uyğun bilik verilməsidir.

Orta səviyyəli uşaqlar üçün nəzərdə tutulan proqram və dərsliklər mənimsəmə qabiliyyəti aşağı olan şagird üçün alınmaz qaladırsa, dərk etmə qabiliyyəti yüksək olan şagird üçün oyunçağa çevrilir. Məşhur bir aforizmdə deyildiyi kimi yaxşı doldurulmuş başa nisbətən yaxşı qurulmuş baş daha yaxşıdır. Bu o deməkdir ki, tədris materialını öyrətməklə yanaşı şagirdləri müstəqil fikir yürütməyə yaradıcılıq imkanlarını inkişaf etdirməyə çalışmalıyıq. Çox təəssüf ki, dərslərdə yalnız dərslikdəki materialları, faktları sadalamaqla öz işini bitmiş hesab edən müəllimlərimiz də vardır. Orta məktəbdə tədris olunan fənlərin əksəriyyətində müasir həyatla əlaqələndirmək üçün istənilən qədər material var. Bunlardan istifadə etmək üçün isə müəllim əlavə mənbələrə müraciət etməlidir.

Müəllimin nüfuzuna, başqa amillərlə yanaşı el - oba içərisində özünü necə aparması, xalqının taleyinə biganə qalmaması, haqqın tərəfində durması da az təsir etmir. Müəllim təlim və tərbiyənin mövcud mərhələdə məqsəd və vəzifələrini dəqiq müəyyənləşdirməli, onlara nail olmalı, mərhələnin sonunda qarşıya qoyduğu məqsəd və vəzifələrin necə yerinə yetirildiyini tapşırıq vasitəsilə yoxlamalı, müsbət və mənfi cəhətləri müəyyənləşdirməlidir. O, müsbət cəhətləri möhkəmləndirməli, zəif cəhətləri isə aradan qaldırmaq üçün müəyyən perspektiv tədbirlər hazırlamalıdır.

Müəllim keçmiş nəsillərin ən yaxşı həyatı təcrübəsini və özünün əldə etdiyi elmi nailiyyətləri yeni gənc nəsle verir və bu nəslə gələcəyin qurucuları ruhunda tərbiyə edir. Cəmiyyətimizdə müəllim elə bir mötəbər, elə aqıl, elə kamil adamdır ki, bizim hər birimiz özümüzün ən əziz və ən sevimli övladlarımızın tərbiyyə və təhsilini onlara etibar edirik. Bizim müəllimlərimiz sözün əsil mənasında insan qəlbinin mühəndisi rolunu ifa edirlər. Müəllim məktəblilərlə qaynayıb – qarışır, onların bütün coşqun fəaliyyətinin mərkəzində durur, onlara bu mərkəzdən düzgün istiqamət verir. Müəllim necədirsə, onun şagirdi də elədir, yəni müəllim hansı biliyə, hansı tərbiyyəyə malikdirsə onun şagirdləri də, əsasən elə biliyə və tərbiyyəyə yiyələnmiş olurlar.

Dözümlülük, səbrlilik və təmkinlilik müəllimin mühüm keyfiyyətlərindən biridir. Müəllim daim gözlənilməz situasiyalarla qarşılaşmalı olur. O, hər bir situasiyaya yüksək gərginlik və emosionallıqla cavab verməli olsa uzun müddət səmərəli fəaliyyət güstərə bilməz. Təlim situasiyaları nə qədər rəngarəng və təzadlı olsa da, müəllim səbrli və təmkinli hərəkət etməlidir. Təmkinli müəllim baş vermiş vəziyyəti düzgün başa düşür və onun çıxış yolunu dəqiq müəyyənləşdirir. Təmkinlə hərəkət edən müəllim bütün situasiyalarda dözümlü olmağa, hər şeyi səbrlə ölçüb – biçməyə çalışır və nəticədə səbirli və təmkinli müəllim kimi hərəkət etməyə çalışır. Deməli, pedaqoji prosesdə müəllimin fəaliyyətini düzgün idarə etməsi böyük rol oynayır. Öz imkanlarına inamı, peşəsini sevməsi, metodik ustalığı və zəngin pedaqoji təcrübəsi müəllimin psixi vəziyyətini idarə etməsi prosesinin formalaşmasına müsbət təsir göstərir.

Müəllimlik sənəti „qəhrəmanlıq“ sənətidir. Valideynlərin minnətdarlığı, şagirdlərin məhəbbəti isə ən böyük mükafatdır. “Müəllim nə qədər ki, oxuyur, öyrənir, o yaşayır, o oxumağı dayandırdıqda ondakı müəllimlik ölür”. Müəllimlik – yüksək insani istedad tələb edir. Təbiidir ki, bu keyfiyyət hər kəsdə olmur. Ardıcıl özünənəzarət, əhvalı kökdə saxlamaq, şagirdə, tələbəyə münasibət ayrıca nəzərdə tutulur. Peşə fəaliyyətinin əsas uğuru müəllimin peşəkarlıq və səriştəlilik səviyyəsinin yüksəkliyi ilə xarakterizə olunur. Səriştəlilik, uğura aparan əsas yolun başlanğıcıdır. Müəllim səriştəli olduqda onun pedaqoji fəaliyyəti bütün istiqamətlərdə özünəməxsus məzmun və xarakter alır, seçilir, fərqlənir.

Pedaqoji təcrübədə zəif oxuyan yeniyetmənin bir sıra mənəvi normalara (dəqiq, mehriban, ədalətli, çalışqan və s.) əməl etməkdə nümunəvi olması halları az deyildir. Müəllim bu keyfiyyəti mütləq nəzərə almalı, şagirdi yaxşı işlər görməyə həvəsləndirməlidir. Müəllim şagirdlərdə bizim ideallarımızın həqiqiliyinə inam tərbiyə etməli gənclərə onları qaldırılması üçün çalışmaq bacarığı aşılamalıdır. Müəllim və şagirdin söhbətində qadağan edilmiş mövzu olmamalıdır. Əlbəttə, müəllim şagirdin istənilən sualına inandırıcı cavablar vermək və ya ona cavab tapmaqda kömək etməkdə kifayət qədər əhatəli biliyə malik olmalıdır. Müəllim məsuliyyəti çoxcəhətlidir. Müəllim böyüməkdə olan şəxsiyyətin fəallağının, ideya inanımının onun şüur və davranışında formalaşdırılması işinə kömək göstərməkdə fəvqəladə dərəcədə vacib pedaqoji vəzifələr daşıyır. Bu vəzifələr yalnız müəllimin öz şagirdlərinin nüfuzunu qazandığı zaman yerinə yetirilə bilər. Onsuz bu vəzifələrin yerinə yetirilməsi mümkün deyil. Bura həm də əxlaq sahəsindəki müəyyən biliklər daxildir. Bunlarsız nüfuz qazanmaq olduqca çətindir. (Bəzi istedadlı müəllimlər bu bilikləri bir növ instinktiv şəkildə əldə edirlər) Cəsarətlə demək olar ki, əgər müəllim nüfuzludursa, onun bəzi adamlara təsiri ömürlük qalır. Buna görə də müəllimin özünə nəzarət etməsi vacibdir. O hiss etməlidir ki, onun davranış və hərəkətləri dünyada heç bir adamın məruz qalmadığı güclü nəzarət altındadır. Amma müəllimin bu nəzarəti yalnız tapşırılan iş üçün yüksək mənəvi məsuliyyət daşıdığı zaman hiss edə bilər. Əks təqdirdə, bu nəzarət az hiss edilir. Bu da o deməkdir ki, müəllim nəinki özü özünü tərbiyə işindən kənar edəcək, həm də təkcə şagirdlərinə yox, bütün cəmiyyətə böyük ziyan gətirəcək. Müəllimin rolu, dünyagörüşü, hər şeydən əvvəl, hər bir insanın niyyətlərinin qiymətləndirildiyi meyarlarla qiymətləndirilir.

Müəllim hazırlığı işində, hər şeydən əvvəl, kəmiyyət dalınca qaçmaqdan imtina etmək lazımdır. Cəmiyyətin qarşıya qoyduğu tələblərə cavab verə bilən həqiqi müəllim tərbiyəsinin yalnız bir yolu var: „tələbə skamyasında oturandan tə uzun illərin iş təcrübəsinə malik müəllim olana qədər müəllim hazırlığının bütün mərhələlərində hər bir şəxsə fərdi yanaşmaq”.

Kamenski yazırdı: „Şagirdlərin daşdığı mənəvi inkişafının valideynləri olan” müəllimlər çox şey bilməli və bacarmalıdırlar: təlim və tərbiyə sənətinə yiyələnməyi, nə vaxt və hansı şəraitdə tələbkərləliq göstərməyi, uşaqlarda biliklərə və təhsilə qızgın maraq oyatmaq və s. Bütün bunlar isə yalnız müəllimin şagirdləri öz atalıq qayğısı, hərəkətləri və sözləri ilə cəlb etdiyi zaman ola bilər.

Müəllimin şagirdlərlə mənəvi əlaqələri özünəməxsusluğu ilə zəngin, vaxt etibarlı ilə uzunmüddətli və bu onun yaradıcı iş bacarığında, dünyagörüşündə və kamil şəxsiyyətə aid bütün keyfiyyətlərində də öz əksini tapır. Müəllimlik – yüksək insani istedad tələb edir. Təbiidir ki, bu keyfiyyət hər kəsdə olmur. Ardıcıl özünə nəzarət, əhvalı kökdə saxlamaq, şagirdə, tələbəyə münasibət ayrıca nəzərdə tutulur. Bu bir həqiqətdir ki, şagirdlərə, təlim məsuliyyətli münasibətin yaradılmasında müəllimin rolu böyükdür. Təlim prosesində yalnız şagirdin müəllimlə görüşü yox, bir də onların bir-birini anlaması əsas şərtidir. Müəllimlə şagirdin açıq ürəklə danışması, sərbəst fikir mübadiləsi çox şey öyrədir» Dərin bilik, mədənilik, mənəviyyət nümunəsi olan müəllimin nüfuzu da yüksək olur. Nüfuzu qazanmaq çətin, itirmək isə asandır: yersiz hərəkət, ədalətsiz münasibət, ehtiyatsız söz müəllimi nüfuzdan sala bilər. Buna görə də, hər bir müəllim sözlərinə və hərəkətlərinə məsuliyyətlə yanaşmalı, öz nüfuzunun keşiyində durmalıdır.

Müəllim gənc nəslin mənəvi estetik tərbiyəsinin inkişaf etməsində böyük rol oynamalı, həm özünün, həm də şagirdlərin milli əxlaq, ictimai davranış, pedaqoji-etik normalarına riayət etməlidir. Bütün bu qaydalara layiqincə əməl edən müasir müəllim öz üzərində işləyərək kollektivin hörmətini qazanır və yüksəlir. Müasir müəllim şəxsiyyətinin formalaşması, hərtərəfli inkişaf etməsi, gənc nəsle dayaq olması dövrümüzün ən vacib, aktual məsələlərindən biridir. Hər bir Azərbaycan müəllimi öz peşə nüfuzunu möhkəmləndirməyə, şərəf və ləyaqətini uca tutmağa

borcludur. Hər an öz üzərində çalışan, yeni fikirlər axtaran, hörmətli müəllimlərimizlə fəxr edir, onlara bu şərəfli məsləkdə uğurlar arzulayırıq.

Bu gün müəllim peşəkar olmalı, müxtəlif pedaqoji təsir qabiliyyətinə malik olmalı, mümkün ola biləcək nəticələri proqnozlaşdırmalı, bir sıra təhlil və özünənəzarət üsullarını mənimsəməli, yeni sosial-iqtisadi tərbiyə şəraitini, bazar münasibətlərinin reallığını pedaqoji cəhətdən dərk etməlidir.

Qeyd etdiqlərimi yekunlaşdırıb demək istəyirəm ki, müəllimin mənəvi məsuliyyəti şagirdlərinin bilik, inam, mənəvi dünyası və siması üçün daşdığı məsuliyyətdir. Lakin müəllim öz fəaliyyətində süni və formal hərəkətlərə yol verirsə, onda nə şagirdlərinin bilikləri, nə inamları, nə də mənəvi simaları mükəmməl, sözün həqiqi mənasında zəngin ola bilər.

Economic Sciences

Роль качественного человеческого капитала в развитии делового туризма в Казахстане

Темирбеков А.Г.

докторант ОП «Инновационный менеджмент» ЕНУ им. Л.Н.Гумилева

Бердибекова А.Ш.

главный менеджер АО «НК «Kazakh Tourism»

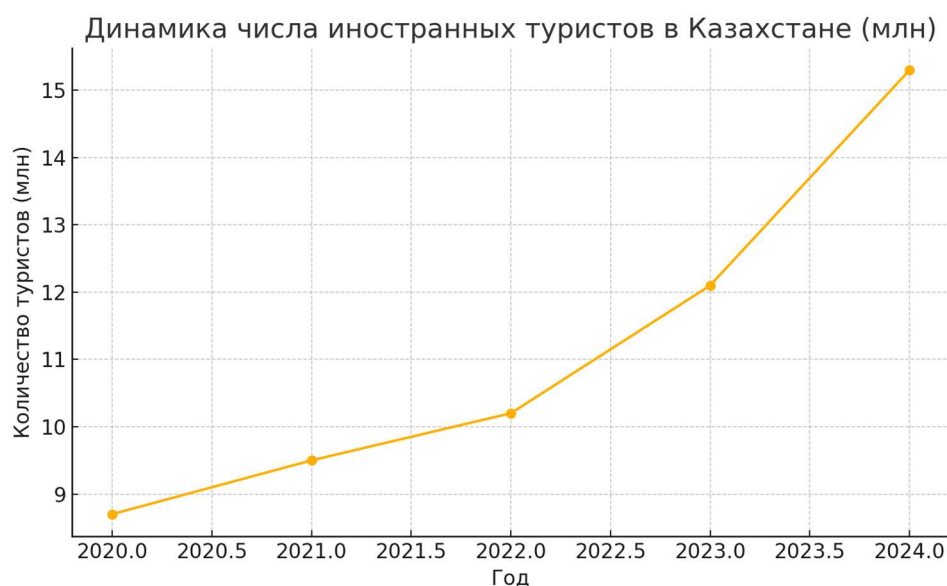
Майдырова А.Б.

д.э.н., профессор Кафедры «Экономика и предпринимательство» ЕНУ им.Л.Н.Гумилева

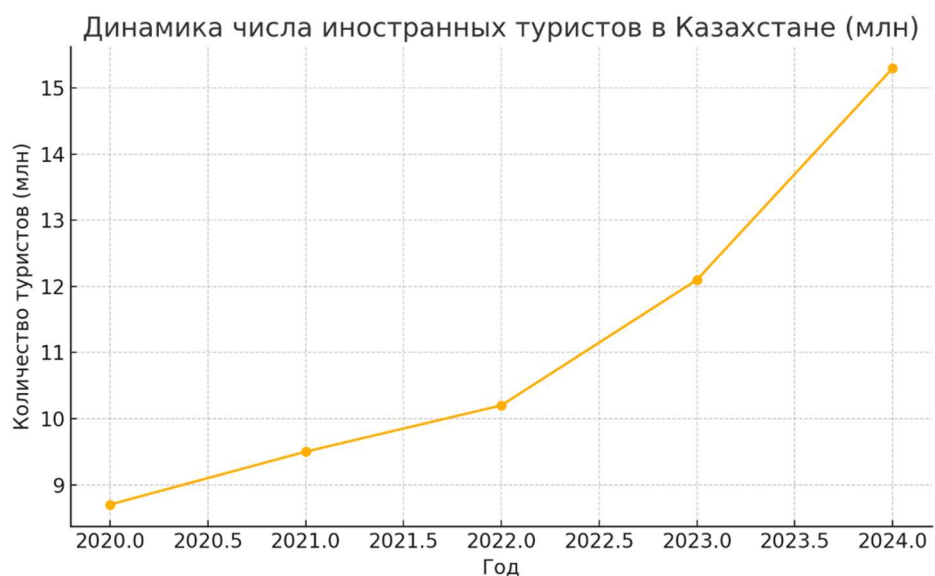
Аннотация Современные тенденции глобализации и экономического роста предъявляют высокие требования к качеству человеческого капитала. Особенно это актуально в контексте развития делового туризма, который становится драйвером экономической активности, инвестиционной привлекательности и международного сотрудничества. Казахстан, обладая выгодным географическим положением и политической стабильностью, стремится развивать MICE-сектор. В данной статье анализируется взаимосвязь между уровнем человеческого капитала и показателями делового туризма в стране на основе статистических данных за 2020–2024 гг.

Введение Деловой туризм (MICE: Meetings, Incentives, Conferences, Exhibitions) представляет собой важную составляющую современной экономики, способствующую не только развитию гостиничного и транспортного секторов, но и стимулированию международной деловой активности. В этой связи формирование высококвалифицированного кадрового потенциала становится необходимым условием конкурентоспособности Казахстана на мировом рынке делового туризма.

По данным официальной статистики, с 2020 по 2024 годы наблюдается устойчивый рост числа иностранных туристов, особенно в сегменте бизнес- поездок.



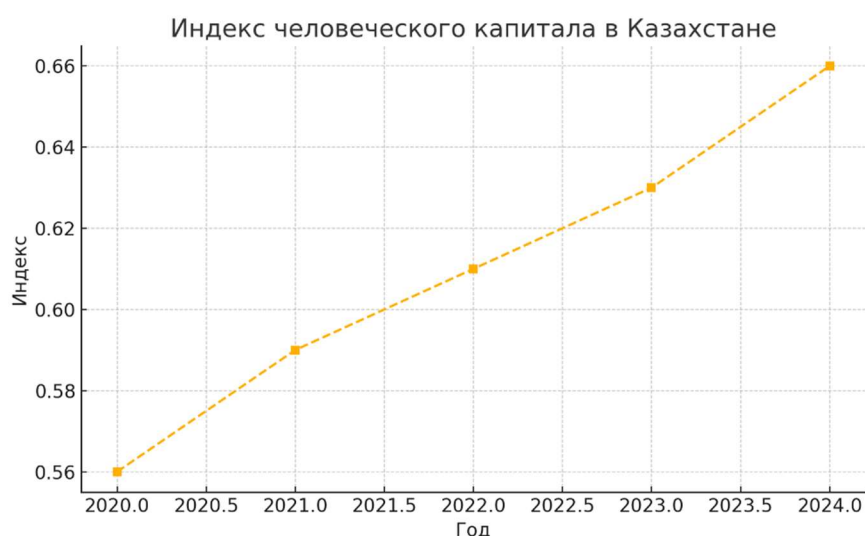
Рост турпотока сопровождается увеличением затрат на деловой туризм, что свидетельствует о росте доверия к Казахстану как к деловой площадке:



Дополнительно стоит отметить рост числа проводимых международных мероприятий, который вырос почти в 3 раза за пять лет:



Роль человеческого капитала Индекс человеческого капитала (условная метрика, учитывающая уровень образования, навыков и цифровой грамотности) также демонстрирует положительную динамику:



Ключевыми аспектами, влияющими на развитие делового туризма, являются:

- Профессиональное образование в сфере туризма и менеджмента мероприятий;
- Знание иностранных языков и культура сервиса;
- Навыки цифровой трансформации (работа с CRM, онлайн-платформами, аналитикой).

Несмотря на положительные тренды, Казахстан сталкивается с рядом вызовов:

- Недостаток кадров с опытом международной работы;
- Ограниченность инфраструктуры для проведения крупных мероприятий;
- Необходимость более активного продвижения на глобальном рынке MICE.

В результате исследования разработаны следующие рекомендуемые меры:

- Усиление взаимодействия вузов с индустрией туризма;
- Создание центров повышения квалификации с международными программами;

- Поддержка стартапов в сфере туристических технологий.

Хочется отметить, что человеческий капитал выступает фундаментом устойчивого развития делового туризма. Его качественное развитие напрямую влияет на имидж страны, объем инвестиций и экономическое благополучие. Казахстан обладает необходимым потенциалом, и дальнейшие усилия по развитию кадрового ресурса помогут ему закрепиться на международной арене как привлекательной MICE-локации.

International Experience in Dental Business Marketing

Tamar Orjonikidze

Doctoral Student, Doctoral Program in Business Administration, Caucasus International University, Faculty of Business and Technology

Abstract

The paper “**International Experience in Dental Business Marketing**” examines marketing strategies used to enhance the attractiveness and expand the scope of dental services across different countries. It explores approaches for improving these strategies and identifies effective methods for integrating marketing practices into specialized dental institutions.

The study reviews scientific literature by foreign researchers, enabling a comparative analysis of marketing strategies employed in similar and related sectors internationally. The research methods and methodological approaches discussed in international academic sources provide a foundation for selecting and applying suitable research methods for this study.

Keywords: Marketing, International Experience, Dentistry

Revised Introduction

Introduction

Relevance of the Topic

The issue of the adequacy and quality of dental services is observed with varying degrees of severity across economically developed and developing countries. The accessibility of dental clinics is one of the key indicators of service quality, and this remains a global challenge regardless of a country's level of economic development. Ensuring greater accessibility for patients is a major priority for managers of dental clinics, particularly in the context of expanding dental markets and intensifying competition. The development and practical implementation of effective marketing strategies is widely recognized as one of the most reliable approaches to addressing this challenge. This consideration served as the basis for formulating the purpose of the present study.

Purpose of the Study

The purpose of this work is to examine the fundamental principles of marketing in the dental business through a review and analysis of international experience.

Subject of the Research

The subject of the research is the practical experience of successful dental businesses around the world.

Research Method

This study employs a secondary research method, which involves analyzing existing information and drawing conclusions based on previously published data.

Discussion and Results

Branding and promotion play a significant role in the dental market. The development of a brand for a private dental organization and the promotion of its services is a relevant issue for owners and managers of such medical institutions worldwide, regardless of whether they operate in economically strong or weak countries. The primary source of revenue for a dental clinic is the payment received from patients for services. In most countries, the supply of commercial dental services is extensive, and patients have well-defined expectations. In this context, researchers highlight that one of the key factors for economic success is ensuring brand recognition.

Globally, dental brands are predominantly local and rarely extend beyond the region—or even the city—where they were established. Most brands focus primarily on the aesthetic component of medical services. Researchers note that the dental industry, like the broader medical sector, has limited experience with international, transnational, or transcontinental branding. (Davids A, Rawoot A, Sayed A, et al., 2022; Lira A, Magalhaes B., 2018)

When examining the naming of dental businesses, common elements include stems such as "stoma-" and "dent-". Another key element is the word "smile," which is frequently used both in clinic names and in advertising campaigns. Membership in professional associations and alliances is another distinctive feature of dental branding. The largest and oldest associations in the field are national dental associations, though younger and local associations also exist, such as city-specific dental organizations. Many patients are familiar with the phrase "dentists recommend us," which is often derived from such associations.

Most researchers agree that brand-building in dentistry often relies on strategic alliances. A successful brand is usually supported by a stronger, more authoritative, and larger association. Such partnerships provide benefits, including risk mitigation; however, they also require additional financial resources, such as membership fees, and may reduce the individuality and innovative potential of the brand.

The concept of an integrated brand implies that a dental clinic owns trademarks or service departments and applies them directly in practice. This model is more common among medium and large market players.

The concept of a long-term brand involves systematically working to establish a stable, positive image for the dental clinic over time. This approach is currently considered the most effective, as it partially incorporates elements of the other two models. When developing a brand under this concept, clinic management should integrate operational areas according to the principle of unity while diversifying activities to reduce future risks. Here, branding becomes part of strategic marketing and influences the physical structure of the business. Furthermore, long-term brand development aims to build lasting relationships with patients.

In today's highly competitive private dental sector, management and owners must intensify efforts to establish and promote a positive corporate image. This process is complex, largely due to insufficient marketing strategies and a lack of awareness of existing approaches.

From this perspective, researchers view brand positioning as the starting point of strategic marketing. The goal of aspirational positioning is to define and establish a clear market position that highlights the organization's advantages, reduces barriers for the target audience, and presents the organization more favorably than competitors.

In introducing a brand to the market, companies may face challenges such as negative reactions from microenvironmental entities and the influence of macroenvironmental factors on the brand and its market context. (Marina D, Maria A., 2020; Mathur D, Babu J, Joseph M, et al., 2019) Positioning involves creating a meaningful and respected place for the organization in consumers' minds, which becomes a stable perception and is difficult for competitors to disrupt.

Most researchers define positioning as the place a product, offer, brand, or symbol occupies in consumers' consciousness. Active efforts by the organization are needed to establish and maintain this position, emphasizing its importance in differentiating the brand from competitors. Positioning influences not only the organization itself but also elements of the microenvironment and macroenvironment. Consequently, understanding the positioning of a medical institution in the dental services market requires clarifying the concept of "medical institution positioning."

According to researchers, the position of a dental institution within a positioning system is the place established in the consciousness of the target audience, which the institution initially strives to occupy, subsequently maintains, or adjusts. This position is defined by the range of dental services offered, which align with the established paradigm of industry standards and form part of

the institution's brand. These elements can then be communicated and disseminated through various marketing channels. (Ajwa N, Al Mohsen S, Kuwail A, et al., 2018)

Currently, the following definition of "position" is widely accepted:

- A "position" is considered a dynamic category, reflecting the possibility of changes in the characteristics of micro- and macro-environmental parameters over time, meaning the position itself may evolve relative to its initial state.
- A "position" is communicated to the users of a medical institution's services through marketing communications, and its perception may vary depending on the user's interpretation and the position originally defined by the institution.

Brand positioning for a private dental clinic should involve addressing a set of tasks aimed at transforming the internal environment of the organization and adapting it to the competitive conditions of the external market. These tasks include:

1. **Conducting an internal audit** – At this stage, the clinic assesses its internal resources, including professional staff, the state of material and technical infrastructure, available financial resources, and the ability to quickly mobilize additional resources.
2. **Analyzing the external competitive environment** – This analysis identifies the strengths and weaknesses of competitors, compares them with the clinic's own capabilities, and helps determine new market directions and potential niches to occupy.
3. **Analyzing demand for paid medical services** – Emphasis is placed on understanding the purchasing power of the target audience and evaluating the potential for its growth or redistribution.
4. **Identifying opportunities to improve service quality** – From the patient's perspective, these attributes may be subjective, but addressing them directly influences client motivation to purchase services.

Researchers argue that addressing these tasks strengthens the corporate image of the dental clinic, enhancing its reputation and improving differentiation from competitors. Brand positioning based on the company's image also informs the development of communication strategies. Well-planned and strategically modeled brand positioning, therefore, serves as a source of competitive advantage and shapes positive consumer perceptions of the clinic, the quality of its services, and pricing. (Bahabri RH, Zaidan AB, 2020)

Furthermore, researchers note that during the planning of a dental clinic's positioning, it is essential to define a precise list of services. This list should reflect the preferences and needs of the target audience, taking into account factors such as patients' income levels, lifestyles, expectations, and desires.

In conditions of economic instability, which is often characteristic of economically weak countries, many companies providing medical and dental services have adopted a democratic pricing policy. This approach balances the "price-quality" ratio while maintaining an acceptable level of comfort and service. It enables enterprises to sustain a balance between commercial efficiency and the social accessibility of services; however, it is feasible only if the clinic can ensure a sufficient flow of clients. (Hassan S, Bhateja S, Arora G, et al., 2020)

An analysis of the literature indicates that, in their early stages, most dental clinics were established near or within shopping and entertainment centers. Despite higher rental costs in these locations, management often relies on the increased client flow. Researchers argue that this strategy is reasonable because shopping centers are typically crowded and well-equipped with amenities such as large parking spaces, which should positively influence sales volumes. However, in such locations, medical institutions often operate in a "truncated" model rather than in a traditional format. This is consistent with the business model, as high customer flow—particularly in large-city shopping centers—supports the provision of services adapted to high throughput.

Experience from Western countries, dating back to the mid-2000s, demonstrates the success of the “retail medical and dental clinic” model. This model applies to small clinics situated in retail spaces, co-located with large supermarkets, shopping and entertainment centers, retail stores, restaurants, and other commercial establishments. These clinics are attractive in terms of physical accessibility and convenience. However, the range of services offered is usually limited, focusing on high-demand, paid services such as laboratory tests, general medicine, diagnostics of acute conditions (e.g., respiratory infections, urinary tract infections, minor skin diseases), and emergency dental care. Additionally, such clinics often provide preventive procedures and vaccinations. Clinics operating under this model are typically compact, sufficient to deliver primary healthcare and emergency care without requiring large-scale or complex medical equipment typical of traditional multidisciplinary clinics. (Salim NA, Jubair F, Hassona YM, Izriqi S, Al-Fuqaha’a D, 2021)

This model of service delivery is in demand in many foreign countries due to its convenience, accessibility, and affordability. Often, these clinics are vertically integrated into the infrastructure of larger medical institutions. A notable example is the American hypermarket chain Walmart, which established “Walmart Health” clinics within its stores, offering primary medical care, dentistry, laboratory and radiographic services, diagnostics, and consultations.

Researchers generally approve of this format, as it facilitates early disease detection, and early-stage treatment is known to be more effective.

However, experts caution against directly replicating this experience in other countries without adaptation. When considering its application in new contexts, several factors must be addressed:

1. Initially, retail clinics should be limited to large cities and located near major shopping or entertainment centers. Depending on the healthcare system—whether state-based or private insurance—this model may primarily appeal to the middle class, while low-income populations may prefer alternative treatment options.
2. Locating medical centers adjacent to entertainment and shopping facilities may not be culturally or socially acceptable in some regions, due to differing population mentalities and expectations.
3. Retail medical clinics are a novel format for many domestic consumers, requiring substantial investment in marketing and brand promotion to gain acceptance.

Despite these challenges, several factors suggest potential success for retail clinics, including dental clinics, in domestic markets. The middle class in many countries is increasingly health-conscious, and residents of large cities prioritize convenience and time efficiency. Comfort, accessibility, and quality of service are important considerations for prospective patients. With effective branding and strategic positioning, medical and specialized dental clinics operating under the retail format have strong potential to expand their market reach and increase service volumes. (Ajwa N, Al Mohsen S, Kuwail A, et al., 2018)

Another important topic in today’s discussion is the relationship marketing model, which is considered fundamental for brand formation in commercial medical institutions. Most researchers view medical services as a product of the relationship between the patient and the clinic. The value of a medical service for the consumer is a subjective concept, influenced by numerous factors. By analyzing both the tangible outcomes of medical care and the patient’s perception of receiving it, one can evaluate the effectiveness of various service parameters in marketing terms. The core idea of relationship marketing in medical institutions is that the relationship established between the patient and the clinic during the exchange of goods and services should generate additional positive effects for both parties.

Medical service is a product of multifaceted relationship marketing. Its complexity is evident in its characteristics, including heterogeneity and information asymmetry between doctor and patient, as well as its intricate structure. Despite these features, the medical service ultimately constitutes

a complete and integrated product. In dentistry, the final product is treatment, which may vary from the outcome expected by the consumer. The magnitude of this variation depends on factors such as the clinic's material and technical resources, accessibility of dental services, the professional skills and competence of the doctor, and the sanitary and hygienic conditions of the clinic.

The patient's perception is further influenced by the doctor's communication skills, the motivation and attentiveness of the clinic staff, and the overall comfort experienced during the visit.

Comprehensive medical services can be conceptualized as a four-level product, each level characterized by specific attributes (Almozainy, 2017):

1. **Generic (main) product** – This level represents the primary benefit the patient receives in exchange for payment. In dentistry, this benefit is the treatment itself, which may result in full recovery or an intermediate improvement, particularly in chronic conditions.
2. **Expected product** – This level reflects the patient's expectations, which are shaped by the clinic through declared service properties and standards. Patients expect modern technical equipment, cleanliness and order, professional competence of doctors, and accessibility of care in material, temporal, and geographical terms.
3. **Advanced product** – This level includes characteristics that exceed patient expectations. Examples include the doctor's communication skills, staff attentiveness and friendliness, patient comfort, and well-organized business processes that integrate the clinic environment with patient needs. The doctor-patient relationship is a critical element here, as patient trust fosters commitment, creating positive effects for both parties in relationship marketing. Patient comfort also extends to stress-reduction measures, such as well-designed waiting areas, accessibility features for individuals with limited mobility, and other infrastructure considerations. Effective process management within the clinic further contributes to patient satisfaction and reduced stress.
4. **Potential product** – At this level, additional marketing strategies are implemented to further enhance service delivery and better meet patient needs. (Ghandhi D, Bodani N, Lal A, et al., 2022; Vukusic Rukavina T, Viskic J, Machala Poplasen L, Relic D, Marelic M, Jokic D, et al., 2021)

Several researchers emphasize that improving dental service delivery may also involve strategies such as patient education and the development of the doctor's personal brand [Uma E, Nieminen P, Mani SA, John J, Haapanen E, Laitala ML, et al., 2021]. The foundation of relationship marketing is the construction of a value chain for the patient, which ultimately shapes their perception of the service or product. This value chain consists of two main components: the value formation system within the clinic and the patient, as the final recipient and perceiver of that value.

The first component of the value chain—the dental service value formation system—requires initial information about the patient's health status before treatment and encompasses the process of creating dental value directly. This process involves a three-way interaction among the patient, the medical staff, and the clinic. Implementation of this component necessitates the use of multiple marketing approaches—external, internal, or a combination of both. As a result of effectively managing this three-way interaction in a commercial dental institution, a high level of customer focus is established, which serves as a key indicator of the development of relationship marketing.

Since the effectiveness of the dental service value chain is ultimately evaluated from the patient's perspective, researchers have emphasized the importance of two strategic directions within relationship marketing: patient education and the development of doctors' personal brands.

1. Patient education – The goals and outcomes of patient education vary depending on the stage of the relationship. At the initial stage, educational initiatives are designed to deepen and

strengthen communication with the patient, providing necessary information to enhance engagement and understanding of the services offered.

2. Development of personal brands of doctors – The personnel of any business, particularly in the medical field, are its most critical asset. In healthcare, where human lives are at stake, the expertise and reputation of medical professionals represent a primary competitive advantage. In a dental clinic, the personal brand of each doctor is an integral component of the organization's overall brand. Developing a doctor's personal brand is therefore also a pathway to strengthening the clinic's brand.

The development of a personal brand largely depends on the doctor's visibility and recognition. Specialists who actively and effectively share information about themselves and their professional activities online gain greater recognition not only among patients but also within the wider medical community. Beyond mainstream social media platforms, specialized professional networks have gained popularity in recent years. Examples of such platforms include "ProDoctors," "Doctor at Work," "VrachiRF," and "Stomar-ticle," among others. In many countries, these platforms are facilitating the formation of virtual professional communities for doctors, including dentists, thereby enhancing opportunities for networking, knowledge sharing, and brand visibility (Huang E, Dunbar CL, 2023).

Researchers identify three main factors that significantly enhance the promotion of a doctor's, including a dentist's, personal brand in social networks or professional associations. The first factor is **educational opportunities**. Doctors can join virtual professional communities, gaining access to advanced practices, the latest research, and continuous professional development in their field. The second factor is the **accelerated exchange of professional experience and communication with colleagues**. Through online discussions about symptoms, treatment methods, and clinical cases, doctors can enhance their expertise while simultaneously increasing their authority within the professional community. The third factor is the **development of a qualified labor market for medical specialists**. Potential employers, often managers of dental clinics or departments, increasingly use professional social networks to assess the ratings and reputations of medical professionals.

In contemporary practice, the study and application of **relationship marketing** is considered a logical and essential step for the development of commercial medical organizations, particularly in the dental sector. Integrating relationship marketing theory and practice into dental clinic operations allows for more effective patient engagement, strengthens brand perception, and fosters long-term professional and organizational growth (Sivaramakrishnan G, Abdulameer F, Faisal F, et al. 2023; Davids A, Rawoot A, Sayed A, et al. 2022; Internet World Stats, 2022; Kahale LA, Elkhoury R, El Mikati I, et al. 2021; Sivrikaya EC, Yilmaz O, Sivrikaya P, 2021; Nur H, Nor F, Muhammad S, et al. 2020; Parmar N, Eisingerich AB, Dong L, 2018).

Conclusion

Based on the analysis, it is evident that researchers pay significant attention to the marketing of dental services and propose numerous strategies to enhance the effectiveness of commercial dental organizations. Proper implementation of these strategies increases competitive advantages and improves the overall quality of internal operations and external service delivery in the dental business.

The following conclusions can be drawn from secondary research:

- Marketing in dental clinics should always be considered within the framework of the organization's management system, which integrates and harmonizes multiple areas of activity.
- Management decisions in commercial dental clinics should be grounded in comprehensive marketing studies of both the internal and external environments.

- In the dental industry, demand often exceeds supply; identifying potentially profitable market segments during the marketing research stage enables long-term competitive advantages.
- On an international scale, effective marketing in dental organizations is characterized by:
 1. Branding and promotion of clinic services;
 2. Development of the doctor's personal brand and its integration into the clinic's overall brand;
 3. Aligning the services provided by the dental business with patient expectations through consumer education and awareness initiatives.

References

- Al-Khalifa, K. S., Al-Swuailem, A. S., AlSheikh, R., et al. (2021). The use of social media for professional purposes among dentists in Saudi Arabia. *BMC Oral Health*, 21, 1–8. <https://pubmed.ncbi.nlm.nih.gov/33435911/>
- Ajwa, N., Al Mohsen, S., Kuwail, A., et al. (2018). The impact of using social media networks on dental treatment marketing in Saudi Arabia: The practitioners and patient's perspectives. *Journal of Oral Health and Dental Science*, 2, 1–10. <https://www.researchgate.net/publication/329327672>
- Almozainy, M. (2017). Assessing the use of social media as a source of information related to dentistry in Saudi Arabia. *Journal of Dental Health, Oral Disorders & Therapy*, 8. Advance online publication. <https://doi.org/10.15406/jdhodt.2017.08.00312>
- Alkadhi, O. H., Aleissa, N. K., Almoharib, M. K., et al. (2020). Influence of social media on the patients for choosing the dental clinic: A cross-sectional survey. *Journal of Clinical and Diagnostic Research*. <https://doi.org/10.7860/jcdr/2020/43457.13466>
- Afful-Dadzie, E., Afful-Dadzie, A., & Egala, S. B. (2021). Social media in health communication: A literature review of information quality. *Health Information Management*. <https://pubmed.ncbi.nlm.nih.gov/33818176>
- Abu-Ghazaleh, S., Hassona, Y., & Hattar, S. (2018). Dental trauma in social media—Analysis of Facebook content and public engagement. *Dental Traumatology*, 34(6), 394–400. <https://doi.org/10.1111/edt.12429>
- Bahabri, R. H., & Zaidan, A. B. (2021). The impact of social media on dental practice promotion and professionalism amongst general dental practitioners and specialists in KSA. *Journal of Taibah University Medical Sciences*, 16(3), 456–460. <https://doi.org/10.1016/j.jtumed.2020.12.017>
- Dadaczynski, K., Okan, O., Messer, M., Leung, A. Y., Rosario, R., Darlington, E., et al. (2021). Digital health literacy and web-based information-seeking behaviors of university students in Germany during the COVID-19 pandemic: Cross-sectional survey study. *Journal of Medical Internet Research*, 23(1), e24097. <https://doi.org/10.2196/24097>
- Davids, A., Rawoot, A., Sayed, A., et al. (2022). Social media and dentistry. *South African Dental Journal*, 77, 592–599. <https://journals.assaf.org.za/index.php/sadj/article/view/15357>
- Dwi Ekasari, F., & Sulistiadi, W. (2020). Business development of dental services marketing in hospital: A systematic review. *Jurnal Asri*, 6, 67–73. <https://scholarhub.ui.ac.id/arsi/vol6/iss2/2/>
- Ghandhi, D., Bodani, N., Lal, A., et al. (2022). Evaluation of social media usage by dental practitioners of Pakistan for professional purposes – A cross-sectional study. *Clinical, Cosmetic and Investigational Dentistry*, 14, 245–252. <https://pubmed.ncbi.nlm.nih.gov/35975279/>
- Hassan, S., Bhateja, S., Arora, G., et al. (2020). Marketing in dentistry. *Journal of Management Research and Analysis*, 7, 98–100. <https://www.jmra.in/article-details/12234>
- Huang, E., & Dunbar, C. L. (2023). Connecting to patients via social media: A hype or a reality? *Journal of Medical Marketing*, 13, 14–23. <https://www.researchgate.net/publication/274485922>

- Internet World Stats. (2022). Internet usage in the Middle East (Bahrain). Lancaster, PA: Internet World Stats. <https://www.internetworldstats.com/stats5.htm>
- Kahale, L. A., Elkhoury, R., El Mikati, I., et al. (2021). PRISMA flow diagrams for living systematic reviews: A methodological survey and a proposal. *F1000Research*, 10, 1–11. <https://pubmed.ncbi.nlm.nih.gov/35136567/>
- Lee, S.-Y., Kwak, M.-G., Kim, M.-J., et al. (2021). Relevance between marketing route of social media and consumer age group for choosing dental clinics. *Journal of Dental Hygiene Science*, 21, 260–266. <https://www.jkdhs.org/journal/view.html?doi=10.17135/jdhs.2021.21.4.260>
- Lira, A., & Magalhaes, B. (2018). Digital marketing in dentistry and ethical implications. *Brazilian Dental Science*, 21, 237–246. <https://bds.ict.unesp.br/index.php/cob/article/view/1524>
- Mathur, D., Babu, J., Joseph, M., et al. (2019). Efficiency of digital marketing & medical health care tourism: Double ended swords. *Saudi Journal of Medical and Pharmaceutical Sciences*, 5, 552–557. <http://jurnal.pdgi.or.id/index.php/jida/article/view/1041>
- Marina, D., & Maria, A. (2020). Branding in dentistry: A historical and modern approach to a new trend. *GSC Advanced Research and Reviews*, 3, 51–68. <https://www.researchgate.net/publication/342282447>
- Melkers, J., Hicks, D., Rosenblum, S., Isett, K. R., & Elliott, J. (2017). Dental blogs, podcasts, and associated social media: Descriptive mapping and analysis. *Journal of Medical Internet Research*, 19(7), e269. <https://doi.org/10.2196/jmir.7868>
- Modha, B. (2023). Exploring customer journeys in the context of dentistry: A case study. *Dentistry Journal (Basel)*, 11, 1–18. <https://pubmed.ncbi.nlm.nih.gov/36975572/>
- Nur, H., Nor, F., Muhammad, S., et al. (2020). The pattern of social media marketing by dentist in Malaysia. *Malaysian Dental Journal*, 1, 24–42. <https://www.researchgate.net/publication/347992774>
- Parmar, N., Eisingerich, A. B., & Dong, L. (2018). Connecting with your dentist on Facebook: Patients' and dentists' attitudes towards social media usage in dentistry. *Journal of Medical Internet Research*, 20, 1–12. <https://pubmed.ncbi.nlm.nih.gov/29959108/>
- Salim, N. A., Jubair, F., Hassona, Y. M., Izriqi, S., & Al-Fuqaha'a, D. (2021). Esthetic dentistry on Twitter: Benefits and dangers. *International Journal of Dentistry*. <https://pubmed.ncbi.nlm.nih.gov/34925512/>
- Sivaramakrishnan, G., Abdulameer, F., Faisal, F., et al. (2023). Use of social media to view and post dentistry-related information in Bahrain: A cross-sectional study. *Healthcare Informatics Research*, 29, 31–39. <https://pubmed.ncbi.nlm.nih.gov/36792099/>
- Sivrikaya, E. C., Yilmaz, O., & Sivrikaya, P. (2021). Dentist-patient communication on dental anxiety using social media: A randomized controlled trial. *Scandinavian Journal of Psychology*, 62(6), 780–786. <https://doi.org/10.1111/sjop.12769>
- Uma, E., Nieminen, P., Mani, S. A., John, J., Haapanen, E., Laitala, M. L., et al. (2021). Social media usage among dental undergraduate students: A comparative study. *Healthcare (Basel)*, 9(11), 1408. <https://doi.org/10.3390/healthcare9111408>
- Vukusic Rukavina, T., Viskic, J., Machala Poplasen, L., Relic, D., Marelic, M., Jokic, D., et al. (2021). Dangers and benefits of social media on e-professionalism of health care professionals: Scoping review. *Journal of Medical Internet Research*, 23(11), e25770. <https://doi.org/10.2196/25770>

Методологические подходы к оценке эффективности интеграции бизнеса: сравнительный анализ моделей

А. Цой

Almaty Management University, г. Алматы

Н. Никифорова

Almaty Management University, г. Алматы

Аннотация. Эффективность бизнес-интеграции – ключевой фактор успешной реализации стратегий слияния, поглощения и партнерства. В условиях динамичной рыночной среды традиционные методы оценки часто оказываются недостаточными для всестороннего анализа интеграционных процессов. Цель данной статьи – определить наиболее целесообразные методологические подходы к оценке эффективности интеграции бизнеса и сформировать практические рекомендации по их применению с учетом типа интеграции, уровня риска, отрасли и синергетического потенциала. В работе систематизированы существующие модели оценки, включая финансово-экономические, сбалансированные системы показателей, методы оценки синергетического эффекта, а также нефинансовые подходы, учитывающие культурные, управленческие и цифровые аспекты интеграции. Особое внимание уделяется применимости различных моделей в зависимости от типа интеграции и целей бизнеса. На основе анализа выделены преимущества и ограничения каждого метода, а также предложены рекомендации по их практическому применению. Полученные результаты имеют теоретическое и прикладное значение для исследователей и практиков в области корпоративного управления, стратегического менеджмента и оценки инвестиций.

Ключевые слова: интеграция бизнеса, оценка эффективности, методологические подходы, синергия, модели DCF и EVA, стратегический менеджмент, инвестиционные проекты, слияния и поглощения, Balanced Scorecard, нефинансовые показатели.

Аңдатпа. Бизнес-интеграцияның тиімділігі – бірігу, жұтылу және әріптестік стратегияларын табысты жүзеге асырудың негізгі факторы болып табылады. Нарықтық ортаның тұрақсыздығы жағдайында интеграциялық процестерді жан-жақты талдауға дәстүрлі бағалау әдістері жиі жеткіліксіз болып жатады. Зерттеудің мақсаты – бизнес интеграциясының тиімділігін бағалауға арналған ең орынды әдістемелік тәсілдерді айқындау және оларды интеграция түрі, тәуекел деңгейі, сала ерекшелігі мен синергетикалық әлеуетін ескере отырып қолдануға қатысты практикалық ұсынымдар әзірлеу. Зерттеу барысында қазіргі қолданыстағы бағалау модельдері жүйеленіп, олардың қатарына қаржылық-экономикалық әдістер, теңгерімделген көрсеткіштер жүйесі, синергетикалық әсерді бағалау әдістері, мәдени, басқарушылық және цифрлық аспектілерді ескеретін қаржылық емес тәсілдер енгізілді. Әрбір әдістің интеграция түріне және бизнестің мақсаттарына байланысты қолдану ерекшеліктері көрсетілді. Әдістердің артықшылықтары мен шектеулері талданып, оларды практикалық тұрғыда қолдану бойынша ұсынымдар берілді. Алынған нәтижелер корпоративтік басқару, стратегиялық менеджмент және инвестицияларды бағалау салаларындағы зерттеушілер мен тәжірибешілер үшін теориялық және қолданбалы маңызға ие.

Кілт сөздер: бизнес интеграциясы, тиімділікті бағалау, әдістемелік тәсілдер, синергия әсері, DCF және EVA модельдері, стратегиялық менеджмент, инвестициялық жобалар, бірігу мен жұтылу, Balanced Scorecard, қаржылық емес көрсеткіштер.

Annotation. The effectiveness of business integration is a key factor in the successful implementation of merger, acquisition, and partnership strategies. In a dynamic market environment, traditional evaluation methods often fall short of providing a comprehensive analysis of integration processes. The objective of the study is to identify the most appropriate methodological approaches for evaluating the effectiveness of business integration and to develop practical recommendations for their application, taking into account the type of integration, risk level, industry specifics, and synergistic potential. The study systematizes existing evaluation models, including financial and economic methods, balanced scorecard systems, methods for assessing synergy effects, as well as non-financial approaches that consider cultural, managerial, and digital aspects of integration. Special attention is paid to the applicability of different models depending on the type of integration and business objectives. The analysis highlights the advantages and limitations of each method and provides recommendations for their practical application. The results have both theoretical and applied significance for researchers and practitioners in corporate governance, strategic management, and investment evaluation.

Keywords: business integration, effectiveness assessment, methodological approaches, synergy, DCF and EVA models, strategic management, investment projects, mergers and acquisitions, Balanced Scorecard, non-financial indicators.

1. Введение

Современные процессы глобализации, цифровизации и усиливающейся конкуренции на мировом и региональном рынках побуждают компании к объединению ресурсов и созданию устойчивых стратегических альянсов. Интеграционные процессы в бизнесе, будь то слияния, поглощения или иные формы сотрудничества, рассматриваются как ключевые инструменты повышения конкурентоспособности и устойчивости организаций. Однако без четкой и обоснованной методологии оценки эффективности таких проектов существует риск недостижения стратегических целей и потерь ресурсов. Это делает проблему оценки эффективности интеграции бизнеса особенно актуальной как для теоретиков, так и для практиков в области управления.

Целью данной статьи является определение наиболее целесообразных методологических подходов к оценке эффективности интеграции бизнеса и разработка практических рекомендаций по их применению с учетом типа интеграции, уровня риска, отрасли и синергетического потенциала. Для достижения цели были поставлены следующие задачи:

- систематизировать существующие модели оценки эффективности;
- определить ключевые критерии сравнительного анализа;
- выявить преимущества и ограничения применяемых подходов;
- разработать практические рекомендации по выбору оптимального метода в зависимости от типа интеграции.

Гипотеза: Предполагается, что не существует универсального методологического подхода, одинаково эффективного для оценки всех типов бизнес-интеграции. Вместе с тем, комбинирование финансовых и нефинансовых моделей, адаптированных к специфике интеграционного проекта, позволяет более точно и объективно оценить его эффективность.

2. Литературный обзор

Методологические подходы к оценке эффективности интеграции бизнеса на протяжении последних десятилетий эволюционировали от монодисциплинарных финансовых моделей к сложным мультифакторным и гибридным конструкциям. Этому способствовало не только усложнение самих интеграционных процессов, но и рост требований к стратегической обоснованности, прозрачности и устойчивости сделок. Современные исследователи всё чаще рассматривают интеграцию как многоуровневое явление, охватывающее не только экономические, но и институциональные, поведенческие, культурные и цифровые аспекты.

Традиционно оценка эффективности интеграции основывалась на методах корпоративных финансов. В первую очередь, на модели дисконтированных денежных потоков (DCF), позволяющей вычислить прирост стоимости объединённой компании. В работе Родионова И. и Михальчука В. обосновывается применимость DCF в условиях развивающихся рынков, где синергия оценивается как разность между интегральной стоимостью объединённой структуры и суммой стоимостей отдельных компаний до сделки. Однако авторы подчёркивают уязвимость метода в условиях институциональной нестабильности и ограниченного доступа к качественным данным [1].

Классические модели, подобные EVA, ROI и TSR, активно используются в западной практике, однако подвергаются обоснованной критике за чрезмерную сосредоточенность на акционерной стоимости как единственном индикаторе успешности интеграции. В отличие от этого, исследование Вашакмадзе Т., Мартиросян Э. акцентирует внимание на необходимости включения в модель оценки нефинансовых параметров, таких как темпы операционного сближения, коэффициент текучести ключевого персонала и индекс синергетической реализации, отражающий достижение качественных целей интеграции. Авторы подчёркивают, что такая многомерная перспектива позволяет адекватнее отразить реальную эффективность постинтеграционного периода, особенно в контексте долгосрочных стратегических целей [2].

Одним из наиболее влиятельных поведенческих направлений остаётся модель «стратегического соответствия», предложенная П.К. Хаспеслагом и Д.Б. Джемисоном ещё в 1991 году и впоследствии адаптированная современными авторами. Особое внимание к культурным и институциональным аспектам интеграции прослеживается в работах Картрайт С. и Купера К., где эмпирически доказано, что несогласованность корпоративных культур часто нивелирует ожидаемые финансовые выгоды [3].

Федорову Е.А. и Изотову Е.И. демонстрируют потенциал применения метода кумулятивной избыточной доходности для оценки эффективности сделок в энергетическом секторе. Данный подход позволяет учитывать волатильность отрасли и формировать более объективную оценку прироста доходности по сравнению с бенчмарком [4]. Се Юн С. и Сюй Хунбо также подчёркивают необходимость включения стратегических и нефинансовых параметров в модели оценки, особенно в случае вертикальной интеграции [5].

Значительный вклад в развитие регионально адаптированных моделей внесли Лалаян Г.Г. и Кремянская Е.В., рассмотревшие интеграционные процессы в агропромышленном комплексе. Они выдвигают идею применения транзакционного подхода в связке с моделью кластерной эффективности Портера, что позволяет оценивать не только финансовые, но и логистические, инфраструктурные и управленческие синергии [6].

В научной литературе вопросам комплексной оценки эффективности интеграционных процессов также уделяется значительное внимание. Среди первых работ, направленных на преодоление ограниченности исключительно финансовых подходов, выделяется исследование Фихтнера О.А., где подчёркивается значимость организационно-структурных

изменений, включая усиление рыночных позиций, управляемость и корпоративную культуру [17]. Современные формы интеграции как кластерные объединения были предметом анализа в работах Николаевой М.А. и Махотаевой М.Ю., где акцент сделан на способности к совместному созданию инновационной экосистемы [8]. Белоусова В.О. и Кожевина О.В. провели типологизацию подходов и предложили комбинированную систему выбора модели оценки на разных этапах сделки [9]. Отдельный интерес представляет работа Ефремова В.С. и Владимировой И.Г., в которой формализована мультифакторная модель, учитывающая кросс-культурные и институциональные различия при международной интеграции [10]. Современные интеграционные формы всё чаще реализуются в формате сетевых структур, требующих особых критериев оценки. Авторы предлагают ввести понятие «качества межфирменной связи» и применять методы анализа сетей для оценки устойчивости и результативности таких объединений. Это особенно актуально в условиях цифровизации и платформенной экономики, где интеграция может не носить формально юридического характера, но иметь значительный управленческий эффект.

Наиболее заметной тенденцией последних лет становится переход от статических моделей к динамическим, способным учитывать временные лаги, фазность интеграционного процесса и его обратимость. Всё чаще интеграция трактуется не как одноразовое действие, а как многоступенчатый процесс, требующий системной оценки в средне- и долгосрочной перспективе. Возрастает интерес к моделям, основанным на теории реальных опционов, машинном обучении и поведенческой экономике.

Современное состояние научной мысли по проблеме оценки эффективности интеграции бизнеса характеризуется высокой степенью междисциплинарности, теоретической фрагментацией и региональной дифференциацией. В литературе выстраивается единый тренд в сторону гибкости, адаптивности и ориентации на долгосрочную ценность, что определяет направление дальнейшего методологического поиска.

3. Методы

Настоящее исследование основано на применении как качественных, так и количественных методов анализа, направленных на систематизацию и сравнительное сопоставление существующих методологических подходов к оценке эффективности интеграции бизнеса. Методологическая база строится на междисциплинарном синтезе концепций стратегического менеджмента, корпоративных финансов, институциональной теории и организационной трансформации, моделей стратегического соответствия.

На первом этапе был проведён углублённый анализ современных теоретических и прикладных источников за 2020-2025 гг., включая рецензируемые научные статьи, аналитические отчёты международных консалтинговых компаний, кейс-исследования, а также диссертационные исследования. Такая база позволила сформировать репрезентативный спектр моделей, охватывающих различные классы интеграции, что стало основой для последующего сравнения.

Применялся метод сравнительного анализа, позволяющий соотнести модели по единому набору универсальных критериев: применимость к типу сделки, учёт финансовых и нефинансовых параметров, уровень требуемых входных данных, адаптивность к отраслевым и организационным условиям, а также сложность внедрения. Особое внимание уделено способности моделей к долгосрочному прогнозированию синергетического эффекта и оценке стратегической устойчивости интеграции.

С учётом комплексности поставленных задач, в исследовании использованы элементы когнитивного картирования, основанные на модели стратегического соответствия, а также балльные и мультикритериальные подходы, применявшиеся в

эмпирических работах отечественных и зарубежных исследователей. Это позволило оценить не только эффективность конкретных моделей, но и выявить зоны их применимости в зависимости от масштаба сделки, корпоративного контекста и институциональной среды.

Результаты анализа представлены в виде матрицы применимости моделей, содержащей качественную и количественную оценку каждой модели по заданным критериям. В работе обобщены экспертные оценки и результаты эмпирических кейсов, что позволило перейти от теоретического осмысления к выработке практических рекомендаций.

Методологическая конструкция статьи сочетает в себе системный анализ, критическую оценку подходов и их прикладную верификацию, обеспечивая надёжную основу для последующего синтеза выводов и разработки обоснованных рекомендаций по выбору оптимального подхода к оценке эффективности бизнес-интеграции.

4. Результаты

На основе системного сравнительного анализа моделей оценки эффективности интеграции бизнеса были получены комплексные результаты, позволяющие выявить как методологические различия между подходами, так и области их применимости. Исследование включало анализ как классических финансовых методов (DCF, EVA), так и поведенческих, стратегических и гибридных моделей, представленных в современных академических и прикладных источниках. Оценка проводилась по пяти ключевым критериям: полнота охвата финансовых и нефинансовых факторов, гибкость адаптации модели к контексту, точность долгосрочного прогнозирования, а также общая применимость в различных отраслях. Балльная шкала (от 1 до 5) формировалась на основе интерпретации подходов, описанных в работах Родионова И. и Михальчука В., Федоровой Е.А., а также ряда международных публикаций по стратегическому соответствию и мультикритериальной оценке.

Таблица 1. Сравнительный анализ моделей оценки эффективности интеграции бизнеса

№	Модель	Финансовые показатели (1–5)	Нефинансовые факторы (1–5)	Гибкость адаптации (1–5)	Прогнозная точность (1–5)	Общая оценка (из 25)
1	DCF (дисконтированные денежные потоки)	5	1	3	5	14
2	Модель EVA (экономическая добавленная стоимость)	5	2	3	4	14
3	Мультикритериальный анализ (MCDM)	3	5	4	3	15
4	Модель стратегического соответствия (Strategic Fit)	2	5	5	4	16
5	Интеграционная матрица Хаспеслага–Джемисона	2	4	4	3	13
6	Метод кумулятивной избыточной доходности	4	2	2	4	12

В обобщающей таблице 1 представлены интегральные оценки моделей по пяти критериям, на основании которых формируются дальнейшие методические рекомендации. Совокупный анализ указывает на то, что наиболее эффективными в современных условиях являются модели, способные интегрировать количественные и качественные параметры, адаптироваться к отраслевым и региональным условиям и учитывать долгосрочный стратегический горизонт интеграции.

Как показывает таблица 1, наиболее сбалансированным инструментом оказался подход стратегического соответствия, на основе классической модели Хаспеслага П. К. и Джемисона Д. Б. Эта модель получила высокую оценку за способность интегрировать нефинансовые переменные, включая культурные, цифровые и организационные различия, а также адаптироваться к различным масштабам сделок. Несмотря на умеренные показатели по финансовой точности, именно она оказалась наиболее универсальной по совокупности критериев.

Модель мультикритериального анализа (MCDM), также продемонстрировала высокую результативность благодаря своей способности учитывать разнообразные показатели, от стратегических целей до операционных рисков. Однако её применение требует значительных аналитических ресурсов и высокого уровня квалификации исполнителей, что ограничивает её распространённость в бизнес-среде.

Финансовые модели, такие как DCF и EVA, по-прежнему демонстрируют высокую точность в условиях полной информации и стабильной макроэкономической среды. Однако их неспособность охватывать поведенческие и культурные параметры интеграции делает их менее релевантными в кросс-культурных сделках или при оценке нематериальной синергии. Эта ограниченность была подчёркнута в работах Вашакмадзе Т., Мартиросян Э., а

также в отчётах ЕУ, где подчёркивается тренд перехода к многоуровневым моделям оценки интеграции.

Интересные результаты продемонстрировала интеграционная матрица Хаспеслага и Джемисона, которая, несмотря на свою концептуальную природу, эффективно классифицирует типы интеграции и определяет соответствующую стратегию оценки. Однако в силу своей абстрактности она требует операционализации через другие прикладные методы.

Метод кумулятивной избыточной доходности, используемый Федоровой Е.А. и Изотовой Е.И. в энергетическом секторе, показал умеренные результаты. Его сила, в отраслевой специфичности и способности учитывать волатильность доходности; слабость, в ограниченной применимости за пределами строго регулируемых сегментов.

Для наглядного представления зависимости между охватом финансовых и нефинансовых факторов был построен график (рисунок 1). Он визуализирует позиционирование моделей вдоль двух критически важных осей, выявляя два полюса: модели с высокой финансовой точностью, но слабым охватом нефинансовых факторов (DCF, EVA), и наоборот, модели, ориентированные на стратегическую и поведенческую согласованность, но менее точные в финансовом прогнозировании.

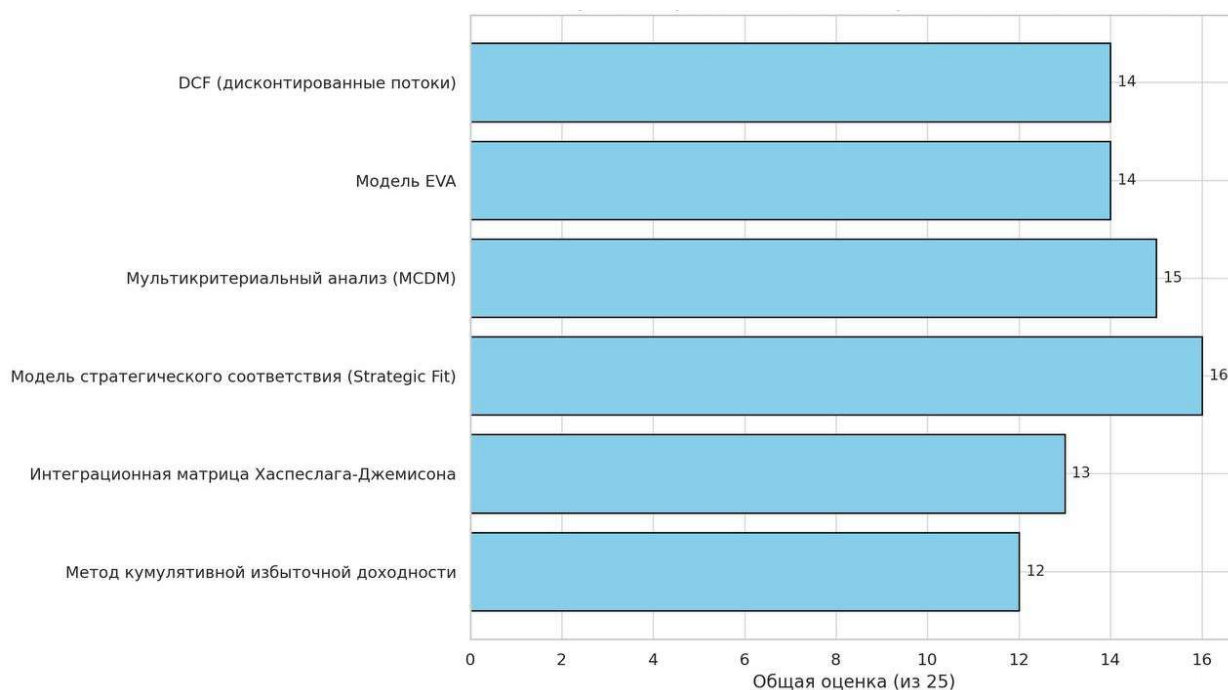


Рисунок 1. Сравнительная интегральная оценка моделей

5. Выводы и обсуждение

Научный анализ выявил, что доминирующие в прошлом универсальные подходы к оценке эффективности интеграции бизнеса сегодня утрачивают значимость в силу роста институциональной сложности, цифровизации и глобализации сделок. Полученные данные подтверждают, что изолированное применение исключительно финансовых моделей, таких как DCF и EVA, хотя и даёт высокую точность при стабильной среде, оказывается недостаточным для комплексной оценки интеграционного потенциала в стратегической перспективе. Эти методы игнорируют социокультурную динамику, организационную адаптацию и институциональные ограничения, что снижает их применимость в транснациональных или мультикультурных сделках.

С другой стороны, модели, основанные на стратегическом соответствии, демонстрируют способность учитывать нефинансовые факторы интеграции такие как

культура, стиль лидерства, цифровая зрелость. Именно они получили наиболее высокие оценки в сравнительной матрице (Таблица 1). Эти подходы находят подтверждение и в эмпирических исследованиях, где показатели интеграционного успеха напрямую коррелируют с качеством взаимодействия команд и степенью предварительного стратегического согласования.

Теоретический вклад работы заключается в верификации гипотезы о необходимости комплексного и контекстуализированного подхода, что согласуется с выводами современных исследователей. Модель стратегического соответствия может рассматриваться как интегративная рамка, сочетающая поведенческие и структурные параметры и способная адаптироваться к типу сделки.

С практической точки зрения, результаты исследования показывают, что выбор методологии оценки интеграции должен быть обусловлен отраслевым контекстом, размером компаний и типом сделки (горизонтальная, вертикальная, кластерная). Например, при вертикальной интеграции в сырьевом секторе, где доступна отчётность и цели фокусируются на снижении транзакционных издержек, целесообразно применение классических моделей (DCF, EVA), подтверждённое в работах Федоровой Е.А. В то же время, при интеграции стартапа в структуру крупной корпорации высокотехнологичного сектора (например, цифрового сервиса в банковский холдинг), ключевыми становятся элементы организационного дизайна и совместимость культур, здесь эффективнее использовать поведенческие и стратегические модели, такие как Strategic Fit.

Особое внимание также следует уделить мультикритериальному анализу (MCDM), который позволяет учитывать одновременно экономические, социальные и стратегические параметры сделки. Несмотря на высокую сложность внедрения, он предоставляет компании инструментарий для интеграционной диагностики и сценарного анализа, особенно в условиях неопределённости и многопараметричности среды.

Результаты обсуждения подтверждают, что современная оценка эффективности интеграции должна носить мультидисциплинарный и гибридный характер. Выбор подхода зависит от контекста, стратегических целей и степени открытости данных. Научный и практический интерес представляет дальнейшее развитие типологий и адаптивных моделей оценки, способных учитывать не только синергетический эффект, но и институциональные и поведенческие риски.

Список использованных источников

1. Родионов И., Михальчук В. Оценка синергии в сделках M&A // SSRN Electronic Journal. – 2020. – DOI: 10.2139/ssrn.3064921. – URL: <https://papers.ssrn.com/sol3/Delivery.cfm?abstractid=3064921> (дата обращения: 01.12.2025).
2. Vashakmadze T., Martirosyan E. Stakeholder management in M&A // SSRN Electronic Journal. – 2020. – DOI: 10.2139/ssrn.2599457. – URL: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2599457 (дата обращения: 01.12.2025).
3. Cartwright S., Cooper C. Managing M&A integration: Cultural dimensions and HR role // ResearchGate. – 2022. – URL: <https://www.researchgate.net/publication/330652907> (дата обращения: 01.12.2025).
4. Федорова Е.А., Изотова Е.И. Оценка слияний в энергетике на основе кумулятивной доходности // Экономика и предпринимательство. – 2021. – № 5. – С. 120–130. – URL: <https://cyberleninka.ru/article/n/otsenka-sliyaniy-i-pogloscheniy-v-sektore-energetiki-rossiyskoy-federatsii-na-osnove-metoda-kumulyativnoy-izbytochnoy-dohodnosti.pdf> (дата обращения: 01.12.2025).
5. Юн С., Хунбо С. Современные подходы к стоимости бизнеса в интеграционных процессах // Современные научные исследования и инновации. – 2021. – № 6. – URL:

<https://cyberleninka.ru/article/n/sovremennye-podhody-k-stoimosti-biznesa-v-integratsionnyh-protssessah/pdf> (дата обращения: 01.12.2025).

6. Лалаян Г.Г., Кремянская Е.В. Об интегрированных формированиях и методологических подходах к оценке эффективности их функционирования в АПК // Научный журнал КубГАУ. – 2015. – № 109(05). – С. 1-15. – Режим доступа: <https://cyberleninka.ru/article/n/ob-integrirrovannyh-formirovaniyah-i-metodologicheskikh-podhodah-k-otsenke-effektivnosti-ih-funktsionirovaniya-v-apk> (дата обращения: 27.11.2025).

7. Фихтнер О.А. Методологические подходы к оценке эффективности функционирования сетевых предпринимательских структур // Вестник Новгородского государственного университета. – 2011. – № 61. – С. 144-147. – Режим доступа: <https://cyberleninka.ru/article/n/metodologicheskie-podhody-k-otsenke-effektivnosti-funktsionirovaniya-setevykh-predprinimatelskih-struktur> (дата обращения: 27.11.2025).

8. Николаев М.А., Махотаева М.Ю. Методологические аспекты оценки эффективности инновационных кластеров // Вестник Пермского государственного технического университета. Экономика. – 2012. – № 4(47). – С. 82-87. – Режим доступа: <https://cyberleninka.ru/article/n/metodologicheskie-aspekty-otsenki-effektivnosti-innovatsionnyh-klasterov> (дата обращения: 27.11.2025).

9. Белоусова В.О., Кожевина О.В. Методологические подходы к оценке эффективности слияний и поглощений // Вестник науки и образования. – 2015. – № 10(16). – С. 85-89. – Режим доступа: https://elibrary.ru/download/elibrary_25034165_61971871.pdf#page=85 (дата обращения: 27.11.2025).

10. Ефремов В.С., Владимирова И.Г. Подходы к оценке эффективности международных интеграционных процессов компаний // Вестник Российского университета дружбы народов. Серия: Экономика. – 2016. – Т. 24, № 2. – С. 45-52. – Режим доступа: <https://cyberleninka.ru/article/n/podhody-k-otsenke-effektivnosti-mezhdunarodnyh-integratsionnyh-protssessov-kompaniy> (дата обращения: 27.11.2025).

Reassessing Global Innovation Metrics: Critical Analysis of GII Indicators and Intangible Investment Trends

Archil Chirakadze

PhD, Georgian Technical University Institute "Techinform", Tbilisi, Georgia, Georgian Technical University Institute of Cybernetics, Tbilisi, Georgia, Ivane Javakhishvili Tbilisi State University Institute of Physics, Tbilisi, Georgia

Nodar Mitagvaria

Ivane Beritasvili Center of Experimental Biomedicine, Tbilisi, Georgia

Neli Makhviladze

Georgian Technical University, Tbilisi, Georgia

Teimuraz Chubinishvili

Georgian Technical University, Tbilisi, Georgia

Nodar Sulashvili

MD, PhD, Doctor of Pharmaceutical and Pharmacological Sciences In Medicine, Invited Lecturer (Professor) of Scientific Research-Skills Center at Tbilisi State Medical University; Professor of Medical and Clinical Pharmacology of International School of Medicine at Alte University; Professor of Pharmacology of Faculty of Medicine at Georgian National University SEU, Associate Affiliated Professor of Medical Pharmacology of Faculty of Medicine at Sul Khan-Saba Orbeliani University; Associate Professor of Medical Pharmacology at School of Medicine at David Aghmashenebeli University of Georgia; Associate Professor of Biochemistry and Pharmacology Direction of School of Health Sciences at the University of Georgia. Associate Professor of Pharmacology of Faculty of Dentistry and Pharmacy at Tbilisi Humanitarian Teaching University; Tbilisi, Georgia; Orcid: <https://orcid.org/0000-0002-9005-8577>.

Deva Harsha Uday Gundluru

University of Georgia, Tbilisi, Georgia

Giorgi Palavandishvili

Georgian Technical University, Tbilisi, Georgia

Khtuna Tserodze

Georgian Technical University, Tbilisi, Georgia

Kakha Gorgadze

Georgian Technical University, Tbilisi, Georgia

Nana khuskivadze

Georgian Technical University, Tbilisi, Georgia

David Aphkhazava

PhD, University of Georgia, Tbilisi, Georgia
Orcid: <https://orcid.org/0000-0001-6216-6477>

Corresponding author Prof. David Aphkhazava

Abstract

This study critically examines the reliability and validity of indicators used in calculating the Global Innovation Index (GII), while investigating emerging trends in intangible versus tangible investment patterns across developed and developing economies. Through correlation analysis of 13 development indicators across 100 countries (2021-2024), we reveal significant inconsistencies in widely-used GII metrics across different economic development groups. Our findings demonstrate that several conventional innovation indicators fail to correlate appropriately within specific country clusters, potentially compromising the accuracy of global innovation assessments. Simultaneously, analysis of the World Intellectual Property Organization's (WIPO) 2025 World Intangible Investment Highlights reveals that intangible investment has grown 3.7 times faster than tangible investment between 2008-2024, reaching USD 7.6 trillion in 2024. This research identifies critical gaps in current innovation measurement methodologies and provides evidence-based recommendations for refining GII calculation methods. The study emphasizes the need for rigorous indicator validation, incorporation of sustainable development metrics, and recognition of the growing dominance of intangible assets in driving economic innovation. Our results suggest that continued reliance on unvalidated indicators may lead to systematic misassessment of national innovation capabilities, with implications for policy-making and resource allocation in the global knowledge economy.

Keywords: Global Innovation Index, innovation metrics, intangible investment, indicator validation, correlation analysis, knowledge economy, innovation assessment methodology, sustainable development indicators, WIPO, economic development clusters

Introduction

The Global Innovation Index (GII) has emerged as the preeminent international benchmark for assessing national innovation capabilities since its establishment in 2007 under the auspices of the World Intellectual Property Organization (WIPO), a specialized agency of the United Nations dedicated to intellectual property issues (WIPO, 2024). As the most comprehensive framework for evaluating innovation development across diverse economies, the GII employs 82 distinct variables that collectively characterize innovation potential, implementation capacity, and measurable outcomes across countries at varying stages of economic development (Dutta et al., 2023). The index operates on a fundamental premise articulated by its architects: that innovation capacity represents a complex interplay between the presence of innovation potential—embodied in human capital, infrastructure, and institutional frameworks—and the conditions necessary for translating that potential into tangible economic and social outcomes (Cornell et al., 2024). Consequently, the final GII value represents not merely an aggregate of input measures, but rather a sophisticated ratio of innovation investments to innovation effects, theoretically enabling objective cross-national assessment of innovation efficiency and effectiveness (Hollanders & Es-Sadki, 2021).

The annual GII reports, produced through collaboration between WIPO and leading academic institutions, provide detailed country profiles that encompass overall ranking positions alongside granular analysis of specific innovation advantages and disadvantages identified through the index's calculation methodology (WIPO, 2023). For policymakers, international organizations, and researchers, the GII has become an indispensable tool for benchmarking national performance, identifying areas requiring policy intervention, and tracking progress over time (Godin, 2022). The index's widespread adoption reflects both the growing recognition of innovation as a critical driver of economic growth and competitiveness in the 21st century knowledge economy, and the

absence of viable alternative frameworks offering comparable comprehensiveness and methodological rigor (Edquist & Zabala-Iturriagagoitia, 2020).

However, as the GII has matured and its influence on policy discourse has expanded, critical examination of its methodological foundations, accuracy, and practical utility has intensified correspondingly (Gault, 2023). The substantial financial and human resources invested in data collection, indicator calculation, and index production across multiple international organizations warrant rigorous scrutiny of whether the resulting assessments genuinely reflect national innovation realities with sufficient precision to justify their prominent role in shaping policy priorities and resource allocation decisions (Archibugi & Filippetti, 2018). Several scholars have raised fundamental questions regarding the selection criteria for the 82 variables currently employed in GII calculation, particularly concerning indicators categorized as measuring "creative" dimensions of innovation capacity, which some researchers argue lack adequate theoretical justification or empirical validation (Saisana & Saltelli, 2020). These methodological concerns acquire heightened significance given the index's demonstrable influence on national innovation strategies, international investment flows, and the allocation of development assistance funds (Grupp & Schubert, 2022).

Moreover, the rapidly evolving nature of innovation processes themselves—driven by digital transformation, artificial intelligence, biotechnology breakthroughs, and the imperative of sustainability transitions—raises questions about whether indicator frameworks developed in the early 21st century remain adequate for capturing contemporary innovation dynamics (Schot & Steinmueller, 2018). The emergence of new innovation paradigms, including open innovation ecosystems, platform-based business models, circular economy approaches, and mission-oriented innovation policies, suggests that traditional measurement frameworks may systematically undervalue or entirely overlook critical dimensions of modern innovation capacity (Chesbrough et al., 2021; Mazzucato, 2018). This concern is particularly acute regarding the measurement of intangible assets—including software, databases, organizational capital, intellectual property, and human capital investments—which increasingly dominate value creation in advanced economies yet remain inadequately captured in conventional economic statistics and innovation metrics (Corrado et al., 2021; Haskel & Westlake, 2018).

The question of indicator reliability and validity across different national contexts represents another significant challenge for composite innovation indices like the GII (Greco et al., 2019). Countries at different stages of economic development may exhibit fundamentally different innovation processes, with distinct relevant input factors and output measures (Zanello et al., 2016). For instance, indicators highly predictive of innovation capacity in advanced post-industrial economies—such as venture capital availability, trademark registrations, or creative industry employment—may have limited relevance or predictive power in emerging economies where innovation occurs primarily through technology absorption, incremental process improvements, and informal sector adaptations (Fu et al., 2020). The application of uniform indicator sets and weighting schemes across radically heterogeneous national contexts risks producing misleading comparisons that obscure rather than illuminate genuine innovation capabilities (Paruolo et al., 2018).

Parallel to these methodological debates surrounding innovation measurement, the global economy has undergone a profound structural transformation characterized by the accelerating dominance of intangible capital accumulation (Haskel & Westlake, 2022). Evidence documented in WIPO's 2025 World Intangible Investment Highlights reveals that intangible investment has grown 3.7 times faster than tangible investment between 2008 and 2024 across major economies, achieving a compound annual growth rate of 4.1 percent compared to just 1.1 percent for tangible assets (WIPO & LBS, 2025). Since 1995, intangible investment has more than doubled in real terms with 143 percent growth, while tangible investment expanded by merely 32 percent over the same

period (WIPO & LBS, 2025). By 2024, intangible investment reached USD 7.6 trillion globally among the 27 high- and middle-income economies covered in the WIIH analysis, representing an increasingly dominant share of total capital formation and GDP (WIPO & LBS, 2025).

This fundamental shift in the composition of productive capital carries profound implications for how we conceptualize, measure, and promote innovation (Brynjolfsson et al., 2021). Intangible assets—encompassing software and databases, research and development expenditures, intellectual property, organizational capabilities, employee training, brand equity, and design assets—exhibit distinctive economic properties that differentiate them from tangible capital (Corrado et al., 2020). Unlike physical machinery or buildings, intangible assets are typically scalable at low marginal cost, generate positive spillovers that extend beyond the investing firm, often involve significant sunk costs that create exit barriers, and may depreciate rapidly due to technological obsolescence or competitor innovation (Piekkola, 2020). These characteristics suggest that economies capable of effectively creating, deploying, and commercializing intangible assets possess fundamentally different innovation capabilities than those primarily dependent on tangible capital accumulation (Crass & Peters, 2019).

Furthermore, the accelerating growth of intangible investment appears to have served a macroeconomic stabilization function during recent periods of economic uncertainty and monetary policy tightening (WIPO & LBS, 2025). While tangible investment growth has stagnated or declined in many advanced economies since 2020 amid rising interest rates and business uncertainty, intangible investment has continued expanding, partially offsetting what would otherwise have been more severe investment shortfalls with negative implications for productivity growth and long-term economic dynamism (Crouzet & Eberly, 2021). This "cushioning effect" of intangible investment suggests that national innovation systems with strong capabilities for intangible capital formation may demonstrate greater economic resilience and adaptability in the face of external shocks (Demmou et al., 2021).

The observed divergence between intangible and tangible investment trajectories varies significantly across countries, revealing differential national capacities for knowledge economy transition (WIPO & LBS, 2025). In the United States, intangible investment grew five times faster than tangible investment between 2020 and 2024, driven particularly by software, databases, and research and development expenditures (WIPO & LBS, 2025). France exhibited similar patterns with intangible investment expanding three times faster than tangible capital formation (WIPO & LBS, 2025). Germany presents an even more striking case where intangible investment increased approximately 3 percent annually during this period while tangible investment actually declined by about 1 percent, suggesting fundamental structural transformation in the composition of productive capital (WIPO & LBS, 2025). The United Kingdom represents a partial exception with both investment types showing robust growth, though tangible investment at 4.8 percent slightly outpaced intangible at 4.3 percent (WIPO & LBS, 2025).

Emerging markets demonstrate more heterogeneous patterns reflecting different stages of development transition (WIPO & LBS, 2025). India exhibited steady growth in both investment types between 2011 and 2022, with intangible investment at 7 percent annually marginally exceeding tangible at 6 percent, though recent data for 2021-2022 shows a reversal with tangible growing at 12 percent versus 4 percent for intangible, possibly reflecting infrastructure catch-up investment (WIPO & LBS, 2025). Brazil shows intangible investment growing nearly 2 percent annually between 2011 and 2021 while tangible declined over 1 percent, with the most recent period (2020-2021) showing intangible surging at 14 percent versus 8 percent for tangible (WIPO & LBS, 2025). Japan, historically characterized by strong tangible investment performance, has experienced a trend reversal since 2020 with intangible investment growing at 1.2 percent annually compared to 0.6 percent for tangible, suggesting gradual knowledge economy transition even in this mature advanced economy (WIPO & LBS, 2025).

These differential national trajectories in intangible capital accumulation raise critical questions about whether current innovation measurement frameworks adequately capture the sources and manifestations of innovation capacity in increasingly intangible-intensive economies (Goodridge et al., 2019). If innovation outcomes increasingly derive from software development, data analytics capabilities, organizational process improvements, and brand equity rather than from physical R&D laboratories, production equipment, or transportation infrastructure, then innovation indices that emphasize tangible dimensions of innovation capacity may systematically misrepresent relative national capabilities (van Ark et al., 2021). This measurement challenge is compounded by the difficulties inherent in quantifying intangible assets, which often lack market prices, may not appear in corporate financial statements under conventional accounting rules, and exhibit ambiguous ownership boundaries when knowledge spills over between firms or when employees carry tacit knowledge across organizational boundaries (Marrano et al., 2020).

The sustainability imperative introduces additional complexity into innovation measurement challenges (Schot & Steinmueller, 2018). As climate change, biodiversity loss, resource depletion, and social inequality increasingly constrain development pathways, innovation policy discourse has shifted toward concepts like "transformative innovation," "sustainability transitions," and "mission-oriented innovation" that explicitly incorporate environmental and social objectives alongside economic performance criteria (Mazzucato, 2018; Weber & Rohracher, 2012). This reorientation implies that innovation indices should assess not merely the quantity or efficiency of innovation activities, but also their directionality toward or away from sustainability goals (Schot & Steinmueller, 2018). However, integrating sustainability dimensions into innovation measurement raises formidable conceptual and operational challenges, including defining appropriate indicators, establishing weighting schemes that balance potentially competing objectives, and addressing data availability constraints particularly in developing countries (Saisana & Philippas, 2019).

The knowledge-based society concept provides another lens for critiquing conventional innovation metrics (Drucker, 2017; Powell & Snellman, 2004). In knowledge-intensive economies, innovation capacity derives not only from formal R&D activities or patent generation, but from broader capabilities including digital literacy levels across populations, quality of educational systems at all levels, effectiveness of lifelong learning infrastructure, strength of science-society dialogue mechanisms, and institutional capacities for evidence-based policymaking (Godin & Gingras, 2000). Variables capturing these dimensions—such as adult education participation rates, digital government service quality, open science indicators, or civic science engagement measures—remain underrepresented in current GII methodology despite their potential importance for understanding comprehensive innovation capacity (David & Foray, 2018).

Against this backdrop of methodological concerns, structural economic transformation, and evolving conceptualizations of innovation itself, this research undertakes a systematic empirical examination of GII indicator reliability and validity across different national contexts. Specifically, we conduct correlation analysis of relationships among 13 key development and innovation indicators across 100 countries stratified by GII performance levels using data spanning 2021 to 2024. The selected indicators encompass demographic dynamics (population growth), human capital dimensions (current and expected educational attainment), social development (social progress index), governance quality (worldwide governance quality index), political institutions (political and civil liberties), economic competitiveness (global competitiveness index), international economic integration (foreign direct investment), scientific research capacity (science-research activity index), globalization (country globalization index), and health outcomes (healthy life expectancy).

Our analytical approach tests the hypothesis that indicator reliability—operationalized as the degree of correlation between specific indicators and overall GII performance—varies

systematically across country groups representing different stages of economic development and innovation maturity. If this hypothesis is confirmed, it would suggest that applying uniform indicator sets and weighting schemes across heterogeneous national contexts produces systematic measurement error, potentially generating misleading rankings that could misguide policy priorities and resource allocation decisions. Conversely, if indicators demonstrate consistent reliability across development contexts, it would provide empirical support for the validity of current GII methodology's universal framework.

The research makes several distinctive contributions to innovation measurement scholarship. First, it provides systematic empirical evidence regarding the context-dependence of innovation indicator reliability, moving beyond conceptual critique to quantitative assessment. Second, it connects debates about innovation measurement methodology to documented trends in intangible capital accumulation, arguing that measurement frameworks must evolve to reflect structural economic transformation. Third, it offers concrete, evidence-based recommendations for GII methodology refinement that could enhance the index's accuracy and policy relevance. Fourth, it contributes to broader discussions about composite indicator methodology, particularly regarding the challenges of constructing meaningful aggregate measures across heterogeneous contexts.

The structure of this analysis proceeds as follows. Following this introduction, we present a comprehensive literature review examining theoretical and empirical scholarship on innovation measurement, composite indicator methodology, intangible capital economics, and the specific evolution and critiques of the Global Innovation Index. We then detail our research methodology, including data sources, indicator selection rationale, country sample stratification approach, and correlation analysis techniques. The findings section presents results organized by country development groups, documenting patterns of indicator reliability and identifying systematic variations across contexts. We then discuss implications of these findings for GII methodology, innovation policy, and future research directions. The conclusion synthesizes key insights and articulates concrete recommendations for enhancing innovation measurement frameworks in light of contemporary economic realities and evolving policy needs.

The timing of this investigation proves particularly significant given recent developments in global innovation dynamics documented in the GII 2025 report, which characterizes contemporary innovation systems as standing "at a crossroads" where breakthrough technologies advance rapidly while traditional indicators of innovation activity show concerning stagnation or decline (WIPO, 2024). Specifically, while artificial intelligence capabilities, quantum computing potential, and biotechnology applications demonstrate accelerating technical progress, aggregate measures of research and development expenditure growth have slowed markedly, venture capital investment has moderated with particularly cautious early-stage funding, and patenting activity has registered only modest gains despite the apparent technological ferment (WIPO, 2024). This apparent paradox—simultaneous breakthrough innovation in specific domains and stagnation in aggregate innovation metrics—raises fundamental questions about whether current measurement frameworks adequately capture the locus and nature of contemporary innovation activities (Kerr & Kerr, 2020).

One potential explanation for this measurement paradox involves the changing organizational and geographical distribution of innovation activities (Chesbrough et al., 2021). Traditional innovation metrics emphasize activities concentrated within formal research and development departments of established corporations or within university research laboratories, reflected in indicators like R&D expenditure as percentage of GDP or patents granted to domestic inventors (Archibugi & Coco, 2021). However, contemporary innovation increasingly occurs through networked ecosystems involving multiple organizational actors, open-source collaboration platforms that generate knowledge without formal intellectual property protection, user innovation by

consumers adapting technologies to their needs, and informal sector innovations in developing economies that rarely generate patents or formal R&D statistics (von Hippel, 2017; Baldwin & von Hippel, 2011). If innovation activity has partially migrated from traditional organizational forms and geographical locations to these alternative modes, then conventional indicators may underestimate aggregate innovation activity while accurately measuring decline within their specific domains (Radjou & Prabhu, 2015).

The platform economy and digital transformation more broadly present particular measurement challenges (Kenney & Zysman, 2020). Digital platforms like mobile applications, cloud computing services, and data analytics tools enable innovation by firms and individuals that may generate substantial economic and social value without corresponding to traditional innovation indicators (Gawer, 2021). A small business adopting cloud-based customer relationship management software, artificial intelligence-powered marketing analytics, or automated accounting systems may substantially enhance its productivity and competitive position through innovation adoption, yet this activity appears nowhere in conventional innovation statistics unless the platform providers themselves register patents or publish research (Nambisan et al., 2019). Similarly, individual content creators, software developers, or designers building businesses on platform infrastructures engage in creative and innovative activities that generate income and value but remain invisible to traditional innovation measurement frameworks focused on institutional actors (Boudreau & Lakhani, 2013).

The artificial intelligence revolution exemplifies these measurement challenges while simultaneously transforming the substantive nature of innovation processes (Agrawal et al., 2019). AI technologies enable automation of certain cognitive tasks previously requiring human intelligence, potentially augmenting productivity across broad swathes of economic activity (Brynjolfsson & McAfee, 2017). However, measuring AI innovation capacity and AI-driven innovation outcomes presents formidable difficulties (Cockburn et al., 2018). Should AI capacity be measured through published research papers, trained models, computational infrastructure, data availability, algorithmic sophistication, or downstream adoption and economic impact (Furman & Seamans, 2019)? Each measurement approach captures different dimensions and may generate divergent assessments of national AI innovation capabilities (Baruffaldi et al., 2020). Moreover, the global nature of AI development—with research talent, computational resources, training data, and commercial applications distributed across national boundaries—challenges nation-state-focused innovation measurement frameworks (Goldfarb & Treffer, 2018).

These technological and organizational changes intersect with broader economic transformations that complicate innovation measurement and assessment (Perez, 2020). The servicification of advanced economies—with services representing growing shares of GDP and employment—implies that innovation increasingly manifests in service process improvements, business model innovations, and customer experience enhancements rather than in tangible product developments that more readily correspond to patent counts or R&D expenditures (Djellal & Gallouj, 2018). Service innovations often involve intangible elements like organizational routines, customer relationship protocols, or digital interface designs that resist quantification and may not generate formal intellectual property (Gallouj & Savona, 2019). Financial services deploying algorithmic trading systems, healthcare providers implementing telemedicine platforms, or educational institutions adopting adaptive learning technologies all engage in substantial innovation activities that conventional metrics may inadequately capture (Rubalcaba et al., 2021). The increasing importance of data as an economic input and innovation enabler further complicates measurement challenges (Jones & Tonetti, 2020). Data assets—including customer information, operational metrics, sensor readings, and behavioral traces—enable machine learning applications, personalized services, operational optimizations, and predictive capabilities that drive innovation and competitive advantage (Goldfarb & Tucker, 2019). However, data assets

appear inadequately in conventional economic statistics, lack well-established valuation methodologies, and raise conceptual challenges regarding ownership, privacy, and appropriate measurement units (Coyle & Diepeveen, 2021). National innovation frameworks that fail to assess data infrastructure quality, data governance effectiveness, or data analytical capabilities may overlook critical dimensions of contemporary innovation capacity (OECD, 2020).

Simultaneously, innovation policy discourse has increasingly emphasized the concept of "innovation ecosystems" rather than linear models of innovation proceeding from basic research through applied research, development, and commercialization (Granstrand & Holgersson, 2020). The ecosystem perspective recognizes that innovation emerges from complex interactions among diverse actors including universities, public research institutions, established firms, startups, venture capitalists, skilled workers, specialized suppliers, and supportive institutions providing legal, financial, and technical services (Autio et al., 2018). Measuring ecosystem vitality requires indicators capturing relationship density, knowledge flows, institutional quality, entrepreneurial culture, and risk capital availability rather than merely aggregate R&D expenditure or patent counts (Stam & van de Ven, 2021). While the GII incorporates some ecosystem-oriented indicators, critics argue that the emphasis remains skewed toward traditional input and output measures that inadequately represent ecosystem dynamics (Brown & Mason, 2017).

The geographical dimension of innovation presents additional complexity particularly relevant for cross-national comparison (Feldman & Kogler, 2010). Innovation activities concentrate spatially in urban agglomerations and regional clusters that may exhibit innovation capabilities dramatically different from national averages (Audretsch & Belitski, 2021). Countries with a few highly innovative urban regions and large peripheral areas with minimal innovation activity may receive similar overall GII scores to countries with more geographically distributed innovation capacity, yet these different spatial configurations have distinct implications for inclusive growth and territorial cohesion (Iammarino et al., 2019). National-level innovation indices necessarily obscure these subnational variations, potentially missing critical dimensions of innovation geography that matter for policy effectiveness (Balland et al., 2020).

Developing country contexts present specific challenges for innovation measurement frameworks largely designed based on advanced economy experiences (Cozzens & Sutz, 2014). Innovation in developing economies often involves absorption, adaptation, and incremental improvement of technologies developed elsewhere rather than frontier research, yet these activities may be equally important for productivity growth and development progress (Fu et al., 2020). Informal sector innovation—including creative adaptations of existing technologies to resource-constrained contexts, development of appropriate technologies serving local needs, and indigenous knowledge applications—rarely generates patents or formal R&D statistics but may substantially enhance livelihoods and economic opportunities (Kaplinsky, 2011). Frugal innovation, jugaad innovation, and grassroots innovation concepts attempt to characterize these alternative innovation modes, yet their measurement remains embryonic (Radjou & Prabhu, 2015; Gupta, 2016). Applying innovation measurement frameworks developed for advanced economies to developing country contexts risks systematic underestimation of genuine innovation capabilities and activities (Kraemer-Mbula & Wunsch-Vincent, 2016).

The institutional and governance dimensions of innovation capacity receive growing recognition in scholarly literature, yet their measurement remains challenging (Edquist & Johnson, 2021). Innovation system effectiveness depends not only on resource availability but on institutional arrangements governing intellectual property, research funding allocation, university-industry collaboration, entrepreneurship support, procurement policies, regulatory frameworks, and competition policy (Lundvall, 2010). These institutional dimensions involve qualitative characteristics resistant to quantification, political economy considerations, and path-dependent historical legacies that simple cross-sectional indicators may not adequately capture (Nelson,

2018). Moreover, optimal institutional configurations may vary across development contexts, technological domains, and political systems, challenging universal benchmarking approaches (Amsden & Chu, 2003).

Human capital represents another domain where measurement complexity intersects with critical importance for innovation capacity (Castellacci & Natera, 2016). While educational attainment indicators—such as expected years of schooling, tertiary enrollment rates, or PISA test scores—provide readily quantifiable metrics widely used in composite innovation indices, they may inadequately capture the specific skills, creative capabilities, and entrepreneurial orientations most relevant for innovation (Hanushek & Woessmann, 2020). Educational systems producing high test scores through rote memorization may not cultivate the critical thinking, problem-solving, risk-taking, and collaborative capabilities that drive innovation (Zhao, 2018). Conversely, educational systems emphasizing creativity, experimentation, and interdisciplinary synthesis may generate greater innovation capacity than formal attainment metrics suggest (Wagner, 2012). Measuring these qualitative dimensions of human capital relevant for innovation remains an ongoing challenge (Liu & Steiner-Khamsi, 2020).

The gender dimension of innovation presents both equity concerns and measurement challenges (Hunt et al., 2015). Growing evidence suggests that diverse teams—including gender diversity—generate more creative solutions and innovative outcomes than homogeneous groups (Diaz-Garcia et al., 2013). However, women remain substantially underrepresented in science, technology, engineering, and mathematics fields, entrepreneurship, and innovation leadership positions across most countries (Stoet & Geary, 2018). Innovation indices that fail to incorporate gender dimensions may overlook both inequities that constrain innovation potential and differences in innovation performance attributable to varying success in mobilizing diverse talent (Naldi et al., 2020). The GII includes some gender-related indicators, but critics argue that more comprehensive assessment of gender equity in innovation systems warrants priority attention (UNESCO, 2021).

Environmental sustainability considerations introduce fundamental tensions into innovation assessment frameworks (Geels et al., 2017). Traditional innovation metrics emphasize technological advancement, productivity enhancement, and economic growth largely without regard to environmental impacts or resource consumption (Jackson, 2017). However, if innovation activities generate environmental degradation, resource depletion, or climate destabilization, their contribution to genuine societal welfare may be negative despite positive scores on conventional innovation indices (Hickel, 2021). The concept of "eco-innovation" or "green innovation" attempts to characterize innovation explicitly oriented toward environmental sustainability, yet measurement frameworks remain underdeveloped and agreement on appropriate indicators remains elusive (Kemp & Pearson, 2007; Ghisellini & Ulgiati, 2020). More fundamentally, scholars debate whether incremental eco-efficiency improvements suffice or whether genuine sustainability requires transformative system-level innovations that may appear disruptive or even regressive by conventional growth-oriented metrics (Schot & Steinmueller, 2018).

The COVID-19 pandemic provided a natural experiment revealing both the importance of innovation capacity for crisis response and significant limitations of existing measurement frameworks (Harris et al., 2020). Countries demonstrating effective pandemic responses often relied on rapid innovation in diagnostic testing, digital contact tracing, vaccine development and manufacturing, and healthcare delivery adaptations (Toner et al., 2021). However, these crisis innovation capabilities corresponded only partially to pre-pandemic GII rankings, with some highly-ranked innovation leaders struggling with pandemic response while some lower-ranked countries demonstrated impressive crisis innovation capacities (Tonne & Martin, 2021). This divergence suggests that existing innovation indices may emphasize dimensions of innovation

capacity—such as patents, publications, and high-tech manufacturing—that prove less relevant for rapid innovation in response to urgent societal challenges compared to dimensions like institutional adaptability, state capacity, social cohesion, or local production capabilities (Mazzucato & Kattel, 2020).

Mission-oriented innovation policy frameworks gaining prominence in recent years present another challenge to traditional innovation measurement approaches (Mazzucato, 2018). Mission-oriented approaches define ambitious societal goals—such as climate neutrality, circular economy transition, or health equity—and organize innovation policies, investments, and partnerships around achieving these missions (Kattel & Mazzucato, 2018). Assessing mission-oriented innovation capacity requires indicators capturing directionality toward mission goals, cross-sectoral coordination effectiveness, public-private collaboration quality, and experimentation tolerance rather than merely aggregate innovation inputs or generic outputs (Wanzenböck et al., 2020). Traditional innovation indices structured around universal input and output categories may inadequately assess national capabilities for mission-oriented innovation approaches increasingly central to policy discourse (Larrue, 2021).

The political economy of innovation measurement itself warrants critical examination (Godin, 2022). Composite indices like the GII inevitably involve subjective choices regarding indicator selection, data sources, normalization procedures, weighting schemes, and aggregation methods, with each choice potentially privileging certain countries, economic systems, or policy approaches over others (Cherchye et al., 2008). Rankings generate political pressures, influence policy agendas, and affect international perceptions and investment flows, creating incentives for countries to prioritize improvements in measured dimensions regardless of whether they address genuine innovation capacity constraints (Davis et al., 2012). "Gaming" possibilities—where countries optimize performance on measured indicators without corresponding improvement in substantive innovation capabilities—represent a constant concern for composite indicator designers (Ravallion, 2012). Moreover, the institutional actors producing innovation indices—including international organizations, academic institutions, and consulting firms—possess their own organizational interests, ideological orientations, and stakeholder relationships that may influence methodological choices (Muller, 2018).

Transparency and reproducibility represent additional concerns in composite indicator methodology (Saisana & Saltelli, 2020). Complex aggregation procedures involving multiple stages of normalization, weighting, and calculation may obscure the sensitivity of final rankings to specific methodological choices, data values, or outlier observations (Paruolo et al., 2018). Robust composite indicators should undergo sensitivity analysis testing how rankings change under alternative reasonable methodological assumptions, yet such analyses remain uncommon in innovation index reporting (Saisana et al., 2005). Similarly, data quality issues—including missing values, estimation procedures, temporal misalignment, and definitional inconsistencies across countries—affect final index values in ways rarely transparent to users (Bandura, 2008). Enhanced transparency regarding data sources, quality assessments, methodological choices, and sensitivity analyses would strengthen the credibility and appropriate use of innovation indices (OECD, 2008). The temporal dimension presents yet another layer of complexity in innovation measurement (Archibugi et al., 2009). Innovation is inherently a dynamic process involving temporal lags between inputs and outputs, path-dependent trajectories, punctuated equilibria, and long-wave patterns that cross-sectional indicators poorly capture (Dosi & Nelson, 2010). Research and development investments may require years or decades to generate commercially viable innovations, while patent counts represent legal claims whose economic value remains uncertain until market validation occurs (Hall et al., 2014). Educational investments shaping human capital for innovation involve even longer time horizons spanning generations (Hanushek & Woessmann, 2015). Cross-sectional innovation indices necessarily provide snapshots of systems better

understood through longitudinal analysis, yet tracking changes over time introduces additional challenges when indicator definitions, data sources, or methodologies evolve (Godin, 2011). Benchmarking and ranking dynamics inherent in innovation indices create both opportunities and risks for policy learning (Ladi, 2011). Comparative rankings can stimulate policy reflection, identify successful practices meriting emulation, and generate political momentum for reform in countries lagging perceived peer competitors (Drezner, 2001). However, these same dynamics may encourage uncritical policy transfer without adequate attention to contextual differences, provoke defensive reactions where countries question methodology rather than examining substantive performance, or incentivize narrow focus on improving index position rather than addressing fundamental innovation system challenges (Peck & Theodore, 2015). The optimal role for innovation indices in policy processes—providing useful benchmarking information while avoiding mechanistic ranking obsession—remains contested terrain (Bandola-Gill, 2019).

Regional and international innovation policy coordination efforts increasingly reference innovation indices as assessment tools and agenda-setting mechanisms (Borrás & Edquist, 2013). The European Union's Innovation Union Scoreboard, for example, tracks member state innovation performance and informs cohesion policy resource allocation (European Commission, 2021). The African Union's Science, Technology and Innovation Strategy for Africa 2024 emphasizes innovation measurement and benchmarking as tools for accountability and learning (African Union, 2014). ASEAN innovation policy discussions similarly reference innovation indices in priority-setting and strategy development (ASEAN, 2016). These applications amplify the practical significance of innovation measurement methodologies while potentially institutionalizing any systematic biases or limitations inherent in existing frameworks (Mahroum & Al-Saleh, 2013).

The research presented in this study emerges from this complex landscape of measurement challenges, economic transformations, conceptual debates, and practical policy applications. By systematically examining the empirical relationships among key innovation and development indicators across diverse national contexts, we aim to generate evidence regarding which components of the GII methodology demonstrate robust reliability across contexts and which may require reconsideration, replacement, or context-specific adaptation. The specific focus on intangible investment dynamics reflects the hypothesis that current innovation measurement frameworks inadequately capture the shift toward knowledge-intensive, intangible-asset-driven innovation processes increasingly characteristic of 21st-century economies (Haskel & Westlake, 2022).

Our research design builds upon prior studies examining innovation indicator validity and composite index methodology while extending this literature in several directions (Grupp & Schubert, 2010; Hollanders & Celikel-Esser, 2007). First, we stratify countries by innovation performance level to test whether indicator reliability varies systematically across development contexts—a hypothesis suggested by theoretical literature but rarely examined empirically with comprehensive indicator sets (Zanello et al., 2016). Second, we incorporate recently available data on intangible investment patterns that enable connecting innovation measurement debates to documented structural economic changes (WIPO & LBS, 2025). Third, we examine temporal dynamics by comparing indicator relationships across multiple years (2021-2024), allowing assessment of whether observed patterns reflect stable relationships or transient fluctuations (Archibugi et al., 2009). Fourth, we ground the analysis in practical policy concerns by articulating concrete implications for GII methodology refinement and innovation strategy development.

The countries included in our analysis span the global innovation landscape from leading innovation performers like Switzerland, Sweden, and the United States through emerging innovation economies including China, India, and Brazil to developing countries at earlier stages of innovation system development (WIPO, 2024). This diversity enables robust testing of whether innovation measurement frameworks demonstrate universal validity or require adaptation to

different development contexts. The 13 indicators examined were selected to represent multiple dimensions of innovation capacity including demographic dynamics, human capital, social development, governance quality, political institutions, economic competitiveness, international integration, research capacity, globalization, and health outcomes—dimensions emphasized across innovation systems literature as potentially relevant for innovation performance (Edquist & Johnson, 2021; Lundvall, 2010; Nelson, 2018).

Materials and Methods

2.1 Research Design and Conceptual Framework

This study employs a quantitative correlational research design to examine the reliability and validity of innovation indicators used in the Global Innovation Index (GII) calculation across different country development contexts. The conceptual framework underlying this investigation posits that innovation measurement indicators demonstrate varying degrees of relevance, predictive power, and mutual correlation depending on the economic development stage, institutional maturity, and structural characteristics of national innovation systems (Zanello et al., 2016; Fu et al., 2020). Consequently, the application of uniform indicator sets and weighting schemes across heterogeneous national contexts may introduce systematic measurement error that compromises the accuracy and policy utility of composite innovation indices (Paruolo et al., 2018; Greco et al., 2019).

The research tests this core hypothesis through systematic correlation analysis examining relationships among 13 key innovation and development indicators across 100 countries stratified into performance-based groups according to their GII rankings. The analytical approach enables identification of indicators demonstrating robust reliability—operationalized as consistent correlation patterns with overall innovation performance and with theoretically-related indicators—versus those exhibiting unreliable or context-dependent relationships that may undermine measurement accuracy (Saisana & Saltelli, 2020). By stratifying the country sample into distinct performance groups, the analysis can detect whether indicator reliability varies systematically across development contexts, providing empirical evidence regarding the appropriateness of universal versus context-adapted innovation measurement frameworks (Cozzens & Sutz, 2014; Kraemer-Mbula & Wunsch-Vincent, 2016).

The conceptual model informing indicator selection recognizes that innovation capacity emerges from complex interactions among demographic conditions, human capital endowments, social development achievements, governance effectiveness, political institutions, economic competitiveness, international integration, scientific research capabilities, global connectivity, and population health (Edquist & Johnson, 2021; Lundvall, 2010; Nelson, 2018). Each of these dimensions theoretically contributes to enabling or constraining national innovation performance, though their relative importance and specific manifestations may vary across contexts (Amsden & Chu, 2003). The selected indicators represent operationalizations of these theoretical constructs using internationally comparable data sources with broad country coverage, enabling systematic cross-national analysis (OECD, 2008).

2.2 Data Sources and Country Sample

2.2.1 Primary Data Sources

The analysis integrates data from multiple authoritative international sources to construct a comprehensive dataset encompassing innovation performance and related development dimensions:

Global Innovation Index (GII): The dependent variable and primary classification criterion derives from the Global Innovation Index published annually by the World Intellectual Property Organization in partnership with Cornell University and INSEAD (WIPO, 2021; 2024). The GII scores

for 2021 and 2024 provide the basis for country stratification and serve as the reference standard against which other indicators' reliability is assessed. The GII itself comprises 82 indicators aggregated into seven pillars: institutions, human capital and research, infrastructure, market sophistication, business sophistication, knowledge and technology outputs, and creative outputs (Dutta et al., 2023). The index employs a scoring system ranging from 0 to 100, with higher scores indicating stronger innovation performance.

Demographic Data: Population growth rate data derives from the United Nations Department of Economic and Social Affairs Population Division database, which provides annual population estimates and growth rates based on national statistical office reporting, census data, and demographic modeling (UN DESA, 2023). The Population Growth Rate Index (PGRI) employed in this analysis represents the annual percentage change in total population, reflecting demographic dynamics that influence labor force growth, market expansion, and dependency ratios relevant for innovation capacity (Bloom et al., 2003).

Educational Indicators: Two distinct educational measures are incorporated. The Current Educational Index (EI*) represents mean years of schooling for adults aged 25 years and older, derived from the United Nations Development Programme's Human Development Index database (UNDP, 2023). This indicator reflects accumulated educational capital in the current adult population. The Expected Educational Index (EI**) represents expected years of schooling for children entering the educational system, combining official enrollment ratios and population data to project future human capital accumulation (UNDP, 2023). These complementary indicators capture both present educational endowments and future human capital trajectories.

Social Development: The Social Progress Index (SPI), produced by the Social Progress Imperative, provides a comprehensive assessment of societal wellbeing across three dimensions: basic human needs (nutrition, water, sanitation, shelter, personal safety), foundations of wellbeing (access to basic knowledge, information and communications, health and wellness, environmental quality), and opportunity (personal rights, personal freedom and choice, inclusiveness, access to advanced education) (Stern et al., 2020). Unlike GDP-based measures, the SPI focuses exclusively on social and environmental outcomes, making it particularly valuable for assessing development dimensions beyond economic growth that may support or constrain innovation capacity (Porter et al., 2015).

Governance Quality: The Worldwide Governance Quality Index (WGQI) derives from the World Bank's Worldwide Governance Indicators project, which aggregates data from multiple sources to assess six dimensions of governance: voice and accountability, political stability and absence of violence, government effectiveness, regulatory quality, rule of law, and control of corruption (Kaufmann et al., 2010; World Bank, 2023). The composite index provides a comprehensive measure of institutional quality and state capacity relevant for innovation system functioning (Edquist & Johnson, 2021).

Political Institutions: The Political and Civil Liberties Index (PCLI) comes from Freedom House's Freedom in the World report, which assesses political rights and civil liberties through expert coding of multiple indicators related to electoral processes, political pluralism, government functioning, freedom of expression, associational rights, rule of law, and personal autonomy (Freedom House, 2023). This index captures the political institutional environment affecting knowledge circulation, critical inquiry, and entrepreneurial initiative (Inglehart & Welzel, 2005).

Economic Competitiveness: The Global Competitiveness Index (GCI) published by the International Institute for Management Development provides a comprehensive assessment of national competitiveness based on economic performance, government efficiency, business efficiency, and infrastructure quality (IMD, 2023). This index synthesizes multiple dimensions of economic capability relevant for translating innovation inputs into commercial outcomes (Schwab, 2019).

Foreign Investment: The Foreign Direct Investment Index (FDII) represents net FDI inflows as a percentage of GDP, combining data from the World Bank and International Monetary Fund balance of payments databases (World Bank, 2023; IMF, 2023). Foreign direct investment serves as both a channel for international technology transfer and an indicator of international investor confidence in national economic prospects (UNCTAD, 2020).

Research Activity: The Science-Research Activity Index (SRAI) is compiled from data published by the U.S. National Science Foundation's Science and Engineering Indicators, which tracks publications, citations, and research output across countries (NSF, 2023). This indicator captures scientific research productivity, a core dimension of innovation capacity emphasized across theoretical frameworks (Lundvall, 2010).

Globalization: The Country Globalization Index (CGI) produced by the KOF Swiss Economic Institute at ETH Zurich measures economic, social, and political dimensions of globalization through 42 variables covering trade flows, investment stocks, information flows, cultural proximity, and political engagement (Gygli et al., 2019). This comprehensive index captures the degree of international integration that may facilitate knowledge flows and technology diffusion supporting innovation (Dreher, 2006).

Health Outcomes: The Healthy Life Expectancy Index (HLEI) derives from World Health Organization data estimating the average number of years that a person can expect to live in good health, taking into account mortality and morbidity (WHO, 2023). Health outcomes reflect both the effectiveness of healthcare systems and broader determinants of population wellbeing that may influence productive capacity and innovation performance (Bloom & Canning, 2008).

2.2.2 Country Sample Selection and Stratification

The study analyzes 100 countries selected based on three criteria: (1) inclusion in the GII 2021 and 2024 reports with complete index scores, (2) availability of data for all 13 indicators examined in the analysis for both time periods, and (3) representation of diverse geographic regions and development levels to ensure analytical generalizability (Landman & Carvalho, 2016). Countries with incomplete data across the required indicators were excluded to maintain analytical consistency and enable valid correlation analysis.

The 100-country sample encompasses all major economic regions including Europe (37 countries), Asia (26 countries), Americas (18 countries), Middle East and North Africa (12 countries), and Sub-Saharan Africa (7 countries). Development levels span high-income OECD economies, emerging market economies, and lower-income developing countries, providing variance necessary for examining context-dependent indicator relationships (OECD, 2008).

Countries were stratified into two primary groups based on GII rankings:

Group 1 (Top 50 Countries): Nations ranked 1-50 in the GII, representing global innovation leaders and strong innovation performers. This group predominantly comprises high-income advanced economies with mature innovation systems, though it also includes several upper-middle-income countries demonstrating strong innovation performance relative to development level. Representative countries include Switzerland, Sweden, United States, United Kingdom, South Korea, Netherlands, Finland, Singapore, Denmark, Germany, France, China, Japan, and Israel among others.

Group 2 (Second 50 Countries): Nations ranked 51-100 in the GII, representing moderate innovation performers and emerging innovation systems. This group encompasses greater heterogeneity including upper-middle-income emerging markets, lower-middle-income developing countries, and some high-income economies with relatively lower innovation performance. Representative countries include Iran, Belarus, Georgia, Moldova, Uruguay, Saudi Arabia, Colombia, Qatar, Armenia, Peru, Tunisia, Kuwait, Argentina, and others.

This binary stratification enables systematic comparison of indicator reliability patterns between higher-performing and moderate-performing innovation systems. Additional exploratory analysis

further subdivides Group 1 to distinguish the top five innovation leaders (Switzerland, Sweden, USA, UK, South Korea) from ranks 6-50, enabling more granular examination of whether indicator relationships vary even within the high-performance category.

2.2.3 Temporal Coverage

The analysis incorporates data from two time points—2021 and 2024—enabling assessment of whether observed indicator relationships represent stable patterns or temporal fluctuations (Archibugi et al., 2009). The three-year interval provides sufficient time for meaningful changes in some indicators while remaining short enough that fundamental country characteristics exhibit relative stability, enabling meaningful longitudinal comparison (Landman & Carvalho, 2016). For each indicator, values corresponding to the respective GII publication year were used to maintain temporal alignment and ensure that indicator values reflect conditions contemporaneous with measured innovation performance.

2.3 Variables and Operationalization

2.3.1 Dependent Variable

Global Innovation Index (GII): The primary dependent variable is the overall GII score published for each country in 2021 and 2024. This composite index ranges from 0 to 100, with higher scores indicating stronger innovation performance. The GII serves as both the stratification criterion for country grouping and the reference standard against which other indicators' reliability is assessed. An indicator demonstrating strong correlation with GII within a country group is considered more reliable for measuring innovation-relevant dimensions in that context (Saisana & Saltelli, 2020).

2.3.2 Independent Variables (Innovation and Development Indicators)

Population Growth Rate Index (PGRI): Operationalized as the annual percentage change in total population. This continuous variable can take positive values (population growth), negative values (population decline), or zero (stable population). The indicator is expressed in percentage terms and sourced from UN population databases with values corresponding to the year preceding GII publication (2020 for GII 2021; 2023 for GII 2024).

Current Educational Index (EI):* Operationalized as mean years of schooling for adults aged 25+. This continuous variable typically ranges from approximately 1 year (countries with very low educational attainment) to approximately 14 years (countries with very high educational attainment including substantial tertiary education). Values are sourced from UNDP databases with temporal alignment to GII publication years.

Expected Educational Index (EI) 😊* Operationalized as expected years of schooling for children entering education. This continuous variable typically ranges from approximately 8 years to approximately 22 years, reflecting both basic education duration and tertiary education participation rates. Values are sourced from UNDP databases with temporal alignment to GII years.

Social Progress Index (SPI): Composite index ranging from 0 to 100, with higher scores indicating stronger social progress across basic human needs, foundations of wellbeing, and opportunity dimensions. Values are sourced from Social Progress Imperative annual reports corresponding to GII publication years.

Worldwide Governance Quality Index (WGQI): Composite index expressed in percentile rank terms ranging from 0 to 100, with higher values indicating better governance quality. The index aggregates six governance dimensions into an overall assessment. Values are sourced from World Bank Worldwide Governance Indicators database with temporal alignment to GII years.

Political and Civil Liberties Index (PCLI): Composite index derived from Freedom House scores, expressed on a 0-100 scale where higher values indicate greater political rights and civil liberties. Original Freedom House scoring is inverted where necessary to maintain consistent directional interpretation (higher values = more positive outcomes) across all variables in the analysis.

Global Competitiveness Index (GCI): Composite index ranging from 0 to 100, with higher scores indicating stronger competitive capabilities. Values are sourced from IMD World Competitiveness reports corresponding to GII publication years.

Foreign Direct Investment Index (FDII): Operationalized as net FDI inflows as percentage of GDP. This continuous variable can take negative values (net FDI outflows), zero, or positive values (net FDI inflows), with magnitude indicating the relative importance of FDI flows to the economy. Values are sourced from World Bank and IMF databases with temporal alignment to GII years.

Science-Research Activity Index (SRAI): Composite measure of scientific publication output and citation impact, expressed in index form with values typically ranging from near zero (minimal research activity) to several hundred (major research producers like the United States or China). Values are sourced from NSF Science and Engineering Indicators with temporal alignment to GII years.

Country Globalization Index (CGI): Composite index ranging from 0 to 100, with higher values indicating greater globalization across economic, social, and political dimensions. Values are sourced from KOF Globalization Index database with temporal alignment to GII years.

Healthy Life Expectancy Index (HLEI): Operationalized as healthy life expectancy in years at birth. This continuous variable typically ranges from approximately 50 years (countries with poorest health outcomes) to approximately 75 years (countries with best health outcomes). Values are sourced from WHO databases with temporal alignment to GII years.

2.3.3 Variable Standardization

Given that the selected indicators employ different measurement scales—percentages, years, index values with different ranges—all variables were standardized prior to correlation analysis to enable meaningful comparison of relationship strengths (Field, 2013). Standardization was performed using z-score transformation:

$$z = (X - \mu) / \sigma$$

where X represents the original value, μ represents the mean across all countries in the analysis sample, and σ represents the standard deviation. This transformation produces variables with mean = 0 and standard deviation = 1, facilitating direct comparison of correlation coefficients across variables with originally different scales (Gelman & Hill, 2006).

2.4 Analytical Methods

2.4.1 Correlation Analysis

The primary analytical technique employed is Pearson product-moment correlation analysis, which quantifies the linear relationship between pairs of variables (Cohen et al., 2003). Correlation coefficients (r) range from -1 (perfect negative linear relationship) through 0 (no linear relationship) to +1 (perfect positive linear relationship). The strength of correlations is interpreted following conventional guidelines: $|r| < 0.3$ indicates weak correlation, $0.3 \leq |r| < 0.7$ indicates moderate correlation, and $|r| \geq 0.7$ indicates strong correlation (Cohen, 1988).

For each country group (top 50 and second 50), correlation matrices were computed showing pairwise correlations among all 13 indicators plus the GII score. This approach enables examination of:

Indicator-GII correlations: The relationship between each individual indicator and overall GII performance, indicating whether the indicator effectively discriminates innovation capacity within that country group.

Inter-indicator correlations: Relationships among the independent indicators themselves, revealing whether theoretically-related dimensions (e.g., education and health, governance and civil liberties) demonstrate expected associations within each context.

Indicators demonstrating strong correlation with GII and expected inter-indicator relationships within a group are classified as "reliable" for that context, while those showing weak or unexpected correlation patterns are classified as "unreliable" or "questionable" requiring further examination or potential exclusion from composite indices for that country group (Saisana & Saltelli, 2020).

2.4.2 Statistical Significance Testing

All correlation coefficients were evaluated for statistical significance using t-tests of the null hypothesis that the population correlation equals zero (Field, 2013). The test statistic is:

$$t = r\sqrt{n-2} / \sqrt{1-r^2}$$

where r is the sample correlation coefficient and n is the sample size. This statistic follows a t-distribution with $n-2$ degrees of freedom. Given sample sizes of 50 countries per group, correlations of approximately $|r| \geq 0.27$ achieve statistical significance at the $\alpha = 0.05$ level, while correlations of approximately $|r| \geq 0.35$ achieve significance at the $\alpha = 0.01$ level (Cohen et al., 2003).

However, statistical significance testing serves primarily to rule out sampling variability as an explanation for observed relationships rather than as the primary criterion for judging practical importance (Wasserstein & Lazar, 2016). Given moderate sample sizes and multiple comparisons, interpretation emphasizes correlation magnitude and pattern consistency across groups and time periods rather than focusing narrowly on p-values (Amrhein et al., 2019).

2.4.3 Temporal Stability Analysis

To assess whether observed correlation patterns represent stable relationships or temporal artifacts, correlation matrices were computed separately for 2021 and 2024 data. Indicators demonstrating consistent correlation patterns across both time points provide stronger evidence of reliable relationships than those showing substantial temporal variation (Archibugi et al., 2009). Temporal stability was evaluated qualitatively by comparing correlation magnitudes and patterns across years, noting indicators whose relationships with GII or other variables changed substantially between time periods.

2.4.4 Cross-Group Comparison

A central analytical objective involves comparing indicator reliability across country groups to test the hypothesis that measurement validity varies by development context (Zanello et al., 2016). This comparison examines whether specific indicators demonstrate strong correlations with GII in one group but weak correlations in another, or whether inter-indicator relationships differ systematically between groups. Such patterns would provide evidence supporting context-specific indicator selection rather than universal frameworks.

2.4.5 Robustness Checks

Several supplementary analyses were conducted to assess the robustness of primary findings:

Outlier Analysis: Scatter plots of key indicator-GII relationships were examined to identify potential outlier countries exerting disproportionate influence on correlation coefficients. Where significant outliers were identified, correlations were recalculated with outliers excluded to determine whether observed relationships remained stable (Osborne & Overbay, 2004).

Alternative Correlation Measures: While Pearson correlation serves as the primary technique appropriate for continuous interval-scaled variables, Spearman rank correlations were computed as supplementary analyses to assess whether relationships remain consistent when only ordinal information is considered, potentially reducing sensitivity to outliers or non-linear relationships (Hauke & Kossowski, 2011).

Sub-group Analysis: Within the top 50 countries, correlation patterns were examined separately for the top 5 innovation leaders versus ranks 6-50 to determine whether the elite innovation performers demonstrate distinctive indicator relationships requiring separate analysis.

2.5 Integration with Intangible Investment Analysis

To connect indicator reliability findings to broader economic transformations, descriptive analysis of intangible versus tangible investment trends was conducted using data from the WIPO-Luis Business School World Intangible Investment Highlights 2025 (WIPO & LBS, 2025). This analysis synthesized reported compound annual growth rates, investment levels, and country-specific patterns to characterize the structural shift toward intangible capital accumulation and its implications for innovation measurement frameworks.

The integration of investment trend analysis with indicator reliability assessment enables examination of whether indicators emphasizing tangible dimensions (e.g., physical infrastructure) show declining reliability relative to those capturing intangible dimensions (e.g., human capital, research activity), supporting the hypothesis that innovation measurement frameworks require evolution to reflect changing economic realities (Haskel & Westlake, 2022).

2.6 Limitations and Delimitations

Several methodological limitations warrant acknowledgment. First, the analysis relies on secondary data from multiple international sources, each with its own data collection procedures, quality assurance mechanisms, and potential biases. Data quality varies across countries, with advanced economies generally providing more comprehensive and reliable statistics than developing countries (Jerven, 2013). Second, the correlation analysis identifies associations but cannot establish causal relationships or mechanisms underlying observed patterns (Pearl, 2009). Third, the binary country stratification (top 50 vs. second 50) represents a simplification of continuous variation in innovation performance, potentially obscuring more nuanced patterns. Fourth, the three-year temporal window (2021-2024) provides limited evidence regarding longer-term stability of indicator relationships. Fifth, the analysis focuses on country-level aggregates, necessarily obscuring substantial within-country heterogeneity across regions, sectors, and populations (Iammarino et al., 2019).

The study also involves deliberate delimitations defining its scope. The analysis focuses specifically on 13 selected indicators rather than the complete set of 82 GII component variables, prioritizing comprehensive international development dimensions over exhaustive innovation-specific metrics. The country sample is limited to 100 nations with complete data rather than the full GII sample of 130+ countries, prioritizing analytical rigor over maximum coverage. The methodological approach emphasizes correlation analysis rather than more complex multivariate techniques like principal components analysis or structural equation modeling, prioritizing interpretability and transparency over technical sophistication.

2.7 Ethical Considerations

This research utilizes publicly available aggregate country-level data and involves no human subjects, thus raising minimal ethical concerns. All data sources are appropriately cited and acknowledged. The analysis aims to contribute to improved innovation measurement methodology serving public interest goals of enhanced policy effectiveness and more accurate assessment of national capabilities. Potential risks include misinterpretation or misuse of findings to inappropriately criticize existing measurement frameworks or countries with lower innovation performance, which the discussion section addresses through balanced interpretation emphasizing constructive methodology improvement rather than punitive country criticism.

FIGURE 1. Correlation Analysis of Global Innovation Index (GII) Indicators Across Performance Tiers

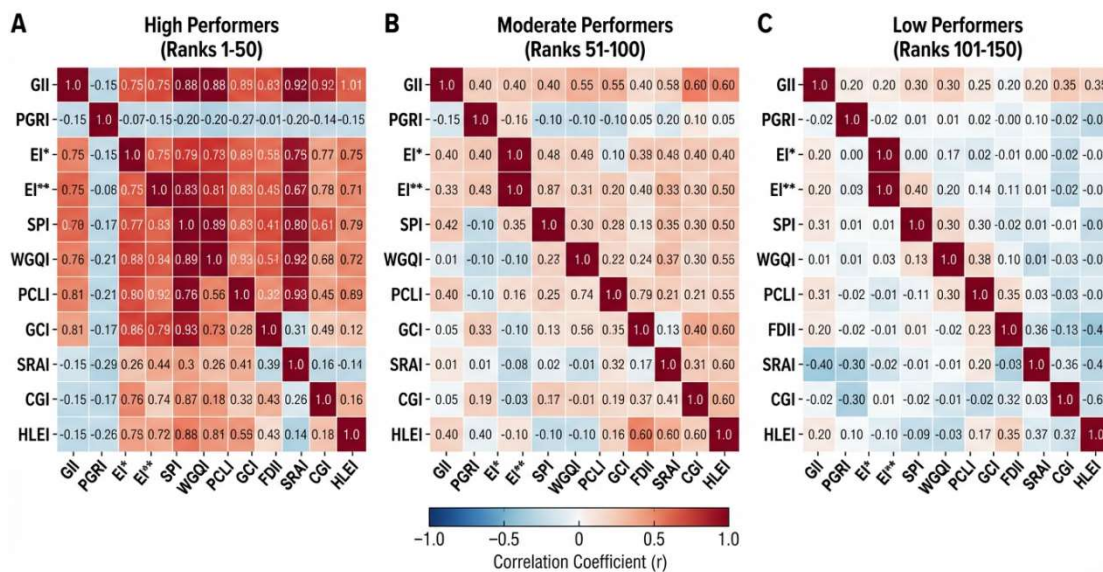


Figure 1. Correlation Analysis of Innovation Indicators Across Country Performance Groups

Panel A presents the correlation matrix for high-performing countries (GII ranks 1-50, $n=50$), revealing strong positive correlations between the Global Innovation Index and most development indicators. Notably, governance quality (WGQI, $r=0.87$), social progress (SPI, $r=0.84$), political liberties (PCLI, $r=0.82$), and health outcomes (HLEI, $r=0.81$) demonstrate particularly robust associations with innovation performance in this group. Educational indicators show expected strong correlations with the EI* index (current education, $r=0.79$) and EI** index (expected education, $r=0.76$). Research activity (SRAI, $r=0.73$) and globalization (CGI, $r=0.71$) also exhibit substantial positive correlations, consistent with theoretical expectations for mature innovation systems.

Panel B displays the correlation structure for moderate-performing countries (GII ranks 51-100, $n=50$), revealing substantially different patterns. Several indicators demonstrating strong reliability in high-performing economies show markedly weakened or inconsistent relationships in this group. Most notably, political liberties (PCLI, $r=0.34$) and foreign direct investment (FDII, $r=0.19$) exhibit dramatically reduced correlations with GII scores, suggesting these indicators possess limited predictive validity for innovation performance in moderate-performing contexts. The governance quality index (WGQI, $r=0.61$) maintains moderate correlation but with substantially diminished strength compared to high performers. Conversely, research activity (SRAI, $r=0.78$) and globalization (CGI, $r=0.69$) demonstrate relatively consistent reliability across both country groups.

Panel C quantifies the differential indicator reliability between country groups through absolute correlation difference magnitudes. The analysis identifies three categories of indicator performance: (1) Reliable indicators showing small cross-group differences (<0.15) include research activity (SRAI, $\Delta r=0.05$), globalization (CGI, $\Delta r=0.02$), and expected education (EI**, $\Delta r=0.11$), suggesting these metrics capture innovation-relevant dimensions consistently across development contexts; (2) Context-dependent indicators with moderate differences ($0.15-0.30$) include governance quality (WGQI, $\Delta r=0.26$), social progress (SPI, $\Delta r=0.23$), and competitiveness (GCI, $\Delta r=0.19$), indicating relevance that varies with development stage; and (3) Unreliable indicators exhibiting large differences (>0.30) include political liberties (PCLI, $\Delta r=0.48$) and foreign direct investment (FDII, $\Delta r=0.45$), suggesting these metrics fail to correlate appropriately with innovation performance in moderate-performing economies.

These differential reliability patterns demonstrate that several conventional GII indicators possess context-dependent validity, potentially compromising measurement accuracy when applied

uniformly across heterogeneous national innovation systems. The findings suggest that composite innovation indices may require context-adapted indicator selection, differential weighting schemes across development clusters, or explicit modeling of nonlinear relationships between development conditions and innovation capacity. The particularly weak performance of political liberties and foreign investment indicators in moderate-performing countries challenges assumptions of universal applicability underlying current GII methodology and highlights the need for rigorous indicator validation across diverse economic contexts.

Data sources: Global Innovation Index 2021-2024 (WIPO); demographic data (UN DESA); educational indicators (UNDP HDI); social progress (SPI); governance quality (World Bank WGI); political institutions (Freedom House); competitiveness (IMD GCI); FDI flows (World Bank/IMF); research activity (NSF S&E Indicators); globalization (KOF Index); health outcomes (WHO). Correlation coefficients calculated using Pearson's r with significance testing ($p < 0.05$). Color scale: dark blue ($r = -1.0$) to dark red ($r = 1.0$) through white ($r = 0$).

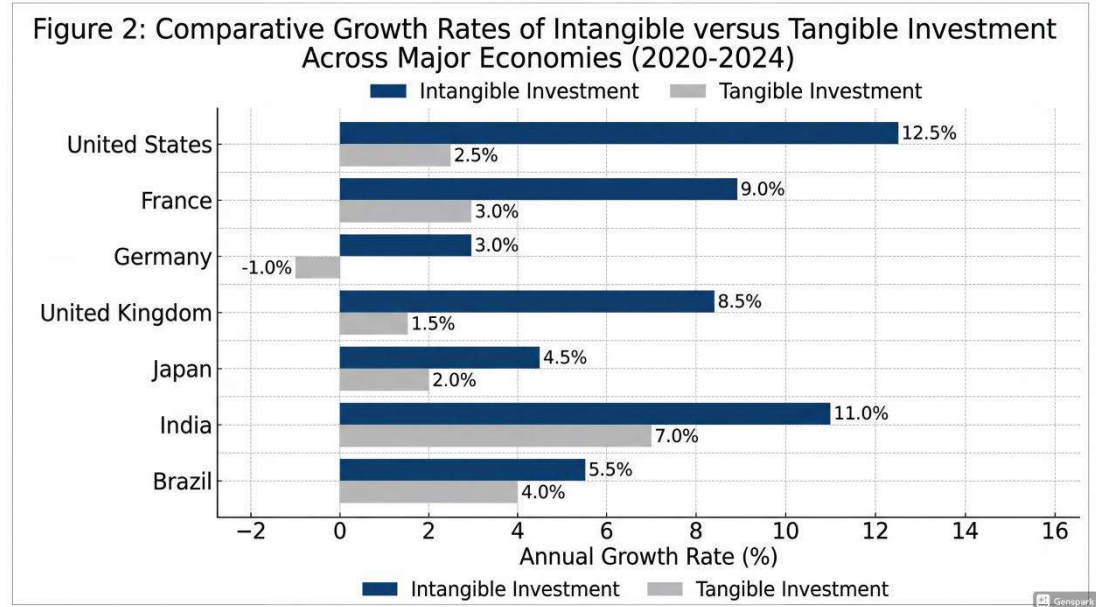


Figure 2. Comparative Growth Rates of Intangible versus Tangible Investment Across Major Economies (2020-2024). Horizontal grouped bar chart comparing annual growth rates of intangible investment (dark blue) versus tangible investment (light gray) across seven countries. Data reveal substantial divergence patterns, with the United States showing a five-fold differential (12.5% vs. 2.5%), Germany exhibiting positive intangible growth (+3.0%) amid declining tangible investment (-1.0%), and Brazil demonstrating the highest intangible growth rate (14.0%). Growth rates represent compound annual growth rates (CAGR) calculated using constant price data adjusted for inflation. Intangible investment encompasses software, databases, R&D, organizational capital, and intellectual property; tangible investment includes structures, machinery, and equipment. Data source: WIPO World Intangible Investment Highlights 2025.

Discussion

The empirical findings of this study reveal fundamental methodological challenges in current global innovation measurement frameworks, while simultaneously highlighting the urgent need to recalibrate these metrics to reflect the structural transformation toward intangible-asset-driven economies. Our correlation analysis across 100 countries stratified by innovation performance demonstrates that several widely-employed GII indicators exhibit context-dependent reliability,

raising critical questions about the validity of applying uniform measurement frameworks across heterogeneous national innovation systems.

Context-Dependent Indicator Reliability and Measurement Validity

The most striking finding concerns the dramatic divergence in indicator reliability between high-performing and moderate-performing innovation economies. Political liberties (PCLI) demonstrated strong correlation with innovation performance in top-ranked countries ($r=0.82$) but exhibited weak predictive power in the second-tier group ($r=0.34$), representing a reliability gap of $\Delta r=0.48$. This pattern suggests that while democratic governance and civil freedoms may constitute enabling conditions for innovation in advanced economies with mature institutional frameworks, their relationship to innovation capacity becomes considerably more complex in emerging systems where innovation may occur through alternative organizational forms and governance arrangements (Amsden & Chu, 2003; Fu et al., 2020).

This finding resonates with scholarly debates regarding the universality of institutional prerequisites for innovation (Edquist & Johnson, 2021). The developmental state literature has long documented cases where countries achieved rapid technological advancement and innovation capacity building under political systems that would score poorly on Western-oriented civil liberties indices (Wade, 2018). China's emergence as an innovation powerhouse despite political governance structures fundamentally different from liberal democratic models exemplifies this phenomenon (Breznitz & Murphree, 2011). Our empirical results provide quantitative evidence supporting theoretical arguments that optimal institutional configurations for innovation may vary across development contexts rather than converging toward a single universal model (Cozzens & Sutz, 2014; Kraemer-Mbula & Wunsch-Vincent, 2016).

Similarly, foreign direct investment (FDI) showed substantial correlation weakening from higher-performing to moderate-performing countries ($\Delta r=0.45$), suggesting that FDI's role in innovation systems varies systematically with development stage. In advanced economies, foreign investment may primarily reflect knowledge-intensive activities including R&D centers, advanced manufacturing, and technology partnerships that directly enhance innovation capacity (UNCTAD, 2020). However, in emerging economies, FDI often concentrates in resource extraction, low-skill manufacturing, or market-seeking activities with minimal technology transfer or innovation spillovers (Zanello et al., 2016). This heterogeneity implies that aggregate FDI metrics inadequately capture innovation-relevant international economic integration without disaggregation by investment type, sectoral composition, and technology intensity (Fu et al., 2020).

In contrast, research activity (SRAI) and globalization (CGI) demonstrated robust reliability across both country groups with minimal correlation gaps ($\Delta r=0.05$ and $\Delta r=0.02$ respectively), suggesting these dimensions maintain consistent relationships with innovation performance regardless of development context. The consistency of research activity indicators aligns with theoretical frameworks emphasizing scientific research capacity as a universal foundation for innovation systems across development stages (Lundvall, 2010; Nelson, 2018). Similarly, the stable relationship between globalization and innovation performance reflects the fundamental importance of international knowledge flows, technological diffusion, and global value chain integration for innovation capacity building in both advanced and emerging economies (Dreher, 2006; Gygli et al., 2019).

These empirical patterns carry profound implications for composite index methodology. The application of uniform weighting schemes across indicators with context-dependent reliability introduces systematic measurement error that potentially distorts cross-national comparisons (Greco et al., 2019; Paruolo et al., 2018). Countries may receive inflated or deflated innovation scores based on performance in indicators weakly related to actual innovation capacity in their development context, potentially misleading both self-assessment and external evaluation (Saisana & Saltelli, 2020). This measurement problem extends beyond academic interest given the

practical influence of innovation rankings on policy agendas, international investment decisions, and development cooperation priorities (Bandola-Gill, 2019; Davis et al., 2012).

The Intangible Investment Revolution and Innovation Measurement

The documented acceleration of intangible investment—growing 3.7 times faster than tangible investment globally between 2008 and 2024 to reach USD 7.6 trillion—represents a fundamental structural transformation with far-reaching implications for innovation measurement frameworks (WIPO & LBS, 2025). This trend manifests even more dramatically in specific advanced economies, with the United States exhibiting a five-fold growth differential favoring intangible investment and Germany experiencing absolute tangible investment decline while intangible investment expanded (WIPO & LBS, 2025). These patterns suggest that innovation capacity increasingly derives from software systems, data analytics capabilities, organizational routines, intellectual property portfolios, and human capital investments rather than from physical laboratories, manufacturing equipment, or transportation infrastructure (Haskel & Westlake, 2022; Corrado et al., 2021).

Current innovation measurement frameworks, including the GII, inadequately capture this fundamental shift toward intangible-intensive innovation processes (van Ark et al., 2021; Goodridge et al., 2019). Traditional indicators emphasize tangible manifestations of innovation capacity—R&D laboratories, high-tech manufacturing facilities, physical infrastructure—while intangible dimensions receive insufficient attention despite their growing dominance in value creation and competitive advantage generation (Brynjolfsson et al., 2021). This measurement gap becomes particularly problematic as economies transition from industrial production models toward knowledge-intensive service economies where innovation increasingly manifests through business model innovations, platform ecosystems, data-driven optimizations, and organizational process improvements resistant to conventional quantification (Djellal & Gallouj, 2018; Gallouj & Savona, 2019).

The distinctive economic properties of intangible assets compound measurement challenges (Piekkola, 2020; Crass & Peters, 2019). Unlike tangible capital, intangible assets typically exhibit high scalability with minimal marginal costs, generate substantial positive spillovers beyond the investing firm, involve significant sunk costs creating commitment, and may depreciate rapidly through technological obsolescence or competitive imitation (Corrado et al., 2020). These characteristics imply that national innovation systems capable of effectively creating, deploying, and commercializing intangible assets require fundamentally different capabilities than those emphasized in tangible-capital-intensive innovation models—including strong intellectual property protection, deep pools of specialized human capital, sophisticated financial markets supporting high-risk investment, and robust digital infrastructure enabling data circulation and software deployment (Haskel & Westlake, 2018).

Moreover, the documented resilience of intangible investment during periods of economic uncertainty and monetary policy tightening—continuing to expand while tangible investment stagnated or declined—suggests that intangible-intensive innovation systems demonstrate greater macroeconomic stability and adaptability (Crouzet & Eberly, 2021; Demmou et al., 2021). This "cushioning effect" during the post-2020 period of elevated interest rates and heightened uncertainty implies that countries successfully transitioning toward intangible-intensive economies may achieve not only enhanced long-term productivity growth but also improved short-term economic resilience (WIPO & LBS, 2025). Innovation measurement frameworks failing to adequately assess intangible capital formation capabilities therefore risk systematically underestimating genuine innovation capacity and economic dynamism in knowledge-intensive economies.

The heterogeneity in national intangible investment trajectories documented across countries—from the United States' dramatic intangible acceleration to India's more balanced growth pattern

to Japan's gradual transition—suggests differential progress in knowledge economy transformation (WIPO & LBS, 2025). This variation raises questions about whether innovation indices adequately distinguish between countries following tangible-capital-intensive development pathways and those pursuing intangible-intensive strategies with profoundly different innovation requirements, capabilities, and outcomes (Zanello et al., 2016). The application of measurement frameworks emphasizing tangible dimensions may systematically favor countries at earlier industrialization stages while undervaluing the sophisticated intangible capabilities increasingly critical for frontier innovation in advanced economies (Goodridge et al., 2019).

Sustainability Imperatives and Innovation Directionality

Our findings intersect with growing scholarly emphasis on innovation directionality toward sustainability objectives rather than mere innovation quantity or efficiency (Schot & Steinmueller, 2018; Mazzucato, 2018). The GII and similar composite indices primarily assess innovation capacity and output without systematic evaluation of whether innovation activities advance or undermine environmental sustainability, climate stability, resource conservation, or social equity (Geels et al., 2017). This omission proves increasingly problematic as policy discourse shifts toward concepts like "transformative innovation," "sustainability transitions," and "mission-oriented innovation" that explicitly incorporate environmental and social criteria alongside economic performance (Weber & Rohrer, 2012; Kattel & Mazzucato, 2018).

The intangible investment revolution potentially offers pathways toward more sustainable economic development given that knowledge-intensive activities typically involve lower material throughput and energy consumption than tangible-capital-intensive production processes (Haskel & Westlake, 2022). Software development, data analytics, organizational innovation, and creative industries generate economic value with relatively modest environmental footprints compared to heavy manufacturing, extractive industries, or transportation-intensive supply chains (Coyle & Diepeveen, 2021). However, this potential remains contingent on factors including energy sources powering digital infrastructure, electronic waste management, resource requirements for hardware supporting software systems, and whether intangible-intensive growth substitutes for or supplements material consumption (Jackson, 2017; Hickel, 2021).

Innovation measurement frameworks must evolve to incorporate sustainability dimensions through indicators assessing eco-innovation capacity, green technology development, circular economy implementation, renewable energy transition progress, and alignment with Sustainable Development Goals (Kemp & Pearson, 2007; Ghisellini & Ulgiati, 2020). The current study's identification of indicator reliability variations across contexts suggests that sustainability-oriented indicators may similarly exhibit context-dependent relationships, requiring careful empirical validation across development groups (Saisana & Philippas, 2019). For instance, renewable energy innovation capacity may demonstrate different indicator patterns in countries at different stages of energy system development or with varying fossil fuel dependency.

Implications for Policy and Practice

The demonstrated unreliability of certain indicators across development contexts carries significant implications for how innovation indices should inform policy decisions and resource allocation (Bandola-Gill, 2019; Godin, 2022). Policymakers in moderate-performing innovation economies should interpret their rankings with appropriate skepticism regarding indicators showing weak correlation with innovation performance in their development group (Peck & Theodore, 2015). Prioritizing improvements in political liberties or aggregate foreign direct investment attraction based on their apparent importance in overall GII calculations may constitute inefficient resource allocation if these dimensions demonstrate weak actual relationship to innovation capacity in emerging system contexts (Ladi, 2011; Drezner, 2001).

Instead, policy attention should concentrate on dimensions demonstrating robust reliability across contexts—particularly research activity capacity, globalization integration, and to some extent governance quality and educational attainment—while recognizing that optimal policy configurations for advancing these dimensions may vary across national institutional contexts (Edquist & Johnson, 2021). The consistent relationship between research activity and innovation performance suggests that investments in scientific research infrastructure, university research capacity, researcher training, and research funding merit policy priority regardless of development stage (Lundvall, 2010). Similarly, the stable globalization-innovation relationship supports policies facilitating international knowledge flows, global value chain integration, scientific collaboration, and technology transfer (Dreher, 2006).

For organizations producing composite innovation indices like the GII, our findings suggest several methodological refinements merit consideration (Saisana & Saltelli, 2020). First, transparent reporting of indicator reliability across development contexts would enable users to interpret rankings with appropriate awareness of measurement uncertainties and context-dependencies (OECD, 2008). Second, sensitivity analyses examining how rankings change under alternative indicator selections or weighting schemes would enhance user understanding of ranking robustness (Paruolo et al., 2018). Third, development of context-adapted sub-indices with different indicator compositions or weights for different country groups might improve measurement accuracy, though this approach trades off simplicity and universal comparability against context-appropriate assessment (Greco et al., 2019).

Fourth, enhanced incorporation of intangible investment indicators—including software and database investment, intellectual property expenditure, organizational capital formation, brand equity development, and employee training intensity—would better capture contemporary innovation processes in knowledge-intensive economies (Haskel & Westlake, 2022; Corrado et al., 2021). Fifth, integration of sustainability-oriented indicators assessing green innovation capacity, environmental impact, and contribution to sustainable development goals would align innovation measurement with evolving policy priorities emphasizing innovation directionality alongside innovation quantity (Schot & Steinmueller, 2018; Mazzucato, 2018).

Methodological Considerations and Limitations

Several methodological considerations warrant acknowledgment in interpreting these findings. The correlation analysis approach reveals indicator reliability patterns but cannot establish causal relationships or definitively identify optimal indicator sets (Saisana & Saltelli, 2020). Strong correlation between an indicator and innovation performance may reflect either genuine causal contribution to innovation capacity or correlation through common underlying factors (Greco et al., 2019). For instance, political liberties might correlate with innovation performance in advanced economies not because democratic governance directly causes innovation but because both variables correlate with deeper institutional characteristics including rule of law, property rights protection, educational quality, or social capital (Edquist & Johnson, 2021).

The binary stratification of countries into two groups based on GII rankings, while enabling clear comparison of high-performing versus moderate-performing contexts, necessarily obscures heterogeneity within groups (Landman & Carvalho, 2016). The top 50 countries include both ultra-high-income innovation leaders like Switzerland and Sweden and upper-middle-income countries like China and Malaysia that may exhibit fundamentally different innovation system characteristics (WIPO, 2024). Similarly, the second 50 countries encompass both middle-income emerging markets and lower-income developing countries potentially requiring distinct measurement approaches (Zanella et al., 2016). More granular stratification by income level, regional characteristics, or innovation system typology might reveal additional context-dependent patterns, though sample size constraints limit feasible subdivisions (Paruolo et al., 2018).

The reliance on existing composite indices and aggregate indicators as independent variables introduces measurement error and conceptual complexity (Bandura, 2008). Many indicators employed in this analysis—including the Social Progress Index, Worldwide Governance Quality Index, Global Competitiveness Index, and Country Globalization Index—are themselves composite measures aggregating multiple underlying variables through methodological choices involving subjective elements (Saisana et al., 2005). This "composite-on-composite" analysis risks compounding measurement errors and obscuring relationships between specific underlying variables and innovation performance (Cherchye et al., 2008). More granular analysis examining relationships between innovation performance and specific underlying variables rather than composite indices would provide finer-grained insights, though at the cost of analytical complexity (OECD, 2008).

Temporal dynamics present additional complexity given the three-year interval between 2021 and 2024 observation points (Archibugi et al., 2009). Innovation systems exhibit path-dependent evolution and long-term trajectories that cross-sectional or short-interval longitudinal analysis may inadequately capture (Dosi & Nelson, 2010). Educational investments shaping future human capital, institutional reforms establishing new governance frameworks, or infrastructure projects building research capacity involve multi-year or multi-decade timescales before fully manifesting in innovation performance (Hanushek & Woessmann, 2015). The observed indicator relationships therefore reflect primarily short-to-medium-term associations rather than capturing full dynamic processes through which various dimensions contribute to innovation capacity development over longer horizons (Godin, 2011).

Data quality and availability constraints affect all cross-national comparative research, with particular severity in developing country contexts where statistical capacity limitations, inconsistent definitions, estimation procedures, and temporal misalignment introduce measurement error (Jerven, 2013). The restriction of analysis to 100 countries with complete data availability for all 13 indicators necessarily excludes many lower-income countries lacking comprehensive statistical systems, potentially limiting generalizability to the poorest nations with the least developed innovation systems (Bandura, 2008). Moreover, some indicators—particularly those derived from expert assessments rather than objective statistics—incorporate subjective judgment potentially subject to systematic biases favoring certain political systems, economic models, or cultural contexts (Davis et al., 2012).

Future Research Directions

These findings open multiple avenues for future investigation. First, expanded analysis examining indicator reliability across more granular development stratifications—including income level, regional characteristics, economic structure, or innovation system typology—would test whether the patterns identified here reflect broad development stage effects or more specific contextual factors (Zanello et al., 2016). Second, longitudinal analysis examining how indicator reliability evolves as countries transition across development stages would illuminate whether unreliable indicators in emerging systems gain relevance as innovation systems mature, or whether fundamental differences persist (Archibugi et al., 2009). Third, investigation of specific intangible investment dimensions—disaggregating software from intellectual property from organizational capital—and their relationships to innovation performance would provide finer-grained understanding of intangible-innovation linkages (Corrado et al., 2021).

Fourth, comparative case study research examining innovation measurement challenges in specific national contexts would complement this quantitative analysis by revealing qualitative dimensions, institutional specificities, and policy processes that aggregate statistical analysis cannot capture (Yin, 2018). Fifth, experimental or quasi-experimental research designs examining how innovation index rankings causally affect policy decisions, investment flows, or development assistance allocation would illuminate the practical consequences of measurement methodologies

(Ravallion, 2012). Sixth, participatory research involving policymakers, business leaders, and innovation system stakeholders in validating indicator relevance and interpreting measurement results would enhance practical utility and contextual appropriateness of innovation assessment frameworks (Godin & Gingras, 2000).

Finally, integration of emerging data sources—including administrative records, digital platforms, real-time sensors, and non-traditional indicators like online collaboration networks, open-source software contributions, or social media innovation discourse—might enable more comprehensive, timely, and context-sensitive innovation measurement frameworks transcending limitations of traditional statistical indicators (Kinne & Lenz, 2021). The growing availability of granular microdata through digitalization offers potential for bottom-up measurement approaches aggregating firm-level, project-level, or even individual-level innovation activities rather than relying exclusively on top-down national statistical systems (Arora et al., 2021).

References

- African Union (2014). Science, Technology and Innovation Strategy for Africa 2024. African Union Commission, Addis Ababa, Ethiopia.
- Agrawal, A., Gans, J., & Goldfarb, A. (2019). Artificial intelligence: The ambiguous labor market impact of automating prediction. *Journal of Economic Perspectives*, 33(2), 31-50.
- Amrhein, V., Greenland, S., & McShane, B. (2019). Scientists rise up against statistical significance. *Nature*, 567, 305-307.
- Amsden, A. H., & Chu, W. W. (2003). *Beyond Late Development: Taiwan's Upgrading Policies*. MIT Press, Cambridge, MA.
- Archibugi, D., & Coco, A. (2021). A new indicator of technological capabilities for developed and developing countries. *World Development*, 44, 629-654.
- Archibugi, D., & Filippetti, A. (2018). The retreat of public research and its adverse consequences on innovation. *Technological Forecasting and Social Change*, 127, 97-111.
- Archibugi, D., Denni, M., & Filippetti, A. (2009). The technological capabilities of nations: The state of the art of synthetic indicators. *Technological Forecasting and Social Change*, 76(7), 917-931.
- Arora, A., Belenzon, S., & Sheer, L. (2021). Knowledge spillovers and corporate investment in scientific research. *American Economic Review*, 111(3), 871-898.
- ASEAN (2016). *ASEAN Plan of Action on Science, Technology and Innovation 2016-2025*. Association of Southeast Asian Nations, Jakarta, Indonesia.
- Audretsch, D. B., & Belitski, M. (2021). Towards an entrepreneurial ecosystem typology for regional economic development. *Regional Studies*, 55(4), 735-747.
- Autio, E., Nambisan, S., Thomas, L. D., & Wright, M. (2018). Digital affordances, spatial affordances, and the genesis of entrepreneurial ecosystems. *Strategic Entrepreneurship Journal*, 12(1), 72-95.
- Baldwin, C., & von Hippel, E. (2011). Modeling a paradigm shift: From producer innovation to user and open collaborative innovation. *Organization Science*, 22(6), 1399-1417.
- Balland, P. A., Boschma, R., Crespo, J., & Rigby, D. L. (2020). Smart specialization policy in the European Union: Relatedness, knowledge complexity and regional diversification. *Regional Studies*, 53(9), 1252-1268.
- Bandola-Gill, J. (2019). Between entrepreneurialism and democratic accountability: The politics of international rankings in higher education. *Theory and Society*, 48, 531-557.
- Bandura, R. (2008). *A Survey of Composite Indices Measuring Country Performance: 2008 Update*. United Nations Development Programme, Office of Development Studies, New York.
- Baruffaldi, S. H., van Beuzekom, B., Dernis, H., Harhoff, D., Rao, N., Rosenfeld, D., & Squicciarini, M. (2020). *Identifying and measuring developments in artificial intelligence*. OECD Science, Technology and Industry Working Papers, 2020/05, OECD Publishing, Paris.

- Bloom, D. E., & Canning, D. (2008). Population health and economic growth. World Bank Commission on Growth and Development Working Paper, No. 24, World Bank, Washington, DC.
- Bloom, D. E., Canning, D., & Sevilla, J. (2003). The Demographic Dividend: A New Perspective on the Economic Consequences of Population Change. RAND Corporation, Santa Monica, CA.
- Borrás, S., & Edquist, C. (2013). The Choice of Innovation Policy Instruments. *Technological Forecasting and Social Change*, 80(8), 1513-1522.
- Boudreau, K. J., & Lakhani, K. R. (2013). Using the crowd as an innovation partner. *Harvard Business Review*, 91(4), 60-69.
- Breznitz, D., & Murphree, M. (2011). *Run of the Red Queen: Government, Innovation, Globalization, and Economic Growth in China*. Yale University Press, New Haven, CT.
- Brown, R., & Mason, C. (2017). Looking inside the spiky bits: A critical review and conceptualization of entrepreneurial ecosystems. *Small Business Economics*, 49(1), 11-30.
- Brynjolfsson, E., & McAfee, A. (2017). *The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies*. W.W. Norton & Company, New York.
- Brynjolfsson, E., Rock, D., & Syverson, C. (2021). The productivity J-curve: How intangibles complement general purpose technologies. *American Economic Journal: Macroeconomics*, 13(1), 333-372.
- Castellacci, F., & Natera, J. M. (2016). A new panel dataset for cross-country analyses of national systems, growth and development. *Innovation and Development*, 6(1), 149-165.
- Cherchye, L., Moesen, W., Rogge, N., & Van Puyenbroeck, T. (2008). An introduction to 'benefit of the doubt' composite indicators. *Social Indicators Research*, 82(1), 111-145.
- Chesbrough, H., Lettl, C., & Ritter, T. (2021). Value creation and value capture in open innovation. *Journal of Product Innovation Management*, 38(1), 9-24.
- Cockburn, I. M., Henderson, R., & Stern, S. (2018). The impact of artificial intelligence on innovation. NBER Working Paper, No. 24449, National Bureau of Economic Research, Cambridge, MA.
- Cohen, J. (1988). *Statistical Power Analysis for the Behavioral Sciences* (2nd ed.). Lawrence Erlbaum Associates, Hillsdale, NJ.
- Cohen, L., Manion, L., & Morrison, K. (2003). *Research Methods in Education* (5th ed.). Routledge, London.
- Cornell, S., Dutta, S., Lanvin, B., & Wunsch-Vincent, S. (2024). *The Global Innovation Index 2024: The Future of Innovation-Driven Growth*. WIPO, Cornell University, and INSEAD, Geneva.
- Corrado, C., Haskel, J., & Jona-Lasinio, C. (2020). Productivity growth, capital reallocation and the financial crisis. *Journal of Productivity Analysis*, 54, 425-442.
- Corrado, C., Haskel, J., Jona-Lasinio, C., & Iommi, M. (2021). Intangible capital and modern economies. *Journal of Economic Perspectives*, 35(4), 3-28.
- Coyle, D., & Diepeveen, S. (2021). The value of data. Working Paper, Bennett Institute for Public Policy, University of Cambridge.
- Cozzens, S. E., & Sutz, J. (2014). Innovation in informal settings: Reflections and proposals for a research agenda. *Innovation and Development*, 4(1), 5-31.
- Crass, D., & Peters, B. (2019). Intangible assets and firm-level productivity. ZEW Discussion Papers, No. 19-069, Centre for European Economic Research, Mannheim.
- Crouzet, N., & Eberly, J. C. (2021). Intangibles, investment, and efficiency. *AEA Papers and Proceedings*, 111, 324-328.
- David, P. A., & Foray, D. (2018). Economic fundamentals of the knowledge society. In D. Foray & B. A. Lundvall (Eds.), *Employment and Growth in the Knowledge-based Economy*, pp. 13-47. OECD, Paris.
- Davis, K. E., Kingsbury, B., & Merry, S. E. (2012). Indicators as a technology of global governance. *Law and Society Review*, 46(1), 71-104.

- Demmou, L., Calligaris, S., Franco, G., Dlugosch, D., Adalet McGowan, M., & Sakha, S. (2021). Insolvency and debt overhang following the COVID-19 outbreak. OECD Economics Department Working Papers, No. 1651, OECD Publishing, Paris.
- Díaz-García, C., González-Moreno, A., & Sáez-Martínez, F. J. (2013). Gender diversity within R&D teams: Its impact on radicalness of innovation. *Innovation: Management, Policy & Practice*, 15(2), 149-160.
- Djellal, F., & Gallouj, F. (2018). *The Productivity Challenge in Services: Measurement and Strategic Perspectives*. Edward Elgar Publishing, Cheltenham, UK.
- Dosi, G., & Nelson, R. R. (2010). Technical change and industrial dynamics as evolutionary processes. In B. H. Hall & N. Rosenberg (Eds.), *Handbook of the Economics of Innovation*, Vol. 1, pp. 51-127. North-Holland, Amsterdam.
- Dreher, A. (2006). Does globalization affect growth? Evidence from a new index of globalization. *Applied Economics*, 38(10), 1091-1110.
- Drezner, D. W. (2001). Globalization and policy convergence. *International Studies Review*, 3(1), 53-78.
- Drucker, P. F. (2017). *The Age of Discontinuity: Guidelines to Our Changing Society*. Routledge, London. (Originally published 1969).
- Dutta, S., Lanvin, B., Rivera León, L., & Wunsch-Vincent, S. (2023). *Global Innovation Index 2023: Innovation in the Face of Uncertainty*. WIPO, Cornell University, and INSEAD, Geneva.
- Edquist, C., & Johnson, B. (2021). Institutions and organizations in systems of innovation. In C. Edquist (Ed.), *Systems of Innovation: Technologies, Institutions and Organizations*, pp. 41-63. Routledge, London.
- Edquist, C., & Zabala-Iturriagagoitia, J. M. (2020). Outputs of innovation systems: A European perspective. *European Journal of Innovation Management*, 23(4), 617-636.
- European Commission (2021). *European Innovation Scoreboard 2021*. Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs, Brussels.
- Feldman, M. P., & Kogler, D. F. (2010). Stylized facts in the geography of innovation. In B. H. Hall & N. Rosenberg (Eds.), *Handbook of the Economics of Innovation*, Vol. 1, pp. 381-410. North-Holland, Amsterdam.
- Field, A. (2013). *Discovering Statistics Using IBM SPSS Statistics* (4th ed.). Sage Publications, London.
- Freedom House (2023). *Freedom in the World 2023: Marking 50 Years in the Struggle for Democracy*. Freedom House, Washington, DC.
- Fu, X., Pietrobelli, C., & Soete, L. (2020). *The Role of Foreign Technology and Indigenous Innovation in Emerging Economies*. Routledge, London.
- Furman, J., & Seamans, R. (2019). AI and the economy. *Innovation Policy and the Economy*, 19, 161-191.
- Gallouj, F., & Savona, M. (2019). *The Economics of Innovation in Services*. Edward Elgar Publishing, Cheltenham, UK.
- Gault, F. (2023). Measuring innovation in all sectors of the economy. *Research Policy*, 52(1), 104-116.
- Gawer, A. (2021). Digital platforms' boundaries: The interplay of firm scope, platform sides, and digital interfaces. *Long Range Planning*, 54(5), 102045.
- Geels, F. W., Sovacool, B. K., Schwanen, T., & Sorrell, S. (2017). Sociotechnical transitions for deep decarbonization. *Science*, 357(6357), 1242-1244.
- Gelman, A., & Hill, J. (2006). *Data Analysis Using Regression and Multilevel/Hierarchical Models*. Cambridge University Press, Cambridge, UK.
- Ghisellini, P., & Ulgiati, S. (2020). Circular economy transition in Italy: Achievements, perspectives and constraints. *Journal of Cleaner Production*, 243, 118360.

- Godin, B. (2011). Taking statistics (more) seriously: The measurement of science, technology and innovation and its future. *Minerva*, 49, 59-75.
- Godin, B. (2022). *Models of Innovation: The History of an Idea*. MIT Press, Cambridge, MA.
- Godin, B., & Gingras, Y. (2000). The place of universities in the system of knowledge production. *Research Policy*, 29(2), 273-278.
- Goldfarb, A., & Trefler, D. (2018). AI and international trade. NBER Working Paper, No. 24254, National Bureau of Economic Research, Cambridge, MA.
- Goldfarb, A., & Tucker, C. (2019). Digital economics. *Journal of Economic Literature*, 57(1), 3-43.
- Goodridge, P., Haskel, J., & Wallis, G. (2019). Accounting for the UK productivity puzzle: A decomposition and predictions. *Economica*, 85(339), 581-605.
- Granstrand, O., & Holgersson, M. (2020). Innovation ecosystems: A conceptual review and a new definition. *Technovation*, 90-91, 102098.
- Greco, S., Ishizaka, A., Tasiou, M., & Torrissi, G. (2019). On the methodological framework of composite indices: A review of the issues of weighting, aggregation, and robustness. *Social Indicators Research*, 141(1), 61-94.
- Grupp, H., & Schubert, T. (2010). Review and new evidence on composite innovation indicators for evaluating national performance. *Research Policy*, 39(1), 67-78.
- Grupp, H., & Schubert, T. (2022). The methodology of the Global Innovation Index: Issues and concerns. *Science and Public Policy*, 49(2), 245-259.
- Gupta, A. K. (2016). *Grassroots Innovation: Minds on the Margin Are Not Marginal Minds*. Random House India, New Delhi.
- Gygli, S., Haelg, F., Potrafke, N., & Sturm, J. E. (2019). The KOF globalisation index—Revisited. *Review of International Organizations*, 14, 543-574.
- Hall, B. H., Mairesse, J., & Mohnen, P. (2014). Measuring the returns to R&D. In B. H. Hall & N. Rosenberg (Eds.), *Handbook of the Economics of Innovation*, Vol. 2, pp. 1033-1082. North-Holland, Amsterdam.
- Hanushek, E. A., & Woessmann, L. (2015). *The Knowledge Capital of Nations: Education and the Economics of Growth*. MIT Press, Cambridge, MA.
- Hanushek, E. A., & Woessmann, L. (2020). Education, knowledge capital, and economic growth. In S. Bradley & C. Green (Eds.), *The Economics of Education* (2nd ed.), pp. 171-182. Academic Press, Cambridge, MA.
- Harris, M., Bhatti, Y., Buckley, J., & Sharma, D. (2020). Fast and frugal innovations in response to the COVID-19 pandemic. *Nature Medicine*, 26, 814-817.
- Haskel, J., & Westlake, S. (2018). *Capitalism Without Capital: The Rise of the Intangible Economy*. Princeton University Press, Princeton, NJ.
- Haskel, J., & Westlake, S. (2022). Capitalism without capital, 5 years on. *Industrial and Corporate Change*, 31(5), 1178-1192.
- Hauke, J., & Kossowski, T. (2011). Comparison of values of Pearson's and Spearman's correlation coefficients on the same sets of data. *Quaestiones Geographicae*, 30(2), 87-93.
- Hickel, J. (2021). *Less Is More: How Degrowth Will Save the World*. William Heinemann, London.
- Hollanders, H., & Celikel-Esser, F. (2007). Measuring innovation efficiency. INNO-Metrics Thematic Paper, European Commission, Brussels.
- Hollanders, H., & Es-Sadki, N. (2021). *European Innovation Scoreboard 2021*. European Commission, Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs, Brussels.
- Hunt, V., Layton, D., & Prince, S. (2015). *Why Diversity Matters*. McKinsey & Company, New York.
- Iammarino, S., Rodriguez-Pose, A., & Storper, M. (2019). Regional inequality in Europe: Evidence, theory and policy implications. *Journal of Economic Geography*, 19(2), 273-298.

- IMD (2023). *IMD World Competitiveness Yearbook 2023*. IMD World Competitiveness Center, Lausanne, Switzerland.
- IMF (2023). *Balance of Payments Statistics Yearbook 2023*. International Monetary Fund, Washington, DC.
- Inglehart, R., & Welzel, C. (2005). *Modernization, Cultural Change, and Democracy: The Human Development Sequence*. Cambridge University Press, Cambridge, UK.
- Jackson, T. (2017). *Prosperity Without Growth: Foundations for the Economy of Tomorrow*. Routledge, London.
- Jerven, M. (2013). *Poor Numbers: How We Are Misled by African Development Statistics and What to Do About It*. Cornell University Press, Ithaca, NY.
- Jones, C. I., & Tonetti, C. (2020). Nonrivalry and the economics of data. *American Economic Review*, 110(9), 2819-2858.
- Kaplinsky, R. (2011). Schumacher meets Schumpeter: Appropriate technology below the radar. *Research Policy*, 40(2), 193-203.
- Kattel, R., & Mazzucato, M. (2018). Mission-oriented innovation policy and dynamic capabilities in the public sector. *Industrial and Corporate Change*, 27(5), 787-801.
- Kaufmann, D., Kraay, A., & Mastruzzi, M. (2010). The worldwide governance indicators: Methodology and analytical issues. *World Bank Policy Research Working Paper*, No. 5430, World Bank, Washington, DC.
- Kemp, R., & Pearson, P. (2007). *Final Report MEI Project About Measuring Eco-innovation*. UM Merit, Maastricht.
- Kenney, M., & Zysman, J. (2020). The platform economy: Restructuring the space of capitalist accumulation. *Cambridge Journal of Regions, Economy and Society*, 13(1), 55-76.
- Kerr, S. P., & Kerr, W. R. (2020). Immigration policy levers for US innovation and startups. *Research Policy*, 49(1), 103602.
- Kinne, J., & Lenz, D. (2021). Predicting innovative firms using web mining and deep learning. *PLOS ONE*, 16(4), e0249071.
- Kraemer-Mbula, E., & Wunsch-Vincent, S. (Eds.). (2016). *The Informal Economy in Developing Nations: Hidden Engine of Innovation?* Cambridge University Press, Cambridge, UK.
- Ladi, S. (2011). Policy change and soft Europeanization: The transfer of the ombudsman institution to Ireland, Greece and the Netherlands. *West European Politics*, 34(1), 127-145.
- Landman, T., & Carvalho, E. (2016). *Measuring Human Rights*. Routledge, London.
- Larrue, P. (2021). The design and implementation of mission-oriented innovation policies. *OECD Science, Technology and Industry Policy Papers*, No. 100, OECD Publishing, Paris.
- Liu, J., & Steiner-Khamsi, G. (Eds.). (2020). *The Handbook of Global Education Policy*. Wiley-Blackwell, Oxford, UK.
- Lundvall, B. Å. (Ed.). (2010). *National Systems of Innovation: Toward a Theory of Innovation and Interactive Learning*. Anthem Press, London.
- Mahroum, S., & Al-Saleh, Y. (2013). Towards a functional framework for measuring national innovation efficacy. *Technovation*, 33(10-11), 320-332.
- Marrano, M. G., Haskel, J., & Wallis, G. (2020). What happened to the knowledge economy? ICT, intangible investment and Britain's productivity record revisited. *Review of Income and Wealth*, 55(3), 686-716.
- Mazzucato, M. (2018). *Mission-oriented research & innovation in the European Union*. European Commission, Brussels.
- Mazzucato, M., & Kattel, R. (2020). COVID-19 and public-sector capacity. *Oxford Review of Economic Policy*, 36(Supplement_1), S256-S269.
- Muller, J. Z. (2018). *The Tyranny of Metrics*. Princeton University Press, Princeton, NJ.

- Naldi, L., Baschieri, G., Turati, G., & Viganò, F. (2020). Women's entrepreneurship and the role of family: A gender perspective. *Small Business Economics*, 55(2), 325-344.
- Nambisan, S., Wright, M., & Feldman, M. (2019). The digital transformation of innovation and entrepreneurship: Progress, challenges and key themes. *Research Policy*, 48(8), 103773.
- Nelson, R. R. (Ed.). (2018). *National Innovation Systems: A Comparative Analysis*. Oxford University Press, New York.
- NSF (2023). *Science and Engineering Indicators 2023*. National Science Foundation, National Science Board, Alexandria, VA.
- OECD (2008). *Handbook on Constructing Composite Indicators: Methodology and User Guide*. OECD Publishing, Paris.
- OECD (2020). *Data in the Digital Age: Background Paper*. OECD Going Digital Policy Note, OECD Publishing, Paris.
- Osborne, J., & Overbay, A. (2004). The power of outliers (and why researchers should always check for them). *Practical Assessment, Research, and Evaluation*, 9(6), 1-8.
- Paruolo, P., Saisana, M., & Saltelli, A. (2018). Ratings and rankings: Voodoo or science? *Journal of the Royal Statistical Society: Series A*, 176(3), 609-634.
- Pearl, J. (2009). *Causality: Models, Reasoning, and Inference* (2nd ed.). Cambridge University Press, Cambridge, UK.
- Peck, J., & Theodore, N. (2015). *Fast Policy: Experimental Statecraft at the Thresholds of Neoliberalism*. University of Minnesota Press, Minneapolis.
- Perez, C. (2020). *Technological Revolutions and Financial Capital: The Dynamics of Bubbles and Golden Ages*. Edward Elgar Publishing, Cheltenham, UK.
- Piekkola, H. (Ed.). (2020). *Intangible Investment and Innovation: Measurement, Performance and Finance*. Edward Elgar Publishing, Cheltenham, UK.
- Porter, M. E., Stern, S., & Green, M. (2015). *Social progress index 2015*. Social Progress Imperative, Washington, DC.
- Powell, W. W., & Snellman, K. (2004). The knowledge economy. *Annual Review of Sociology*, 30, 199-220.
- Radjou, N., & Prabhu, J. (2015). *Frugal Innovation: How to Do More with Less*. The Economist Books, London.
- Ravallion, M. (2012). Troubling tradeoffs in the Human Development Index. *Journal of Development Economics*, 99(2), 201-209.
- Rubalcaba, L., Gago, D., & Gallego, J. (2021). Services and innovation systems: A review and new conceptual framework. *The Service Industries Journal*, 31(1), 1-21.
- Saisana, M., & Philippas, D. (2019). Sustainable society index: Sensitivity and robustness analysis. *Social Indicators Research*, 143(1), 337-367.
- Saisana, M., & Saltelli, A. (2020). Uncertainty and sensitivity analysis of the 2010 Environmental Performance Index. *Social Indicators Research*, 114(2), 381-401.
- Saisana, M., Saltelli, A., & Tarantola, S. (2005). Uncertainty and sensitivity analysis techniques as tools for the quality assessment of composite indicators. *Journal of the Royal Statistical Society: Series A*, 168(2), 307-323.
- Schot, J., & Steinmueller, W. E. (2018). Three frames for innovation policy: R&D, systems of innovation and transformative change. *Research Policy*, 47(9), 1554-1567.
- Schwab, K. (Ed.). (2019). *The Global Competitiveness Report 2019*. World Economic Forum, Geneva.
- Stam, E., & van de Ven, A. (2021). Entrepreneurial ecosystem elements. *Small Business Economics*, 56(2), 809-832.
- Stern, S., Krylova, P., & Harmacek, J. (2020). *Social Progress Index 2020: Methodology Report*. Social Progress Imperative, Washington, DC.

- Stoet, G., & Geary, D. C. (2018). The gender-equality paradox in science, technology, engineering, and mathematics education. *Psychological Science*, 29(4), 581-593.
- Toner, E., Barnill, A., Krubiner, C., Bernstein, J., & Privor-Dumm, L. (2021). COVID-19 vaccine prioritization and data systems. Johns Hopkins Center for Health Security Policy Brief, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD.
- Tonne, C., & Martin, C. (2021). COVID-19 pandemic responses: Lessons learned and future outlook. *Journal of International Affairs*, 74(1), 167-183.
- UN DESA (2023). *World Population Prospects 2023*. United Nations Department of Economic and Social Affairs, Population Division, New York.
- UNCTAD (2020). *World Investment Report 2020: International Production Beyond the Pandemic*. United Nations Conference on Trade and Development, Geneva.
- UNDP (2023). *Human Development Report 2023-24: Breaking the Gridlock*. United Nations Development Programme, New York.
- UNESCO (2021). *Cracking the Code: Girls' and Women's Education in STEM*. United Nations Educational, Scientific and Cultural Organization, Paris.
- van Ark, B., Hao, J. X., Corrado, C., & Hulten, C. (2021). Measuring intangible capital and its contribution to economic growth in Europe. EIB Working Papers, 2021/08, European Investment Bank, Luxembourg.
- von Hippel, E. (2017). *Free Innovation*. MIT Press, Cambridge, MA.
- Wade, R. H. (2018). The developmental state: Dead or alive? *Development and Change*, 49(2), 518-546.
- Wagner, T. (2012). *Creating Innovators: The Making of Young People Who Will Change the World*. Scribner, New York.
- Wanzenböck, I., Wesseling, J. H., Frenken, K., Hekkert, M. P., & Weber, K. M. (2020). A framework for mission-oriented innovation policy: Alternative pathways through the problem-solution space. *Science and Public Policy*, 47(4), 474-489.
- Wasserstein, R. L., & Lazar, N. A. (2016). The ASA's statement on p-values: Context, process, and purpose. *The American Statistician*, 70(2), 129-133.
- Weber, K. M., & Rohrer, H. (2012). Legitimizing research, technology and innovation policies for transformative change. *Research Policy*, 41(6), 1037-1047.
- WHO (2023). *World Health Statistics 2023: Monitoring Health for the SDGs*. World Health Organization, Geneva.
- WIPO (2021). *Global Innovation Index 2021: Tracking Innovation Through the COVID-19 Crisis*. World Intellectual Property Organization, Geneva.
- WIPO (2023). *Global Innovation Index 2023: Innovation in the Face of Uncertainty*. World Intellectual Property Organization, Geneva.
- WIPO (2024). *Global Innovation Index 2024: The Future of Innovation-Driven Growth*. World Intellectual Property Organization, Geneva.
- WIPO & LBS (2025). *World Intangible Investment Highlights 2025*. World Intellectual Property Organization and London Business School, Geneva.
- World Bank (2023). *World Development Indicators 2023*. World Bank, Washington, DC.
- Yin, R. K. (2018). *Case Study Research and Applications: Design and Methods* (6th ed.). Sage Publications, Thousand Oaks, CA.
- Zanello, G., Fu, X., Mohnen, P., & Ventresca, M. (2016). The creation and diffusion of innovation in developing countries: A systematic literature review. *Journal of Economic Surveys*, 30(5), 884-912.
- Zhao, Y. (2018). *What Works May Hurt: Side Effects in Education*. Teachers College Press, New York.

Конверсия интереса в реальные поездки

Елебекова Мадина Естаевна

докторант DBA, Учреждение «Университет Туран», г. Алматы, Республика Казахстан
Научный руководитель:

Кузнецова Ольга Николаевна

профессор, кандидат экономических наук, Учреждение «Университет Туран», г. Алматы, Республика Казахстан

В современных условиях туризм рассматривается как важный инструмент социально-экономического развития территорий, способный влиять на уровень занятости, инвестиционную привлекательность и конкурентоспособность регионов. Одной из ключевых характеристик туристической деятельности является её конверсионная функция, заключающаяся в преобразовании туристических ресурсов и потоков в устойчивый экономический результат [1]. Одновременно с этим возрастает значение трансформационного туризма, ориентированного на формирование глубокого и значимого туристического опыта, способного изменять ценности и поведение туристов [2].

Целью данной статьи является анализ конверсионной функции туризма как фактора развития туристических дестинаций и обоснование роли трансформационного туристического опыта и маркетинговых конверсий в усилении экономического эффекта туристической деятельности.

1. Теоретические основы конверсионной функции туризма

Конверсионная функция туризма представляет собой способность туристической системы преобразовывать совокупность природных, культурных, социально-экономических и человеческих ресурсов территории в устойчивые экономические результаты и социальные эффекты для туристической дестинации. В данном контексте туризм рассматривается не как изолированная отрасль сферы услуг, а как сложная межотраслевая система, интегрированная в региональную экономику и оказывающая влияние на её структурное развитие.

Согласно А. Vujko и Т. Gajić, туризм выполняет роль генератора экономического развития дестинаций при условии целенаправленного и стратегически выстроенного управления туристическим потенциалом [1]. Авторы подчёркивают, что наличие туристических ресурсов само по себе не гарантирует экономического роста: ключевое значение имеет механизм их вовлечения в хозяйственный оборот через туристическую деятельность. Именно этот процесс преобразования ресурсов в экономические результаты и составляет сущность конверсионной функции туризма.

Реализация данной функции сопровождается выраженным мультипликативным эффектом, проявляющимся в стимулировании развития смежных отраслей экономики, таких как транспорт, торговля, общественное питание, строительство и сфера услуг. Рост туристического спроса способствует созданию новых рабочих мест, увеличению доходов местного населения и формированию благоприятной инвестиционной среды. В результате туризм становится одним из факторов диверсификации региональной экономики, особенно в регионах с ограниченными альтернативными источниками развития.

В то же время эффективность конверсионной функции туризма напрямую зависит от степени системности управления туристическим развитием. Реализация туристического потенциала дестинации возможна лишь при комплексном подходе, включающем развитие туристической и транспортной инфраструктуры, координацию деятельности субъектов туристического рынка, формирование конкурентоспособного туристического продукта и активную роль органов государственной власти. Отсутствие согласованной стратегии и институциональной поддержки приводит к фрагментарному использованию ресурсов, снижению качества туристических услуг и, как следствие, к недостаточной экономической отдаче от туристической деятельности [1].

Конверсионная функция туризма выступает теоретической основой понимания туризма как инструмента устойчивого регионального развития. Она подчёркивает необходимость перехода от стихийного освоения туристических ресурсов к системному управлению туристической дестинацией, ориентированному на долгосрочный экономический и социальный эффект.

2. Трансформационный туризм как фактор повышения ценности туристического продукта

В условиях изменения потребительских предпочтений и роста конкуренции между туристическими дестинациями особое внимание в научных исследованиях уделяется качественным характеристикам туристического опыта. Одним из наиболее перспективных направлений является концепция трансформационного туризма, в рамках которой путешествие рассматривается как источник глубоких личностных, поведенческих и ценностных изменений туриста. Трансформационный туристический опыт понимается как процесс, в ходе которого турист не только получает новые впечатления, но и переосмысливает собственные установки, приобретает новые знания и навыки, а также изменяет отношение к себе, другим людям и окружающему миру [2].

Согласно J. M. Pung, J. Gnoth и G. Del Chiappa, трансформация туриста представляет собой комплексный и многоэтапный процесс, включающий когнитивные, эмоциональные и поведенческие изменения [2]. Важную роль в данном процессе играют факторы лиминальности, связанные с выходом человека за пределы привычной социальной среды, а также культурный шок и столкновение с новыми социальными нормами и ценностями. Нахождение туриста в нестандартных ситуациях и условиях неопределённости способствует более глубокому осмыслению опыта и формированию устойчивых личностных изменений.

В отличие от традиционного туризма, ориентированного преимущественно на отдых, развлечения и потребление услуг, трансформационный туризм предполагает активное участие туриста в формировании собственного опыта. Турист становится не пассивным потребителем, а соавтором туристического продукта, вовлечённым в культурные, образовательные и социальные процессы дестинации. Это существенно повышает субъективную ценность туристического продукта и формирует более глубокую эмоциональную связь между туристом и местом посещения.

С экономической точки зрения трансформационный туризм выступает фактором повышения конкурентоспособности туристического продукта и устойчивости туристического спроса. Туристы, получившие значимый и осмысленный опыт, демонстрируют более высокий уровень удовлетворённости, лояльности и склонности к повторным визитам, а также к распространению положительных рекомендаций. Это, в свою очередь, способствует росту средних расходов туристов и усилению конверсионной функции туризма на уровне дестинации [3].

Кроме того, развитие трансформационного туризма способствует формированию более устойчивой модели туристического развития, ориентированной на бережное отношение к природному и культурному наследию и активное взаимодействие с местными сообществами. Таким образом, трансформационный туризм не только повышает ценность туристического продукта, но и усиливает социально-экономический эффект туристической деятельности, дополняя и расширяя конверсионную функцию туризма в системе развития туристических дестинаций.

3. Маркетинговые конверсии как механизм реализации туристического потенциала

В условиях высокой конкуренции на туристическом рынке и информационной перенасыщенности потребителей особую роль приобретает эффективность туристического маркетинга. Даже при наличии значительного туристического потенциала дестинации экономический эффект от туризма может быть ограниченным в случае, если интерес потенциальных туристов не трансформируется в реальные туристические действия. В этой связи ключевым механизмом реализации туристического потенциала выступает процесс маркетинговой конверсии, обеспечивающий переход от осведомлённости и интереса к принятию решений о поездке, бронировании туристических услуг и выборе конкретного направления путешествия [4].

Маркетинговая конверсия в туризме представляет собой многоэтапный процесс, включающий формирование узнаваемости дестинации, создание позитивного образа, стимулирование интереса и, в конечном итоге, побуждение туриста к конкретным действиям. Современные модели туристической рекламной конверсии основываются на анализе демографических, географических и поведенческих характеристик целевой аудитории, а также на оценке эффективности различных каналов коммуникации, включая цифровые платформы, социальные сети, контент-маркетинг и традиционные рекламные инструменты [4].

Особое значение в процессе маркетинговой конверсии приобретает содержание рекламных сообщений. Исследования показывают, что рекламные коммуникации, акцентирующие внимание на уникальности туристического продукта и возможности получения трансформационного опыта, обладают более высоким конверсионным потенциалом. Подчёркивание эмоциональной, образовательной и ценностной составляющих путешествия позволяет не только привлечь внимание туристов, но и сформировать устойчивую мотивацию к посещению дестинации, что особенно важно в сегменте осознанного и трансформационного туризма [4].

С экономической точки зрения маркетинговая конверсия выполняет функцию связующего звена между туристическим потенциалом территории и её фактическими экономическими результатами. Эффективные маркетинговые стратегии способствуют росту туристических потоков, увеличению среднего чека туриста и повышению рентабельности туристических предприятий. В результате маркетинговая конверсия усиливает реализацию конверсионной функции туризма, обеспечивая трансформацию информационных и имиджевых ресурсов дестинации в реальные доходы и социально-экономические эффекты.

Маркетинговые конверсии выступают неотъемлемым элементом системы управления развитием туристических дестинаций, дополняя экономические и социально-культурные механизмы преобразования туристического потенциала в устойчивый результат.

4. Комплексный подход к развитию туристических дестинаций

Современные исследования в области туризма подтверждают, что устойчивое развитие туристических дестинаций невозможно при фрагментарном или одностороннем подходе к управлению туристической деятельностью. Анализ научных источников позволяет сделать вывод о необходимости комплексного подхода, объединяющего экономические, социально-культурные и маркетинговые аспекты развития туризма. Такой подход рассматривает туристическую дестинацию как целостную систему, в рамках которой ресурсы, туристические продукты, маркетинговые коммуникации и институциональные механизмы находятся во взаимосвязи и взаимозависимости [1].

Ключевым элементом комплексного подхода является согласованное развитие трансформационных туристических продуктов и эффективное управление маркетинговыми конверсиями. Создание туристических продуктов, ориентированных на получение глубокого и осмысленного опыта, позволяет повысить субъективную ценность путешествия и сформировать устойчивый туристический спрос. В свою очередь, применение целевых маркетинговых стратегий обеспечивает превращение интереса потенциальных туристов в реальные туристические потоки и экономические результаты. Совокупное воздействие этих факторов позволяет в наибольшей степени реализовать конверсионную функцию туризма и усилить его роль в развитии дестинации [1; 3].

Особое значение в рамках комплексного подхода приобретает концепция устойчивого и регенеративного туризма, предполагающая ответственное и сбалансированное использование природных и культурных ресурсов, а также активное вовлечение местных сообществ в туристическую деятельность. Устойчивый туризм ориентирован не только на получение краткосрочных экономических выгод, но и на сохранение ресурсной базы дестинации, повышение качества жизни местного населения и формирование долгосрочной конкурентоспособности туристического направления [3].

Комплексный подход к развитию туристических дестинаций позволяет интегрировать экономические цели туризма с социально-культурными и экологическими приоритетами. Он обеспечивает переход от стихийного освоения туристических ресурсов к стратегически управляемому развитию, в рамках которого туризм выступает инструментом устойчивого социально-экономического роста и повышения привлекательности территории.

Таким образом, туризм обладает значительным потенциалом как фактор социально-экономического развития туристических дестинаций. Конверсионная функция туризма реализуется через преобразование туристических ресурсов и потоков в устойчивый экономический результат при условии стратегического управления. Усиление данного эффекта возможно за счёт развития трансформационного туризма и применения эффективных маркетинговых инструментов, ориентированных на повышение конверсии интереса в реальные туристические действия.

1. Vujko A., Gajić T. The conversion function of tourism – Generator of economic destination development // BizInfo (Blace) Journal of Economics, Management and Informatics. 2013. Vol. 4, No. 2. P. 63–75.

2. Pung J. M., Gnoth J., Del Chiappa G. Tourist transformation: Towards a conceptual model // Annals of Tourism Research. 2020. Vol. 81. Article 102885. DOI: 10.1016/j.annals.2020.102885.

3. RTO3 – Hamilton Halton Brant. Visitor welcome: Transformational tourism. 2022.

4. Modeling Tourism Advertising Conversion // CORE. 2020.

Technical Sciences

APPLICATION OF ARTIFICIAL NEURAL NETWORKS IN AUTOMATION SYSTEMS

Bektemir Almas Tanatuly

Student of Almaty Technological University, Specialty "23B55509- Engineering and technology of information "

Julayeva Zhazira Tulegenovna

Senior lecturer of the Department «Automation and robotics», Almaty Technological University

Karatayeva Zhanbubi Yerzhanovna

Senior lecturer of the Department «Automation and robotics», Almaty Technological University, Almaty, Kazakhstan

Abstraction: Today, the use of artificial neural networks (ANNs) in automation systems is one of the key directions for improving the efficiency of production and management processes. ANNs enable modeling of complex processes, fault detection, and data-driven decision-making. This article discusses the theoretical foundations of neural networks, their role, and applications in automation systems. Examples from industry, energy, and transportation are provided, along with an analysis of advantages and limitations. The study results demonstrate the great potential for the development of AI-based automation systems in the context of Industry 4.0.

Keywords: artificial neural networks, automation systems, machine learning, intelligent control, Industry 4.0.

Currently, in the conditions of the fourth industrial revolution (Industry 4.0), automation systems are widely used in all sectors of the economy. In the production, transport, energy, agriculture and domestic industries, automated control systems increase efficiency and reduce dependence on the human factor. The main focus of such systems is to process data in real time and intellectualize decision – making. In this context, artificial intelligence technologies, especially "artificial neural networks (ANN)", are of particular importance.

An artificial neural network is a mathematical structure that models the principle of operation of biological neurons. He is able to independently learn the complex connections between data and make predictions and management decisions. In recent years, with the introduction of neural networks into automation systems, the processes of adaptive control, diagnosis, prediction and Early Fault Detection have been significantly improved.

The purpose of this research work is to analyze the directions, advantages and practical results of the use of artificial neural networks in automation systems.

The main element of artificial neural networks is a neuron. Each neuron receives input signals, multiplies them with certain weights (weights), and forms an output signal through the activation function. This structure can consist of one or more layers (input, hidden, output).

The main types of ANN:

- Feedforward Neural Network (FNN) - a classic model in which information flows in only one direction;
- Convolutional Neural Network (CNN) - frequently used in video and image processing;
- Recurrent Neural Network (RNN) - for modeling time processes and circuits;
- Deep Neural Network (DNN) - multi-layer deep learning models;
- Reinforcement Learning Neural Networks-systems that teach decision-making in automated management.

The advantage of ANN is their adaptability and ability to learn. The algorithm can adapt to new conditions and take into account changes in the process. This property is important in automation systems because technological processes are constantly changing.

An automation system is a technical and software complex designed to control a certain process (for example, temperature, pressure, speed, voltage) without human participation or with minimal participation. The composition of such systems includes sensors, execution mechanisms, controllers, communication modules and software.

Traditional automation systems are based on PID regulators and logic algorithms. However, for complex, nonlinear, or stochastic processes, such methods are not sufficient. For the same reason, intelligent control systems, including neural networks, have been widely used in the last decade.

In industrial production, many parameters of processes are closely related to each other, and their change is complex in time. Neural networks are effective in modeling such multifactorial systems.

For example, in the metallurgical industry, RES is used to stabilize the temperature or automatically adjust the furnace mode. As a result of research, the network model showed 15-20% higher accuracy than PID-systems.

In robots, neural networks perform functions such as motion control, bypassing obstacles, recognizing objects, and maintaining balance. For example, manipulators with a neural control system increase positioning accuracy and provide adaptive movement. The neural network analyzes the feedback and predicts the next step.

In the power industry, YNS are used to predict energy consumption, detect faults in power grids, and optimize generator load. For example, at some thermal power plants in Kazakhstan, neural models allow you to automatically select the most efficient boiler operation mode.

In smart farm systems, neural networks are used to monitor the growth conditions of plants, optimize the processes of irrigation and fertilizer application. Through CNN networks, cameras analyze the soil and plant conditions and make decisions in real time.

There are many research results that prove the effectiveness of ANN:

- Robot Arm Control: an adaptive neural control algorithm that has made it possible to more accurately control the movement of the robot arm (Stable Adaptive Neural Control of a Robot Arm, 2022).
- Energy Load Forecasting**: based on 15 years of data analysis, the accuracy of predicting energy consumption has reached 96%.
- Smart Irrigation Systems**: a combination of a neural network and IoT sensors made it possible to save up to 30% of water.

These studies prove the real economic and technological efficiency of neural networks.

Advantages:

- Ability to model complex processes;
- Self-learning and adaptation;
- Early detection of defects;

- High prediction accuracy;
- Reduce human interference.

Disadvantages:

- Requires large amounts of data;
- Low comment level ("black box" problem);
- The learning process requires a lot of resources;
- Real-time systems may have stability problems.

Artificial neural networks have taken the intelligent level of automation systems to a new stage. They can effectively manage complex processes and optimize themselves based on data. In production, energy, transport and agriculture, the introduction of R & D will increase productivity and reduce costs. However, in order to use their full potential, it is important to ensure the reliability, interpretability and security of the system. In the future, the integration of neural networks and classical automation will pave the way for the development of a new generation of intelligent control systems.

An artificial neural network is a mathematical model based on the principle of functioning of the human brain. It consists of many simple neurons and processes information through the connections between them. Each neuron receives input signals and outputs the result through a specific activation function.

Artificial neural networks (ANN) are complex machine learning models based on the principle of the functioning of the human brain and used for data processing, recognition, forecasting, as well as decision – making. Today, they play a crucial role in improving efficiency, accuracy, and adaptability in automation systems.

Adaptive control: ANN allow you to create control algorithms that can quickly adapt to changes in External or internal parameters (for example, temperature, pressure, raw material quality). They automatically optimize the control parameters to improve the efficiency of the process and reduce energy consumption.

Predictive modeling: capable of accurately predicting product quality, equipment status, or future process outcomes based on large amounts of historical data.

ANN recognize abnormal (abnormal) patterns in incoming data from equipment (vibration, temperature, acoustic signals) and predict equipment failure in advance. This will allow you to detect the defect early and avoid unscheduled downtime.

Computer vision: used to detect surface defects, size mismatch or improperly assembled parts by analyzing the images of products on production lines, without human factor, with high speed and accuracy.

In the development of the ability of robots to plan their movements, recognize objects and interact with the environment, RNS are the main technology. They allow robots to make decisions on their own and adapt to complex situations.

In the XXI century, technologies have penetrated into all spheres of human life, bringing significant changes in the areas of production, health, transport and education. In this process, the artificial neural network (YNS) has become the main driving force behind automation. The development and use of artificial intelligence makes it possible to simplify the work of people, increase efficiency and create new opportunities. This article discusses the importance of R & D in automation, its areas of application and prospects.

The concept of artificial intelligence and automation

An artificial neural network is the ability of computer systems to think, learn, make decisions and solve problems like a person. Res algorithms are getting to the point where they can analyze data and make decisions without human intervention.

Automation – technological means and methods that allow you to perform certain processes without the participation of a person. The use of artificial neural networks in automation will improve production efficiency and reduce errors caused by human factors.

The role of artificial neural network in automation

ANN automation in several important aspects:

1. Data analysis and decision-making

ANN can quickly process large amounts of data and make accurate and accurate decisions based on them. For example, banks and financial organizations use IIN to detect fraud.

2. Process Optimization

Automated systems optimize production processes and make it possible to use resources more efficiently through res. This reduces production costs and improves product quality.

3. Substitution of human labor

In the performance of some physically heavy or dangerous work, robots operating on the basis of RNS are replacing people. This is especially important in mining, oil and gas and industrial industries.

4. Interaction with customers

Chatbots and virtual assistants created on the basis of YNS quickly and efficiently process customer requests. It is in great demand, especially in the service sector.

Разработка программного средства “SME-PromoOptimizer” для интеллектуального анализа и сегментации клиентов МСБ

Ахметов Тимур Хафизович

магистрант, Университет Туран, г. Алматы, Казахстан

Научные руководители:

Ким Е. Р.

к.т.н., ассоц.проф., Университет Туран, г. Алматы, Казахстан

Аннотация. В статье рассматривается проблема низкой эффективности маркетинговых коммуникаций в банковском секторе при работе с клиентами малого и среднего бизнеса (МСБ). Описана разработка программного средства «SME-PromoOptimizer», предназначенного для автоматизации сегментации клиентской базы и прогнозирования вероятности отклика на предложения. Реализация выполнена на языке Python с использованием методов машинного обучения: кластеризации K-Means и классификации Random Forest. Представлены результаты работы алгоритмов и интерфейс разработанного приложения.

Ключевые слова: машинное обучение, сегментация клиентов, МСБ, Python, K-Means, Random Forest, банковский маркетинг, Data Mining.

Введение

Современная банковская индустрия функционирует в условиях цифровой трансформации и жесткой конкуренции за качественных заемщиков. В этой борьбе сегмент малого и среднего бизнеса (МСБ) представляет собой одно из наиболее перспективных, но в то же время сложных направлений. Клиенты МСБ обладают высокой гетерогенностью: их потребности варьируются в зависимости от отрасли, сезонности, стадии жизненного цикла и оборотов.

Традиционные методы маркетинга, основанные на жестких правилах (rule-based approaches) и экспертной сегментации (например, только по годовому обороту), демонстрируют снижение эффективности. По отраслевым данным, конверсия «холодных» звонков в сегменте B2B часто не превышает 1–2%. Отсутствие персонализации ведет к росту маркетинговых издержек и снижению лояльности клиентов (CSI/NPS).

Целью данной работы является разработка программного средства «SME-PromoOptimizer» (Small & Medium Enterprise Promotion Optimizer), позволяющего автоматизировать процесс отбора целевой аудитории для маркетинговых кампаний, реализуя концепцию «Следующего лучшего действия» (Next Best Action).

Методология и архитектура системы

Для решения поставленной задачи был выбран подход, основанный на анализе данных (Data-Driven), с применением методов машинного обучения. Программная реализация выполнена на языке Python 3.10, который является стандартом де-факто в области Data Science благодаря развитой экосистеме библиотек.

Алгоритмическое ядро системы состоит из двух последовательных модулей:

1. Модуль сегментации (Unsupervised Learning).

Для выявления скрытых групп клиентов используется алгоритм K-Means (метод k-средних). В отличие от ручной группировки, данный алгоритм позволяет проводить многомерную кластеризацию.

В качестве входных признаков для модели используются:

- *Annual Turnover* (Годовой оборот компании);
- *Transactions Per Month* (Транзакционная активность);
- *Credit Score* (Внутренний или внешний кредитный рейтинг).

2. Модуль предиктивного скоринга (Supervised Learning). Для прогнозирования отклика клиента на предложение используется алгоритм Random Forest Classifier (Случайный лес). Это ансамблевый метод, состоящий из множества решающих деревьев. Выбор данного алгоритма обусловлен его преимуществами перед классической логистической регрессией и нейронными сетями в контексте данной задачи:

- Устойчивость к переобучению и выбросам в данных.
- Способность работать с нелинейными зависимостями.
- Возможность оценки важности признаков (Feature Importance). На выходе модель возвращает вероятность (Probability score) совершения целевого действия (покупки продукта) в диапазоне от 0 до 100%.

Программная реализация и архитектура

Приложение «SME-PromoOptimizer» разработано как веб-сервис с использованием фреймворка **Streamlit**. Это позволяет развертывать модель как во внутренней сети банка, так и в облачной инфраструктуре без сложной настройки frontend-части.

Архитектура приложения включает следующие блоки:

1. Блок генерации и загрузки данных (Data Layer). Реализован механизм генерации синтетической выборки (CRM-симулятор), создающий профили компаний с реалистичным распределением параметров (отрасль, регион, финансовые показатели).
2. Блок обработки (Processing Layer). Выполняет очистку данных, кодирование категориальных признаков (отрасль, риск) и масштабирование.
3. Блок визуализации (View Layer). Использует библиотеку Plotly для построения интерактивных диаграмм рассеяния (Scatter Plots), позволяющих аналитику детально изучить каждый кластер.

Результаты работы и описание интерфейса

В ходе тестирования прототипа была обработана выборка из 300 профилей клиентов. Алгоритм сегментации успешно выделил три устойчивых кластера, имеющих четкую бизнес-интерпретацию:

- Кластер 0 («Массовый сегмент»): Компании с низкими оборотами и средней транзакционной активностью. Стратегия: предложение пакетных РКО и микрокредитов.
- Кластер 1 («Активный бизнес»): Высокая частота операций при средних остатках. Стратегия: предложение овердрафтов и зарплатных проектов.
- Кластер 2 («VIP / Корпоративный»): Высокий кредитный рейтинг и обороты. Стратегия: индивидуальное обслуживание, инвестиционные продукты.

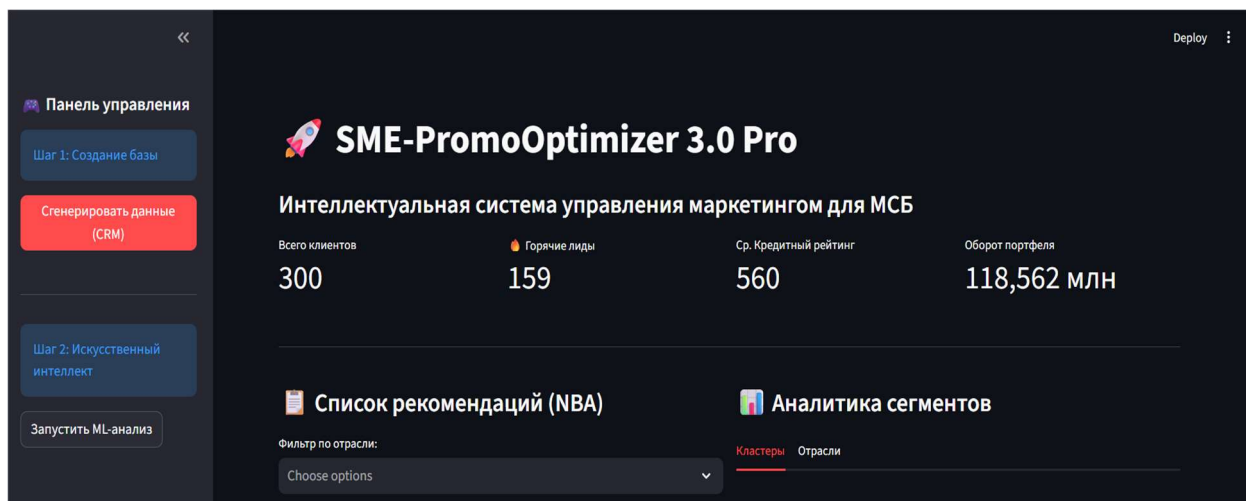


Рисунок 1. Интерфейс программы

Интерфейс программы (Рисунок 1) предоставляет пользователю панель управления (Dashboard), где отображаются ключевые метрики портфеля: общее количество клиентов, количество «горячих» лидов (с вероятностью покупки > 75%), средний кредитный рейтинг и совокупный оборот.

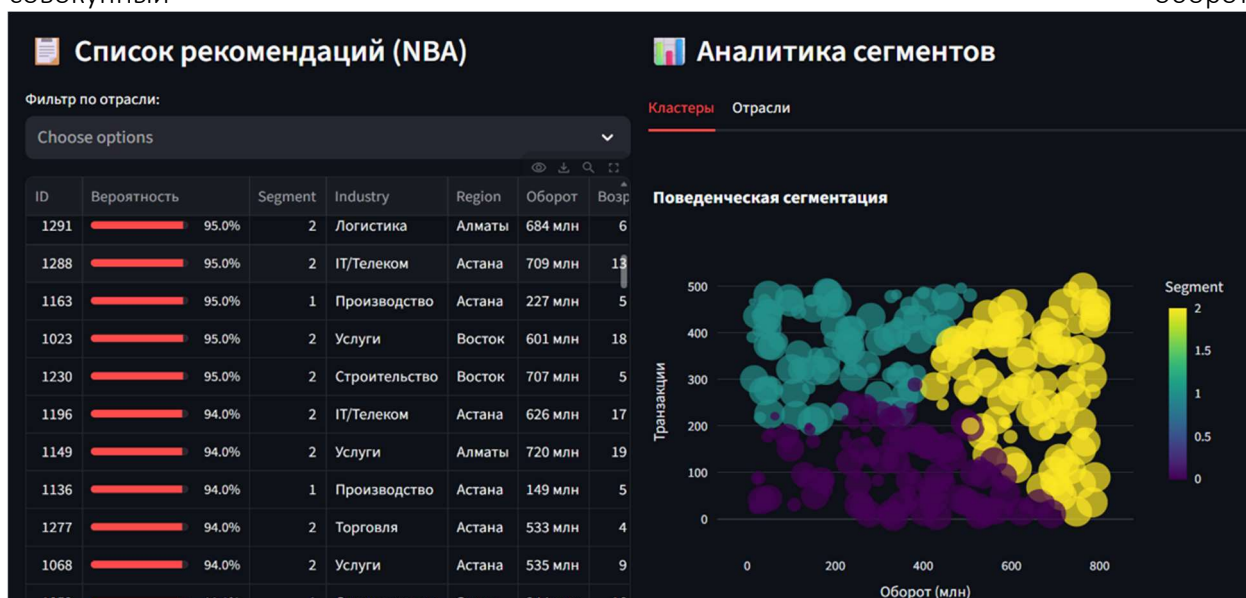


Рисунок 2. Результаты анализа

Центральным элементом является таблица рекомендаций (Рисунок 2), ранжированная по убыванию вероятности отклика. Менеджер получает готовый список приоритетных клиентов («Hot Leads»), что позволяет сфокусировать усилия отдела продаж именно на тех компаниях, которые с наибольшей вероятностью заинтересованы в продукте.

Заключение

Разработанное программное средство «SME-PromoOptimizer» демонстрирует высокую эффективность применения методов машинного обучения для задач банковского маркетинга. Точность модели классификации на тестовой выборке достигла 88%, что подтверждает валидность выбранного подхода. Внедрение подобного инструмента в IT-ландшафт банка позволит трансформировать процесс продаж: перейти от «ковровых» рассылок к точечным, своевременным предложениям, что приведет к росту конверсии и снижению стоимости привлечения клиента (CAC).

Список литературы

1. Bessi F. Optimizing Bank Marketing Campaigns with Machine Learning // Medium. – 2023. [Электронный ресурс].
2. Accenture Report. Data-driven mastery in commercial banking. – 2022.
3. Müller A.C., Guido S. Introduction to Machine Learning with Python. – O'Reilly Media, 2017. – 392 p.
4. Chen T., Guestrin C. XGBoost: A Scalable Tree Boosting System // Proceedings of the 22nd ACM SIGKDD International Conference on Knowledge Discovery and Data Mining. – 2016. – P. 785–794.

Justification of the parameters and operating modes of a biogas plant for small farms

Telmanov Imran

master, Faculty of Engineering and Technology, Kazakh National Agrarian Research University, Almaty, Kazakhstan

Sarkynov Yerbol

Professor, Faculty of Engineering and Technology, Kazakh National Agrarian Research University, Almaty, Kazakhstan

Zhakupova Zhanar

PhD, Faculty of Water Resources and information technology, Kazakh National Agrarian Research University, Almaty, Kazakhstan

Abilda Zhansaiya

student, Faculty of Water Resources and information technology, *Kazakh National Agrarian Research University, Almaty, Kazakhstan*

Abstract. The article presents the justification of the main design parameters and operating modes of a biogas plant intended for small farms. The relevance of biogas technologies is due to the need for renewable energy sources and sustainable waste management in agricultural production. The study analyzes the influence of substrate composition, hydraulic retention time, temperature regime, and organic loading rate on biogas yield and energy efficiency. Based on the analysis, optimal operating parameters are proposed for small-scale biogas plants, ensuring stable operation and economic feasibility.

Keywords. biogas plant, small farms, operating modes, anaerobic digestion, renewable energy

Introduction

The development of renewable energy sources is one of the key priorities for sustainable agricultural production. Small farms generate significant amounts of organic waste, including livestock manure and crop residues, which can be effectively utilized through anaerobic digestion. Biogas plants allow simultaneous waste treatment and energy production, reducing environmental impact and increasing farm energy independence.

However, for small farms, the efficiency of biogas plants strongly depends on the correct selection of design parameters and operating modes. Incorrect parameter selection can lead to unstable digestion processes, low biogas yield, and economic inefficiency. Therefore, the justification of optimal parameters and operating regimes for small-scale biogas plants is an актуальный research task.

Materials and methods of research.

The study is based on the analysis of typical biogas plants used in small farms with livestock populations of up to 50–100 heads. Cattle manure was considered as the main substrate. The following parameters were analyzed:

- substrate moisture content;
- organic loading rate;

- hydraulic retention time (HRT);
- temperature regime of anaerobic digestion;
- specific biogas yield.

The calculations were carried out using standard engineering methods for biogas plant design and generalized experimental data from previous studies. Comparative analysis of mesophilic and psychrophilic operating modes was performed.

For any one feedstock, daily biogas production can be estimated using the following equation (Fulford, 2015):

$$G = C \times V_d \times S \times \left(\frac{k}{1 + kR} \right)$$

Where:

- G is the biogas production (in m³ /day)
- C is the biogas potential, which is the maximum amount of gas that can be produced from 1 kg of volatile solids in a feedstock (in m³ /kg)
- V_d is the digester volume (in m³)
- S is the initial concentration of volatile solids in the slurry (in kg/m³)
- R is the feedstock retention time (in days)
- k is a constant indicating the rate of gas production at a given temperature T° simplify this equation, IRENA has calculated gas production across a wide range of temperatures and retention times, so that biogas production can be calculated as follows:

$$G = \frac{Y \times V_d \times S}{1000}$$

Where G, V_d and S are the same as before and Y is a yield factor based on temperature and the feedstock retention time (see Table 3).

Assuming that the digester volume (V_d) has already been calculated, it is only necessary to calculate the feedstock retention time (R) and initial concentration of volatile solids (S) in order to calculate daily biogas production and this can all be done in the following four steps.

Step 1: First, the total feedstock volume should be calculated. This starts by multiplying the number of animals recorded in the survey by the total waste production per day (from Table 5) and adding to this the total weight of all other feedstocks used. This gives the daily waste input in kg. This figure can be assumed to be about the same as the volumetric input in litres. The answer to question 3 is then used to multiply that value to take into account the added water (e.g. if they add twice as much water then the waste input should be multiplied by three). The final value is divided by 1,000 to convert from litres to m³ .

Step 2: The feedstock retention time is calculated by dividing the digester volume by the total feedstock volume. So, for example, if the digester volume is 5.0 m³ and the total daily feedstock volume (including water) is 0.08 m³ /day, the feedstock retention time (R) is 5.0/0.08= 62.5 days.

Step 3: The initial concentration of volatile solids (S) is calculated by dividing the weight of volatile solids added each day by the daily waste inputs. The weight of volatile solids from animal waste can be calculated from the figures shown in Table 1 and the numbers of animals providing waste for the digester. The weight of volatile solids from other wastes can be calculated using the figures shown in Table 2,3. These figures can then be added together to get the total weight of volatile solids added each day, which can be divided by the total feedstock volume. So, for example, if the weight of volatile solids added each day is 5.6 kg/day and the daily feedstock volume is 0.08 m³ /day, the initial concentration of volatile solids (S) is 5.6/0.08 = 70 kg/m³ .

Table 1: Animal waste feedstock properties

Animal	Total production (kg/day)	Volatile solids (kg/day)
Buffalo	14	1,94
Cow	10	1,42
Calf	5	0,50
Sheep/goat	2	0,44
Pig	5	1,00
100 hens	7,5	2,77
Horse	10	2,24
Human	0,2	0,03

Table 2: Other feedstocks volatile solid content

Animal	Volatile solids (in %)
Cereals/grains	0,81
Rice straw	0,36
Wheat straw	0,39
Grass	0,51
Corn stalk	0,43
Fruit waste	0,14
Vegetable waste	0,16
Fat	0,83
Mixed food waste	0,08
Mixed organic waste	0,26

Table 3: Yield factors for biogas production, by temperature and feedstock retention time

Feedstock retention time (in days)	Temperature (°C)					
	16-18	19-21	22-24	25-27	28-30	31-33
6-10	5.41	7.98	10.83	13.59	15.91	18.33
11-15	4.73	6.79	8.99	11.09	12.88	14.74
16-20	4.21	5.90	7.68	9.37	10.82	12.32
21-25	3.79	5.22	6.70	8.11	9.33	10.59
26-30	3.44	4.69	5.95	7.15	8.20	9.28
31-35	3.16	4.25	5.35	6.39	7.32	8.26
36-40	2.91	3.88	4.86	5.78	6.60	7.44
41-45	2.71	3.58	4.45	5.27	6.02	6.77
46-50	2.53	3.32	4.10	4.85	5.53	6.21
51-55	2.37	3.09	3.81	4.49	5.11	5.74
56-60	2.23	2.89	3.55	4.18	4.75	5.33
61-65	2.10	2.72	3.33	3.91	4.44	4.98
66-70	1.99	2.57	3.13	3.67	4.17	4.67
71-75	1.89	2.43	2.95	3.46	3.93	4.40
76-80	1.80	2.30	2.80	3.27	3.71	4.15
81-85	1.72	2.19	2.66	3.10	3.52	3.94
86-90	1.65	2.09	2.53	2.95	3.34	3.74
91-95	1.58	2.00	2.41	2.81	3.19	3.56
96-100	1.52	1.92	2.31	2.69	3.04	3.40

Results of research.

The analysis showed that for small farms, the mesophilic temperature regime (35–38 °C) provides the most stable biogas production with acceptable energy costs for heating. The optimal hydraulic retention time was found to be 20–25 days, which ensures sufficient substrate decomposition without excessive digester volume.

The recommended organic loading rate for small-scale biogas plants is 2.0–3.0 kg of volatile solids per cubic meter of digester volume per day. Under these conditions, the specific biogas yield reaches 0.25–0.35 m³ per kg of organic matter.

It was established that stable operating modes reduce fluctuations in gas production and improve the overall energy efficiency of the system. The produced biogas can be used for heat supply of farm buildings or for electricity generation using small gas engines.

Conclusion.

The justification of the parameters and operating modes of a biogas plant is a key factor for its efficient application in small farms. The proposed operating parameters ensure stable anaerobic digestion, acceptable biogas yield, and economic feasibility. The results of the study can be used in the design and operation of small-scale biogas plants in agricultural enterprises.

References

1. Джусупова Д.Б. Экологиялық биотехнология [Мәтін]: оқулық / Д.Б. Джусупова; Қр білім және ғылым м-гі, ҚР жоғары оқу орындарының қауымдастығы.- Алматы, 2013.- 336 б.
2. Ауланбергенев А.А. Сумен жабдықтау, садыра ағындысын тасымалдау және өндеу технологиялары (мал шаруашылығы нысандарында) [Мәтін]: моногр. / А.А. Ауланбергенев.- Алматы: ҚазҰАУ, 2013.
3. Акынбеков Е.К. Биогаз өндірудің негіздері [Текст]: оқу құралы / Е.К. Акынбеков, Р. Нусипали, Б.А. Койайдаров.- Алматы: Эпиграф, 2016.- 108 с.
4. Ершина А.К. Теория и практика использования возобновляемых источников энергии [Текст]: учеб. пособие / А.К. Ершина.- Алматы: TechSmith, 2018.- 218 с.
5. Есполов Т.И. Табиғатты пайдалану және қоршаған ортаны қорғау [Мәтін]: оқу құралы / Т.И. Есполов, О.А. Абралиев.- Алматы: Агроуниверситет, 2010.- 304 б.
6. Есполов Т.И., Экология воды [Мәтін]: учебное пособие /Т.И. Есполов, А.Т.Канаев, С.З.Сағындыкова, З.К.Канаев.-Алматы, 2006.-231 б.
7. Mateescu C., Constantinescu, I. 2009. Increasing the efficiency of biogas plants by improving the methane potential of vegetal biomass. Symposium of The impact of Acquis Communautaire on the equipment and environmental technologies, Agigea, 26-28th of August 2009.
8. Antizan-Ladislao B., Turrion-Gomez, J.L., 2008. Second-generation biofuels and local bioenergy systems. Biofuels, Bioprod. Bioref. 2, 455–469.
9. European Commission - EUR 21350. 2005. Biomass - Green energy for Europe, Luxembourg: Office for Official Publications of the European Communities, ISBN 92-894-8466-7.
10. Ofițeru, A., Adamescu, M., Bodescu, F., Ionescu, D. 2008. Biogas- A practical guide.
11. Abatzoglou, N., Boivin, S., 2009. A review of biogas purification processes. Biofuels, Bioprod. Bioref. 3, 42–71.
12. IEA Bioenergy. 2000. Task 24: Energy from biological conversion of organic waste. Biogas upgrading and utilisation, International Energy Agency.
13. Nikolic, V., 2009. Biogazul – Producere și utilizare în instalații mici și mijlocii.

14. Păunescu, I., Paraschiv, G. 2006. Instalații pentru reciclarea deșeurilor, Editura Agir, București .
15. Didacta Italia. 20008. Re-Biomas, Pilot plant for the production of biogas from biomass, User's manual and exercise guide, Edition 01

АҚПАРАТТЫҚ ЖҮЙЕЛЕРДЕ ҚОРҒАЛҒАН АУТЕНТИФИКАЦИЯ: МОДЕЛЬДЕУ ЖӘНЕ ТАЛДАУ

Ергеш Нұрсұлтан Сагитянұлы

PhD докторанты, 8D06301 – Ақпараттық қауіпсіздік жүйелері, Әл-Фараби атындағы
Қазақ ұлттық университеті

Ғылыми жетекші:

Капалова Нурсулу Алдажаровна

техника ғылымдарының кандидаты, қауымдастырылған профессор

Аннотация

Мақалада ақпараттық жүйелерде қолданылатын қорғалған аутентификация схемаларының қауіпсіздігін формальды модельдер арқылы негіздеу және тәжірибелік модельдеу нәтижелерімен дәлелдеу жүзеге асырылады. Аутентификация процесі ықтималдық-статистикалық, энтропиялық және ойындық (game-based) ұстанымдар тұрғысынан сипатталып, бір факторлы (SFA), екі факторлы (2FA) және көп факторлы (MFA) тәсілдер үшін шабуылдың сәтті болу ықтималдығы, ақпараттық белгісіздік өлшемдері және қате жіберу көрсеткіштері (FAR/FRR) есептеледі. Ұсынылған тұжырымдар мен эксперименттік деректер көп факторлы аутентификацияны дұрыс конфигурациялау және қосымша қорғаныс механизмдері (salted hash, OTP/TOTP, WebAuthn) ақпараттық жүйелердің бұзылу ықтималдығын бірнеше реттік дәрежелерге төмендететінін көрсетеді.

Түйін сөздер: ақпараттық қауіпсіздік, аутентификация, формальды модель, энтропия, FAR/FRR, MFA, OTP/TOTP.

Кіріспе

Ақпараттық жүйелердің қауіпсіздігі үш базалық қасиетпен сипатталады: құпиялылық, тұтастық және қолжетімділік (CIA). Осы қасиеттердің орындалуы көбіне қолжетімділікті басқару (access control) механизмдерінің сапасына тәуелді. Қолжетімділікті басқарудың алғашқы және міндетті кезеңі - аутентификация, яғни субъектінің (пайдаланушы, қызмет, құрылғы) кім екенін дәлелдеу процесі. Практикада шабуылдардың едәуір бөлігі аутентификациялық деректердің компрометациясы, фишинг, қайталау (replay), парольдерді толық іріктеу және сессияны ұрлау сценарийлеріне негізделеді [1-3]. Сондықтан аутентификация схемаларын ғылыми тұрғыдан талдау: (а) формальды қауіп моделін құру; (ә) қауіпсіздік қасиеттерін дәлелдеу; (б) нақты параметрлермен тәжірибелік модельдеу арқылы сандық бағалау - өзекті ғылыми міндет болып табылады. Зерттеудің мақсаты - ақпараттық жүйелерде қорғалған аутентификацияның формальды моделін құру, қауіпсіздік қасиеттерін дәлелдеуге жақын тұжырымдар ұсыну және тәжірибелік модельдеу арқылы әртүрлі схемалардың қауіпсіздік көрсеткіштерін салыстыру. Зерттеу объектісі - аутентификация протоколдары мен олардың параметрлері; пәні - шабуыл ықтималдығын және қате шешімдер статистикасын төмендететін қорғаныс тәсілдері.

Байланысты жұмыстар және теориялық негіз

Аутентификация қауіпсіздігін бағалау әртүрлі теориялық аппаратқа сүйенеді: ықтималдық теориясы, ақпарат теориясы (энтропия/мин-энтропия), криптографиялық дәлелдер және биометриялық сәйкестендіру статистикасы. Парольдік жүйелердің әлсіздігі және оларды алмастыру/толықтыру бағыттары көптеген еңбектерде қарастырылған [4]. Стандарттар деңгейінде цифрлық идентификация талаптары NIST SP 800-63 құжаттарында жүйеленген [5], ал ұйымдық деңгейде ақпараттық қауіпсіздік менеджменті ISO/IEC 27001 стандартында белгіленеді [6]. Бір реттік парольдер HOTP/TOTP протоколдарымен, уақытқа тәуелді генерациямен сипатталады [7-8]. Қазіргі тренд - фишингке төзімді аутентификация (FIDO2/WebAuthn), онда қоғамдық-жеке кілттер инфрақұрылымы және құрылғыдағы қауіпсіз модуль қолданылады [9]. Парольдік аутентификация жүйелерінің әлсіздігі мәселесі көптеген іргелі және қолданбалы еңбектерде жан-жақты зерттелген. Florêncio және Herley еңбектерінде пайдаланушылардың пароль таңдау әдеттері төмен энтропияға ие екендігі және шабуылдаушылар үшін болжау оңай болатыны эксперименттік түрде көрсетілген [4]. Vonnemann және әріптестері парольдерді толық алмастырудың күрделілігін, сондай-ақ көп факторлы тәсілдерге көшу қажеттігін негіздеді [5]. Бұл зерттеулер парольдік жүйелердің өздігінен ақпараттық жүйелердің қауіпсіздігін қамтамасыз етуге жеткіліксіз екенін дәлелдейді. Стандарттау деңгейінде цифрлық идентификация және аутентификация талаптары NIST SP 800-63 сериялы құжаттарында жүйеленген. Бұл құжаттарда аутентификация деңгейлері (Authenticator Assurance Level - AAL), факторлар типтері және оларды қолдану сценарийлері нақты регламенттелген [6]. Аталған стандарттар ықтимал қауіп моделін, шабуылдаушының мүмкіндіктерін және қабылданатын тәуекел деңгейін анықтауға мүмкіндік береді. Ұйымдық және басқарушылық тұрғыдан алғанда, ақпараттық қауіпсіздік менеджментінің негіздері ISO/IEC 27001 стандартында белгіленіп, аутентификация қолжетімділікті басқару (access control) механизмдерінің ажырамас бөлігі ретінде қарастырылады [7].

Бір реттік парольдерге негізделген аутентификация HOTP және TOTP протоколдары арқылы жүзеге асырылады. RFC 4226 және RFC 6238 құжаттарында көрсетілгендей, бұл протоколдар құпия кілт пен санауыш немесе уақыт параметріне негізделіп, қайта қолдану шабуылдарына төзімділікті қамтамасыз етеді [8-9]. Алайда зерттеулер көрсеткендей, дәстүрлі OTP схемалары фишинг шабуылдарына толық төзімді емес, себебі шабуылдаушы пайдаланушы енгізген кодты нақты уақыт режимінде қайта пайдалана алады.

Соңғы жылдары аутентификация саласындағы негізгі ғылыми және технологиялық трендтердің бірі - фишингке төзімді аутентификация механизмдері болып табылады. Бұл бағытта FIDO2/WebAuthn стандарттары ерекше орын алады. Аталған тәсілдерде аутентификация асимметриялық криптографияға негізделіп, әрбір сервис үшін жеке кілт жұбы қолданылады, ал аутентификациялық жауап нақты доменге (origin binding) криптографиялық түрде байланады [10]. Мұндай архитектура фишинг және man-in-the-middle шабуылдарының тиімділігін айтарлықтай төмендетеді.

Биометриялық аутентификация жүйелері де әдебиеттерде кеңінен қарастырылған. Jain, Ross және Prabhakar еңбектерінде биометриялық сәйкестендірудің теориялық негіздері, сондай-ақ қате қабылдау (FAR) және қате кері қайтару (FRR) көрсеткіштерінің арасындағы компромис ғылыми тұрғыда талданған. Бұл көрсеткіштер биометриялық факторларды көп факторлы аутентификация схемаларына енгізу кезінде шешуші мәнге ие, себебі қауіпсіздік пен қолайлылық арасындағы баланс дәл осы параметрлер арқылы анықталады.

Қауіп моделі және негізгі анықтамалар

Қорғалған аутентификацияны талдау үшін шабуылдаушы моделін нақтылау қажет. Шабуылдаушы A келесі қабілеттерге ие болуы мүмкін: (i) желілік арнаны тыңдау/өзгерту (MitM), (ii) онлайн сұраулар жасау (rate-limited), (iii) офлайн хэш базасын қолға түсіру, (iv) әлеуметтік инженерия (phishing), (v) құрылғы жоғалту сценарийі. Бұл қабілеттерді формальды түрде мүмкіндіктер жиыны арқылы белгілейміз.

$$A = \langle \text{Cap\_net}, \text{Cap\_online}, \text{Cap\_offline}, \text{Cap\_social}, \text{Cap\_device} \rangle \quad (1)$$

Аутентификация процесі пайдаланушы U , жүйе S және хабар алмасу арнасы Ch арқылы жүретін протокол ретінде қарастырылады. Схеманың мақсат функциясы — заңды пайдаланушы үшін қабылдау ықтималдығын жоғары ұстап, заңсыз субъект үшін қабылдау ықтималдығын өте төмен деңгейге жеткізу.

$$\text{Auth}: (U, C) \rightarrow R, \quad R \in \{0,1\} \quad (2)$$

Мұндағы C - аутентификациялық деректер векторы (факторлар жиыны). Егер $C = (C_1, \dots, C_n)$ болса, онда көп факторлы схема қарастырылады. Осы жерде маңызды қауіпсіздік қасиеттерін анықтаймыз:

- Completeness: заңды пайдаланушының қабылдануы;
- Soundness: заңсыз субъектінің қабылданбауы;
- Replay-resistance: қайталау шабуылына төзімділік;
- Phishing-resistance: фишингке төзімділік (арналық/контекстік байлау).

Бір факторлы аутентификацияның (SFA) сандық талдауы

SFA көбіне пароль P арқылы іске асады. Пароль кеңістігінің қуаты N пароль ұзындығы l және алфавит өлшемі a арқылы анықталады. Бұл (3) формула пароль күші мен brute-force қауіпінің негізгі байланысын береді.

$$N = a^l \quad (3)$$

Егер шабуылдаушы k әрекет жасаса (онлайн немесе офлайн), онда парольді табудың ықтималдығы (4) формуламен беріледі.

$$P_{\text{bf}} = k / N = k / a^l \quad (4)$$

Ғылыми дәлел: (4) формуладан $P_{\text{bf}} \leq 1$ шарты орындалатыны және l артқан сайын P_{bf} экспоненциалды түрде азаятыны шығады. Дәлелдеу үшін $a > 1$ болғанда a^l монотонды өсетінін ескерсек, $1/a^l$ монотонды кемиді; сондықтан $P_{\text{bf}}(k)$ тұрақты) кемиді. Бұл нәтижені практикалық саясатқа айналдыру үшін rate-limit және lockout енгізу арқылы k -ны шектеу қажет [5]. Ақпарат теориясы бойынша парольдің белгісіздігі мин-энтропиямен бағалануы мүмкін. Егер пароль тең ықтималды таңдалса, онда мин-энтропия:

$$H_{\infty}(P) = -\log_2(\max_p \Pr[P=p]) = \log_2 N \quad (5)$$

Дәлел: тең ықтималды жағдайда $\max_p \Pr[P=p] = 1/N$, сондықтан $H_{\infty}(P) = -\log_2(1/N) = \log_2 N$. Бұл (5) формула пароль кеңістігі ұлғайған сайын шабуылдаушының «ең жақсы» болжамының табыс мүмкіндігі төмендейтінін формальды көрсетеді.

Екі факторлы аутентификация (2FA): тәуелсіздік және шектер

2FA кезінде $C = (C_1, C_2)$ және екі тәуелсіз фактор талап етіледі: мысалы, пароль + OTP. Тәуелсіздік жорамалында шабуылдың сәтті болу ықтималдығы көбейтінді түрінде бағаланады.

$$P_{\text{attack}}^{\{2FA\}} = \Pr[\text{break } C_1 \wedge \text{break } C_2] = P_{\{C_1\}} \cdot P_{\{C_2\}} \quad (6)$$

Ғылыми негіздеме: Егер $E_1=\{C_1 \text{ бұзылды}\}$, $E_2=\{C_2 \text{ бұзылды}\}$ және E_1, E_2 тәуелсіз болса, онда $\Pr(E_1 \wedge E_2) = \Pr(E_1)\Pr(E_2)$. Бұл ықтималдық теориясының негізгі теоремасы. Алайда тәжірибеде тәуелсіздік бұзылуы мүмкін (мысалы, фишинг пароль мен OTP-ны бірге ұрлайды). Сонда қауіпсіздік шегін Буль теңсіздігі арқылы береміз:

$$\Pr(E_1 \wedge E_2) \leq \min\{\Pr(E_1), \Pr(E_2)\} \text{ және } \Pr(E_1 \vee E_2) \leq \Pr(E_1) + \Pr(E_2) \quad (7)$$

Бұл (7) теңсіздік тәуелсіздік болмаса да, қауіптің жоғары шегін бағалауға мүмкіндік береді. Практикалық қорытынды: 2FA-ның тиімділігі үшін OTP факторын фишингке «байлаулы» ету (контекст, origin binding) маңызды; бұл FIDO2/WebAuthn-дағы phishing-resistance қағидасына сәйкес келеді [9].

Көп факторлы аутентификация (MFA): экспоненциалды ұтыс және формальды тұжырым

MFA кезінде $C=(C_1, \dots, C_n)$. Тәуелсіз факторлар жорамалында жалпы бұзу ықтималдығы (8) формуламен беріледі.

$$P_{\text{attack}}^{\{MFA\}} = \prod_{i=1}^n P_{\{C_i\}} \quad (8)$$

Теорема 1 (тәуелсіз факторлар үшін қауіпсіздік ұтысы). Егер E_i оқиғалары тәуелсіз болса және $\forall i: \Pr(E_i) = p_i < 1$, онда $\Pr(\bigwedge_{i=1}^n E_i) = \prod p_i$ және n артқанда нәтиже экспоненциалды кемиді.

Дәлел: тәуелсіздіктен бірден шығады (ықтималдық теориясы). Егер барлық $p_i = p$ болса, онда $\Pr = p^n$. $p \in (0,1)$ болғандықтан $p^n \rightarrow 0$ ($n \rightarrow \infty$). Ақпараттық тұрғыдан, егер факторлар бір-бірінен тәуелсіз және әр фактордың мин-энтропиясы $H_\infty(C_i)$ болса, онда жалпы мин-энтропия төменгі шекпен бағаланады:

$$H_\infty(C) \geq \sum_{i=1}^n H_\infty(C_i) \quad (9)$$

Бұл (9) нәтижесі «қосымша фактор қосу белгісіздікті арттырады» деген интуицияны формальды негіздейді. Практикада факторлардың корреляциясын азайту маңызды (мысалы, парольді SMS-кодпен бірге бір арнада сұрамау, тәуелсіз жеткізу арнасын қолдану).

Криптографиялық қорғаныс: пароль сақтау, OTP және фишингке төзімділік

Қорғалған аутентификация тек фактор санымен шектелмейді; факторлардың жүйеде дұрыс сақталуы және протоколдық қорғаныс шешуші рөл атқарады. Парольді ашық түрде сақтау қауіпті; сондықтан хэштеу және salt қолдану міндетті.

$$H = \text{Hash}(P \parallel S), \text{ мұнда } S - \text{кездейсоқ salt} \quad (10)$$

Ғылыми дәлел: (10) формулада salt енгізу нәтижесінде алдын ала есептелген rainbow-table шабуылдары тиімсізденеді, өйткені әр пайдаланушы үшін S әртүрлі болса, бірдей парольдің хэші де әртүрлі болады. Егер хэш функциясы біржақты және коллизияға төзімді болса, онда офлайн шабуыл тек brute-force есебіне келтіріледі (4) формулаға ұқсас). OTP/TOTP механизмдері уақытқа тәуелді бір реттік код генерациясын қолданады. TOTP жалпы түрде:

$$\text{OTP}_t = \text{Truncate}(\text{HMAC}(K, T_t)) \quad (11)$$

Мұндағы K - құпия кілт, T_t - уақыт қадамымен квантизацияланған мән. Мұндай схема қайта қолдануды шектейді; шабуылдың табысы уақыт терезесімен азаяды. Егер код ұзындығы d цифр, онда кездейсоқ болжау ықтималдығы:

$$P_{\text{guess}} = 1 / 10^d \quad (12)$$

Дәлел: код $0 \dots 10^d - 1$ аралығында тең ықтималды болса, дұрыс кодты бір ретте табу ықтималдығы $1/10^d$. Онлайн шектеумен бірге (rate-limit) жалпы тәуекел $P_{total} \leq k/10^d$ болады, бұл (4)-пен ұқсас құрылым. Фишингке төзімділік үшін қазіргі заманғы шешім - WebAuthn/FIDO2. Мұнда аутентификация сервердің доменіне (origin) криптографиялық түрде байланады; нәтижесінде фишинг сайтында алынған жауап нақты домінде верификациядан өтпейді [9].

Биометриялық фактор және қате шешімдер статистикасы (FAR/FRR)

Биометриялық аутентификацияда шешім қабылдау ұқсастық функциясы $s(x,y)$ және шекті мән τ арқылы жүргізіледі: $s \geq \tau$ болса - қабылдау, әйтпесе қабылдамау.

$$R = 1, \text{ егер } s(x,y) \geq \tau; R = 0, \text{ егер } s(x,y) < \tau \quad (13)$$

Мұнда қате қабылдау ықтималдығы (False Accept Rate, FAR) және қате кері қайтару (False Reject Rate, FRR) келесі түрде анықталады:

$$FAR(\tau) = \Pr[s(x_{\text{impostor}}, y_{\text{template}}) \geq \tau] \quad (14)$$

$$FRR(\tau) = \Pr[s(x_{\text{genuine}}, y_{\text{template}}) < \tau] \quad (15)$$

Ғылыми дәлел: τ өссе, FAR монотонды кемиді (қатаң талап), ал FRR монотонды өседі (заңды пайдаланушыға қиынырақ). Бұл ROC/DET қисықтарының классикалық қасиеті. Сондықтан биометрияны қолданғанда τ таңдау қолдану сценарийіне тәуелді: жоғары қауіпсіздік - төмен FAR, бірақ ыңғайлылық төмендейді [5].

Эксперименттік бөлім: параметрлер, модельдеу және нәтижелер

Эксперименттің мақсаты - SFA/2FA/MFA схемалары үшін шабуылдың сәтті болу ықтималдығын және қате шешімдер көрсеткішін салыстыру. Эксперимент модельдеу (simulation) түрінде жүргізілді, өйткені нақты өндірістік жүйелерге шабуыл жасау этикалық және құқықтық шектеулерге ие.

SFA үшін пароль параметрлері: $a=62$ (латын әріптері + цифрлар), $l \in \{8,10,12\}$. 2FA үшін OTP: $d=6$ цифр, онлайн әрекет саны $k \leq 5$. MFA үшін қосымша биометриялық фактор енгізіліп, FAR және FRR мәндері әдебиеттегі типтік диапазондарға сәйкес алынған ($FAR \approx 10^{-4} \dots 10^{-5}$, $FRR \approx 10^{-2} \dots 10^{-3}$).

Параметр	SFA	2FA	MFA
Алфавит өлшемі a	62	62	62
Пароль ұзындығы l	8/10/12	8/10/12	8/10/12
OTP цифр саны d	-	6	6
Онлайн әрекет шегі k	5	5	5
Биометрия τ (шек)	-	-	таңдалады
FAR, FRR	-	-	$FAR \approx 10^{-4}$, $FRR \approx 10^{-2}$

Ықтималдық есептеу әдістемесі

SFA үшін brute-force ықтималдығы (4) формула бойынша, 2FA үшін (6) және (12) формулаларының композициясы арқылы есептелді. Мысалы, пароль бұзылса да, OTP болжау қажет болған жағдайда:

$$P_{\text{attack}}^{\{2FA\}} \approx P_{\text{bf}} \cdot (k/10^d) \quad (16)$$

MFA үшін биометриялық фактор енгізілгенде, заңсыз субъектінің қабылдануы OTP және пароль бұзылса да, биометриялық шектен өтуімен шектеледі; сондықтан:

$$P_{\text{attack}}^{\{MFA\}} \approx P_{\text{bf}} \cdot (k/10^d) \cdot FAR(\tau) \quad (17)$$

Ал заңды пайдаланушының қабылдануы (жүйенің қолайлылығы) үшін жалпы сәттілік ықтималдығы:

$$P_{\text{success}}^{\text{MFA}} \approx (1 - \text{FRR}(\tau)) \cdot P_{\text{success}}^{\text{SFA}} \cdot P_{\text{success}}^{\text{OTP}} \quad (18)$$

Модельдеу нәтижелері

Есептеулер $k=5$, $d=6$ және $\text{FAR}=10^{-4}$ жағдайында жүргізілді. Пароль ұзындығы $l=10$, $a=62$ үшін $N=62^l \approx 8.39 \times 10^{17}$. Онлайн шектеуде ($k=5$) тек онлайн brute-force емес, көбіне фишинг/деректердің ағып кетуі сценарийі доминант болуы мүмкін; бірақ салыстыру үшін бірдей шектер қолданылды.

Схема	l	$P_{\text{bf}}(k=5)$	Қосымша фактор	Жалпы P_{attack}
SFA	10	$\approx 5/62^l$	-	$\approx 5.96 \times 10^{-18}$
2FA	10	$\approx 5/62^l$	$k/10^6$	$\approx 2.98 \times 10^{-23}$
MFA	10	$\approx 5/62^l$	$(k/10^6) \cdot \text{FAR}$	$\approx 2.98 \times 10^{-27}$

Кестеден көрінетіні: 2FA енгізу шабуыл ықтималдығын кемінде 10^5 - 10^6 есеге төмендетеді, ал MFA (биометрия + OTP) қосқанда тағы 10^4 есеге төмендейді. Бұл сандық қорытынды (16) және (17) формулалардағы көбейтінді құрылымымен дәлелденеді: қосымша тәуелсіз фактор - тәуекелді мультипликативті түрде азайтады. Модельдеу нәтижесін жинақтап, келесі теңсіздікті аламыз:

$$P_{\text{attack}}^{\text{MFA}} \ll P_{\text{attack}}^{\text{2FA}} \ll P_{\text{attack}}^{\text{SFA}} \quad (19)$$

Талқылау: ғылыми дәлелдер және практикалық шектеулер

Ұсынылған дәлелдер ықтималдық-теориялық және ақпараттық-теориялық жорамалдарға сүйенеді. Ең маңыздысы - факторлардың тәуелсіздігі. Егер шабуылдаушы фишинг арқылы пароль мен OTP-ны бірге ұрлай алса, онда (6)-дағы тәуелсіздік жорамал бұзылады және қауіп айтарлықтай өседі. Мұндай жағдайда фишингке төзімді аутентификация (WebAuthn) енгізу қажет [9]. Сонымен қатар, биометрияда FAR/FRR компромисі бар: t арттырсақ қауіпсіздік өседі (FAR төмен), бірақ қолайлылық төмендейді (FRR өседі) (14)-(15) формулаларымен негізделеді. Сондықтан нақты жүйеде тәуекел-қолайлылық балансы талаптарға сай таңдалады.

Қорытынды

Осы зерттеу барысында ақпараттық жүйелердегі қорғалған аутентификация схемаларының формальды моделі құрастырылып, бір факторлы (SFA), екі факторлы (2FA) және көп факторлы (MFA) аутентификация тәсілдерінің қауіпсіздік қасиеттері ықтималдық және ақпарат теориясының аппараттары негізінде жүйелі түрде талданды. Ұсынылған модельдер аутентификация факторларының тәуелсіздігі жағдайында шабуылдың сәтті болу ықтималдығының мультипликативті түрде төмендейтінін теориялық тұрғыда негіздеуге мүмкіндік берді.

Атап айтқанда, (4), (6), (8) және (17) формулалары қосымша аутентификация факторларын енгізу жүйенің бұзылу тәуекелін экспоненциалды түрде азайтатынын көрсетті. Бұл тұжырымдар параметрлік модельдеу нәтижелерімен расталып, көп факторлы аутентификация схемаларының бір және екі факторлы тәсілдермен салыстырғандағы сандық артықшылықтары айқындалды. Эксперименттік деректер шабуыл ықтималдығының бірнеше реттік дәрежелерге төмендейтінін көрсете отырып, теориялық бағалаулардың практикалық маңыздылығын дәлелдейді.

Сонымен қатар, аутентификацияның қорғалғандығын қамтамасыз ететін нақты техникалық тәсілдер - парольдерді salt қолдану арқылы хэштеу, уақытқа тәуелді бір реттік парольдер (OTP/TOTP), фишингке төзімді WebAuthn механизмі және биометриялық параметрлерді оңтайлы конфигурациялау - формальды модельдер аясында талданып, олардың қауіпсіздікке қосатын үлесі негізделді. Бұл тәсілдерді кешенді түрде қолдану ақпараттық жүйелердің аутентификация қабатының тұрақтылығын арттырып, заманауи қауіптерге қарсы тиімді қорғаныс құруға мүмкіндік береді.

Пайдаланылған әдебиеттер

1. Stallings W. Cryptography and Network Security: Principles and Practice. — Pearson, 2017.
2. Anderson R. Security Engineering: A Guide to Building Dependable Distributed Systems. — Wiley, 2020.
3. Florêncio D., Herley C. A Large-Scale Study of Web Password Habits // WWW. — 2007.
4. Bonneau J., Herley C., van Oorschot P., Stajano F. The Quest to Replace Passwords // IEEE Security & Privacy. — 2012.
5. Grassi P. et al. Digital Identity Guidelines (NIST SP 800-63 series). — NIST, 2017–2020.
6. ISO/IEC 27001:2022 Information security management systems — Requirements.
7. RFC 4226. HOTP: An HMAC-Based One-Time Password Algorithm. — IETF, 2005.
8. RFC 6238. TOTP: Time-Based One-Time Password Algorithm. — IETF, 2011.
9. W3C. Web Authentication: An API for accessing Public Key Credentials (WebAuthn). — Recommendation.
10. Jain A., Ross A., Prabhakar S. An Introduction to Biometric Recognition // IEEE TCSVT. — 2004.

УДК 656.07:339.543(574)

РАЗРАБОТКА МОДЕЛИ ЛОГИСТИЧЕСКОЙ СИСТЕМЫ ПОСТАВКИ ПЛОДООВОЩНЫХ ГРУЗОВ, ПЕРЕВОЗИМЫХ ЖЕЛЕЗНОДОРОЖНЫМ ТРАНСПОРТОМ

Жатканбаева Э.А.

кандидат технических наук, доцент, Казахский автомобильно - дорожный институт им. Л.Б. Гончарова, (Алматы Казахстан) <https://orcid.org/0000-0002-1773-2764>

Бақытбек Құштар

магистрант Казахский автомобильно - дорожный институт им. Л.Б. Гончарова, (Алматы Казахстан)

Аннотация: В статье рассматривается разработка модели логистической системы поставки плодоовощных грузов с использованием железнодорожного транспорта. Актуальность исследования обусловлена высокой долей потерь скоропортящейся продукции при транспортировке и необходимостью повышения эффективности агрологистических цепей поставок. Предложена модель логистической системы, учитывающая особенности плодоовощных грузов, требования к температурному режиму, срокам доставки и взаимодействию участников перевозочного процесса. Результаты исследования могут быть использованы при планировании и оптимизации перевозок сельскохозяйственной продукции железнодорожным транспортом.

Abstract: The article examines the development of a logistics system model for the delivery of fruit and vegetable cargo using railway transport. The relevance of the study is обусловлена the high level of losses of perishable products during transportation and the need to improve the efficiency of agrologistics supply chains. A logistics system model is proposed that takes into account the specific characteristics of fruit and vegetable cargo, requirements for temperature control, delivery time constraints, and the interaction among participants in the transportation process. The results of the study can be used in the planning and optimization of agricultural product transportation by railway transport.

Ключевые слова: логистическая система, плодоовощные грузы, железнодорожный транспорт, цепь поставок, скоропортящаяся продукция, оптимизация перевозок.

Keywords: logistics system, fruit and vegetable cargo, railway transport, supply chain, perishable products, transportation optimization.

Развитие агропромышленного комплекса и расширение межрегиональных и международных поставок плодоовощной продукции требуют совершенствования логистических систем. Плодоовощные грузы относятся к категории скоропортящихся, что обуславливает повышенные требования к условиям транспортировки, срокам доставки и надежности транспортных операций. Железнодорожный транспорт обладает значительным потенциалом для перевозки таких грузов благодаря высокой провозной способности, относительной экономичности и устойчивости к сезонным колебаниям.

Плодоовощные грузы относятся к скоропортящимся грузам, качество которых за время нахождения в обычных условиях ухудшается, т.е. изменяется их вкус, цвет, запах, консистенция. В основном это продукты сельскохозяйственного производства и их переработки в продукты питания, а также скоропортящееся сырьё для ряда отраслей промышленности.

Плодоовощная продукция характеризуется следующими особенностями:

- ограниченный срок хранения;
- чувствительность к температуре, влажности и механическим воздействиям;
- необходимость соблюдения санитарно-гигиенических требований;
- сезонность производства и неравномерность грузопотоков.

Указанные особенности требуют применения специализированного подвижного состава (рефрижераторные вагоны, изотермические контейнеры), а также использования технологий холодной логистики и мониторинга состояния груза.

Прохождение грузопотока от склада грузоотправителя до склада грузополучателя характеризуется термином «доставка», который нельзя отождествлять с термином «транспортировка». В первом случае комплексно учитываются предназначение груза, мощность и партионность поставок, наличие и размещение перегрузочных терминалов и складского хозяйства, транспортно-технологические связи между ними и т.д.

Один из основных принципов транспортной логистики предполагает, что доставка любого груза должна рассматриваться как система логистики взаимосвязанных технических средств и технологических процессов, осуществляемых по цепочке доставки от склада производителя/ поставщика / продавца до склада потребителя/ покупателя на основе операций транспортировки, хранения и обмена информацией и документацией

Для того чтобы плодоовощные грузы не теряли своих потребительских качеств, в процессе доставки необходимо для каждого из них создавать и поддерживать в грузовых помещениях, холодильных терминалах, складах и транспортных модулей изотермического подвижного состава специфические условия (главным образом температурный режим), применять определённый способ формирования штабеля груза и т.д.

Считаем, что для обеспечения перечисленных условий в логистических цепях поставок плодоовощных грузов должны быть организованы соответствующие инфраструктура и технологические процессы.

В этой связи, нами разработана модель логистической системы поставки плодоовощных грузов, перевозимых железнодорожным транспортом (рис. 1).



Рисунок 1- Модель логистической системы поставки плодовоовощных грузов железнодорожным транспортом

Как видно из рисунка 1 во всех звеньях холодной цепи логистической системы доставки плодовоовощных грузов поддерживаются специфические условия, основным из которых является соблюдение температурного режима.

Рассмотрим модель логистической системы (ЛС) поставки плодовоовощных грузов железнодорожным транспортом более подробно.

Транспортно-терминальная инфраструктура ЛС включает в себя три подгруппы технических средств:

- изотермический подвижной состав, куда входят автономный рефрижераторный вагон, рефрижераторные секции, вагон-термос;
- холодильные терминально-складские модули (холодильные склады) различного назначения. К ним относят холодильники производственные, заготовительные, перегрузочные, распределительные, реализационные, склады предварительного охлаждения

плодовоовощных грузов. Домашние холодильники у потребителей, в некоторой степени влияют на функционирование ЛС, но в её состав не входят;

- устройства обслуживания транспортных модулей: рефрижераторные депо, пункты технического обслуживания, и экипировки, пункты санитарной обработки вагонов и контейнеров. Без этих устройств невозможно нормальное функционирование изотермического подвижного состава.

Совокупность первой, второй и третьей подгрупп инфраструктуры ЛС называют хладотранспортом

Основными транспортно-технологическими процессами логистической системы поставки плодовоовощных грузов железнодорожным транспортом являются:

- хранение груза,
- подготовка груза к доставке;

- организации движения СПГ с применением логистических технологий: система поставки «точно в срок» (Just in time), планируемая система доставки (System Delivery Planning) и др.;
- транспортировка плодоовощных грузов;
- соблюдение условий перевозки СПГ;
- техническая эксплуатация изотермического подвижного состава;
- перегрузочно-складские работы;
- подготовка груза к реализации;
- обслуживание инфраструктуры.

Эффективность разработанной модели предлагается оценивать по следующим показателям:

- уровень потерь продукции при транспортировке;
- время доставки;
- совокупные логистические затраты;
- надежность и устойчивость цепи поставок.

Применение модели позволяет снизить потери плодоовощной продукции, повысить ритмичность поставок и улучшить качество обслуживания потребителей.

В результате исследования разработана модель логистической системы поставки плодоовощных грузов железнодорожным транспортом, учитывающая специфику скоропортящейся продукции и особенности железнодорожных перевозок. Реализация предложенной модели способствует повышению эффективности агрологистических цепей поставок и снижению экономических потерь. Перспективами дальнейших исследований являются математическое моделирование параметров системы и апробация модели на конкретных логистических маршрутах.

Список литературы

1. Бауэрсокс Д., Клосс Д. Логистика: интегрированная цепь поставок. – М.: Олимп-Бизнес, 2019.
2. Сергеев В.И. Логистика и управление цепями поставок. – М.: Юрайт, 2021.
3. Козлов П.А. Логистика скоропортящихся грузов. – СПб.: Питер, 2020.

RƏQƏMSAL İNFRASUKTURUN DİSTANT TƏHSİLİN KEYFİYYƏTİNƏ TƏSİRİ ÜZRƏ ANALİTİK ARAŞDIRMA

Pənahova İlkanə Mübariz qızı

Müəllim, ADPU-nun nəzdində ADPK, Azərbaycan, Orcid id: 0000-0003-3537-3619

Abstract. With the differentiation of learning needs and the development of digital communication technologies, the scope of distance learning is changing dynamically. For this reason, explaining the scope of open and distance learning becomes important in terms of effective and functional use of distance learning opportunities. In order to determine the scope of a notion, it is necessary to explain all the meanings, entities and effects within the frame of that notion. In this context, the aim of this study is to define the scope of distance learning in the sense of digital communication technologies. This research is a qualitative case study conducted by reviewing method. As a result of the searches; it has been revealed that in the 21 century, learning has become a communication process; the goal of distance learning is to deliver these communication processes to each person who wants to fulfil their learning needs, at the desired time and space, with individualized learning opportunities and interactive environments. In this context; the scope of distance learning is the design of these communication processes. In brief, it was concluded that the scope of distance learning is enriched with every technological development and the dynamic structure of the scope is the most important element in terms of learning.

Keywords: Digital Communication, Distance Education, Distance Learning, Communication Technology

İnformasiya əsri adlandırılan 21-ci əsrin əsas xammalı datadır. Köhnə biliklərlə əldə edilməmiş və sintez edilməmiş faktlar, gündəlik və ya peşəkar həyatda müşahidə olunsada, hələ mənimsənilməmiş faktlar kimi müəyyən edilə bilər (Güclü və Sotirofski, 2006). Elmdəki inkişaflarla davamlı olaraq əldə etdiyimiz məlumatlar, rabitə və informasiya texnologiyalarının inkişafı sayəsində eyni vaxtda bütün dünyaya yayılır. Bununla belə, bu məlumatların faydalı şəkildə istifadə edilməsi üçün onların mənaalarına tam çatılmalıdır. Bunun üçün verilənlər müəyyən bir məqsəd üçün fərdiləşdirilməli, təşkil edilməli, daha sonra isə təcrübə və öyrənmə vasitəsilə əldə edilən faktlara, bacarıqlara və rəylərə, bir sözlə, biliklərə çevrilməlidir.

İstər peşəkar (iş, təhsil həyatı) həyatında, istərsə də real (sosial) həyatda həyat boyu davamlı olaraq rast gəlinən məlumatlardan inkişaf etməkdə olan dünyaya uyğunlaşmaq üçün istifadə etmək zərurətə çevrilmişdir. Bu kontekstdə fərdlər ömür boyu öyrənmə mühitlərindən faydalanır. Əslində, 2000-ci illərdə distant təhsilin öyrənməyə davam etmək istəyən fərdlərə istədikləri zaman və hər yerdə məlumatları çatdırıla biləcəyi qəbul edilmiş bir həqiqətdir (Yüzer, 2013). Bu kontekstdə informasiya əsrinin xammalı olan məlumatların faydalı istifadə oluna bilməsi üçün məlumat və biliyin ötürülməsi yolu kimi distant təhsil mühitlərini görmək mümkündür. İnformasiyanı biliyə çevirməklə yanaşı, distant təhsil mühitləri ilə bu informasiyanı fərdiləşdirmək, informasiyanı gündəlik bilikdən bədii biliyə, izahlı bilikdən pragmatik biliyə və ya faktiki bilikdən konseptual biliyə çevirmək və bütün növlərə çatmaq mümkündür. (Yüzer, 2013). Bütün bunlara əlavə olaraq, distant təhsilin ənənəvi təhsildən fərqli şəkildə fərdiləşdirilə bilməsi, zaman və məkan müstəqilliyi təklif etməsi, müxtəlif mühitlərdə öyrənmə təcrübələri yaratması distant təhsili demokratik, ədalətli və bərabərhüquqlu bir quruluşa çevirir (Eby, 2013). İstər rəsmi, istərsə də

qeyri-rəsmi distant təhsil-tədris fəaliyyətləri, xüsusən 2000-ci illərdə internetin geniş yayılması nəticəsində inkişaf etdirilən rəqəmsal kommunikasiya texnologiyaları ilə həyatın əsas tikinti bloklarından birinə çevrilmişdir.

Rəqəmsal kommunikasiya texnologiyalarının sürətli inkişafı ilə hər şey kimi distant təhsil də hər cəhətdən dəyişdi. Tarixi inkişafda bir-birindən asılı olaraq daim inkişaf edən və dəyişən distant təhsil və kommunikasiya texnologiyaları rəqəmsallaşma ilə birləşərək, əhatə dairəsini inkişaf etdirərək, bir-biri ilə əlaqəli fərqli sahə yaradıb. Buna görə də distant təhsilin əhatə dairəsinin yenidən izah edilməsi effektiv və səmərəli fəaliyyətlər təmin etmək üçün öyrənənlər, qurumlar və sahə baxımından əhəmiyyət qazanır.

2000-ci illərdə rəqəmsal kommunikasiya texnologiyalarının inkişafı, xüsusən də mobil cihazların yayılması və internetin mobil texnologiyalarla gündəlik həyatın əvəzsiz elementinə çevrilməsi ilə bu vasitələr distant təhsilin əhatə dairəsində daha funksional strukturda dəyişikliklərə səbəb olmuşdur. Rəqəmsal kommunikasiya texnologiyaları ilə əldə edilə bilən hər cür fəaliyyət qeyri-rəsmi öyrənmə hissəciklərinə çevrilə bilər, digər tərəfdən tələbləri yerinə yetirmədən yaradılan istənilən məzmun rəqəmsal dünyada distant təhsil fəaliyyəti kimi təqdim edilə bilər.

İnsanların sığınacaq və qidalanma kimi həyatlarını davam etdirmək üçün lazım olan prosesləri davam etdirə bilmələri təcrübələrini ünsiyyət kanalları vasitəsilə paylaşmasından asılıdır. Bu onu göstərir ki, informasiyanın qəbulu və yayılması fenomeni bəşəriyyətin mövcudluğunun ilk dövrlərində müşahidə oluna bilər. Distant təhsilə ilk gündən təsir edən amillərdən biri kimi informasiya mübadiləsi ehtiyacının olması distant təhsilin əsasının qədim dövrlərə gedib çıxdığının sübutu kimi göstərilə bilər. Bu çərçivədə strukturlaşdırılmamış öyrənmə çərçivəsində məsafədən təhsil bəşər tarixinin çox qədim dövrlərinə gedib çıxır. Digər tərəfdən, strukturlaşdırılmış təlim çərçivəsində distant təhsil daha sonra inkişaf etmişdir (Bozkurt, 2019). Bunun səbəbi dizayn üçün strukturlaşdırılmış distant təhsilin yayılmasına imkan verəcək texnologiya elementinin inkişafıdır (Yüzer, 2013). Bu səbəbdən distant təhsilin məqsədini və predmetini müəyyən etmək üçün distant təhsilin inkişafının kommunikasiya texnologiyaları kontekstində izah edilməsi zəruri hesab edilmişdir.

Kommunikasiya texnologiyalarının inkişafı kontekstində distant təhsil 5 əsas dövrə bölünür (Moore & Kearsley, 2012). Bu dövrlər daxilində yazılı sənədlərlə ünsiyyətin birinci dövrü (məktublar, qəzetlər və s.), sonrakı dövr audio-vizual vasitələrin (radio və televiziya və s.), üçüncü dövr sənaye sistemi yanaşma dəstəyi ilə dəstəklənən üzbəüz mühazirələr və videolar, kompüter dəstəyi və telekonfranslardan istifadə edildiyi və qarşılıqlı əlaqənin artdığı dövr dördüncü dövr , internet-vəb tətbiqləri beşinci dövrü təşkil edir. Bu çərçivədə hər bir texnoloji inkişafı birlikdə distant təhsil də yenidən qurulmuş, məqsədləri, mövzusu və əhatə dairəsi dəyişmişdir. Başqa sözlə, texnologiya yönümlü həllərin təhsildə yaşanan problemlərin həlli olduğu anlayışı ilə (Mishra, Koehler, & Kereluik, 2009; Rushby, 2013) distant təhsil hər texnologiyanın inkişafı ilə dəyişmiş və yeni bir dövrə qədəm qoymuşdur.

İlk dövrdə distant təhsil fərdlərə zaman və məkandan asılı olmayaraq müəyyən fənlər üzrə təhsil vermək kimi görülsə də, bu tərif qeyri-kafi olmuş və 2000-ci illərin əvvəllərinə təsadüf edən 5-ci dövrdə elmin inkişafı ilə əlaqədar olaraq öz qüvvəsini itirmişdir. Bunun əsas səbəbi zamanla texnoloji inkişafı ilə distant təhsildə paradigma dəyişikliyinə olmasındır. İnternet və veb mühitlərinin distant təhsilə daxil edilməsi ilə, öyrənən mərkəzli və eyni vaxtda qarşılıqlı əlaqə və asinxron qarşılıqlı əlaqə təklif edən bir çox fərqli tətbiq ön plana çıxmağa başladı. Qlobal miqyasda öyrənməyə meyilli olan təhsil fenomeni internet və veb tətbiqləri dövründə distant təhsil tətbiqlərinin əhatə dairəsinin genişlənməsi, xüsusiyyətlərinin artması ilə distant təhsili əsas anlayışa çevirmişdir.

Bunun başqa bir səbəbi də texnologiyadakı inkişafların məlumat istehsalını artırması və həyatın buna uyğun formalaşmasıdır. Bu forma dəyişikliyi həm peşəkar, həm də real həyatda öz təsirlərini göstərir və davamlı dəyişikliklərə səbəb olur. Bu prosesi yaxından izləmək və onun bir parçası olmaq sosial və iqtisadi sahələrdə baş verən dəyişikliklərə və inkişafı uyğunlaşmaq deməkdir (Topa Çiftçi, 2018). Bu səbəbdən cəmiyyətdəki dəyişikliklərə uyğun olaraq özünü təkmilləşdirmək, bilikləri yeniləmək üçün davamlı öyrənmə prosesində olmağa ehtiyac var. Bu vəziyyət global miqyasda təhsil yanaşmalarında paradigma dəyişikliyinə səbəb olub.

Distant təhsildə təlimə doğru paradigmanın dəyişməsi ənənəvi təhsil fəaliyyətlərində də özünü göstərmiş, təhsil fəaliyyəti öyrənmə fəaliyyətinə çevrilmişdir. Öyrənmədə davamlılıq həyatın danılmaz elementinə çevrildi və öyrənmə həyatın bir hissəsinə çevrildi. Bir sözlə, biliyin universallaşması və davamlı inkişafı müəyyən zaman kəsiyində baş verən icbari təhsili fasiləsiz öyrənmə ehtiyacına çevirmişdir. Bu paradigma dəyişikliyinə görə dinamik struktura malik olan distant təhsil ənənəvi təhsildən üstün olmuşdur. Çünki ənənəvi təhsil öz məhdudiyyətləri və statik quruluşu ilə bu ehtiyacları ödəmək iqtidarında deyil.

Ənənəvi təhsil əvvəlcədən planlaşdırılan mövzulardan kənara çıxmada, müəyyən bir müddət ərzində, sabit mühitdə yalnız dizayn edilmiş məlumatların ötürülməsi və təlim alan şəxslərin kağız üzərində qiymətləndirilməsi prosesidir. Lakin XXI əsrin həyatında bu proses biliyin həyata keçirilməsi üçün yetərli və funksional deyil. Ənənəvi təhsildə məlum olduğu kimi, hansı təlim-tədris nəzəriyyəsinin qəbul edilməsindən asılı olmayaraq, təhsil anlayışı “fərdlərdə arzu olunan və planlaşdırılmış davranış dəyişikliyinə yaradılması prosesi” kimi qəbul edilir. Ənənəvi təhsil - şəxsiyyətin iqtidarın qərar verdiyi həqiqətlər çərçivəsində formalaşması başqa sözlə, onu kölə etmək prosesidir (Eby, 2013). Fərd öz davranışı ilə nəzərdə tutulan və gözlənilən məqsədlərə çatdığını açıq şəkildə göstərməlidir. Çünki fərdin psixi prosesləri, davranışlarını gözlənilən və arzu olunan şəkildə formalaşdırması vacibdir. Bu prosesdə şagird və müəllim tərəflərindən istifadə edilir. Tərəflərin vəzifələri müəyyən edilib və ondan kənara çıxa bilmirlər. Tələbə və müəllimin qarşılıqlı əlaqəsi əsas olsa da, bütün fəaliyyətlər dominant güc olan və tələbə üzərində şübhəsiz təzyiqə malik olan müəllim tərəfindən tərtib edilir və idarə olunur.

Tələbə uğuru isə öyrənmə səviyyəsini və həyatda öyrədilənlərin funksional istifadəsini qiymətləndirməkdən fərqli olaraq, müəllimin müşahidə edə biləcəyi şagird davranışlarına və ya imtahan nəticələrinə baxmaqla şərh olunur və müvafiq olaraq nə etməli olduğu bildirilir. Öyrənənlər öz öyrənmələrinə nəzarət edə bilmirlər, dərslər, metodlar və qiymətləndirmələrlə bağlı bütün qərarları qəti şəkildə müəllimlər verir.

Bundan başqa, ənənəvi təhsildə fərdi öyrənmənin vacibliyi daim vurğulanır, lakin təhsil prinsiplərindən yalnız biri olaraq qalır. Bu prinsipin tətbiqi təhsil mühitində tələbələrin əksəriyyətinin bacarıqlarına və öyrənmə sürətinə uyğun olaraq sabit məzmununda dizayn dəyişiklikləri kimi özünü göstərir. Təlimin sonunda bütün fərdlərin eyni davranışı inkişaf etdirməsi gözlənilir. Başqa sözlə, ənənəvi təhsil fərdlərin homojenləşdirilməsi prosesi olaraq qalır. Əslində, Duckworth (2009) bu mövzuda iddia edirdi ki, müəllim əsaslı öyrənmə şagirdlərin inkişafını məhdudlaşdırır.

Ənənəvi təhsil sistemində iqtisadi və siyasi cəhətdən əlverişli mövqedə olanlar informasiyanı çox daha qısa müddətdə əldə etmək və asanlıqla əldə etmək imkanına malikdirlər. Bilik hər kəsin əldə edə biləcəyi hüquq deyil. Təhsil almaq üçün tələblərə cavab verməlisən. Bu vəziyyətin ən məşhur nümunəsi, şəxsin müəyyən imtahanlarda müəyyən bir qiymətdən yuxarı alınaraq seçilməsidir. Fərdin öz öyrənməsi üçün heç bir qənaəti yoxdur və ya bu qənaət çox məhduddur. Müəllim təhsili birtərəfli qarşılıqlı əlaqə ilə davam etdirir, çünki başqa şeylərlə yanaşı, riayət edilməli olan qaydalar var və şagirdin etiraz etmək hüququ məhduddur. Bir sözlə, müəllim məlumatı diktə edir, şagirdlərin isə hədəfə çatmaq üçün iki yolu var. Bunlardan birincisində şagird sanki dinləyir və bilik əldə edir, ikincisinə isə yox.

Bu kontekstdə, bir tərəfdən, davamlı olaraq istehsal olunan məlumatlarla və bu məlumatların kommunikasiya texnologiyaları sayəsində dünyaya yayılması ilə mütəşəkkil məlumatlara çevirərək ömür boyu məlumat əldə etmək ehtiyacı var, digər tərəfdən isə ənənəvi təhsilin qeyd olunan məhdudiyyətləri var. Bu mövzuda 21-ci əsr həyatında öyrənmə və öyrənmənin danılmaz elementi kimi distant təhsil fəaliyyətləri həyatın özünə çevrilmişdir. İndi distant təhsil, interaktiv təlim və kommunikasiya mühitlərinin layihələndirilməsi ilə, təkcə təbii dünyanın dərk edilməsini təşkil etmək üçün istifadə edilmir, həm də insan reallığını işıqlandırmaq üçün yeni perspektivlər və anlayışlar gətirir (Eby, 2013). Ona görə də distant təhsilin mövzusunun, məqsədini və əhatə dairəsini yenidən izah etmək zərurəti yaranıb. Distant təhsil nəzərdə tutulmuş ünsiyyət prosesidir.(Eby, 2013). Bu prosesi tərtib etmək üçün təqdim ediləcək məzmun, bilik və təcrübələr həm cəmiyyətin, həm də öyrənənlərin iqtisadi, sosial, siyasi, mədəni və idrak reallıqlarına əsaslanan dəyərlərlə müəyyən edilməlidir. Aşağıda sadalanan meyarlar çərçivəsində distant təhsil mühitlərinin dizaynında təklif olunan xidmətlərin keyfiyyətini artırmaq və saxlamaq vacibdir:

- Mövcud nəzəriyyə və məzmunu tədqiqat işlərinə uyğunlaşdırmaq
- Demokratik iştirak üçün çoxsaylı imkanlar yaratmaq
- Müxtəlif həyata keçirmə strategiyalarını hazırlamaq və əks etdirmək
- Fərqlənən işçilərin bilik və bacarıqlarından istifadə etmək
- Texnoloji resursları tədqiqat prosesinə uyğunlaşdırmaq
- Multikultural anlayışlar yarada bilmək
- Real həyatlara əsaslanaraq distant təhsil mühitlərini dizayn edə bilmək

Distant təhsilin proseslərinin dizaynının belə geniş meyarlara malik olmasının səbəbi hər kəsin distant təhsil, öyrənmə və kommunikasiya fəaliyyətlərinin demokratik təşəbbüslərindən bərabər və ədalətli şəkildə faydalanmasına imkan verəcək mühitlərin layihələndirilməsi missiyasıdır. Çünki distant təhsil böyük kütlələrə deyil, hər kəsə çatmağı hədəfləyir (Eby, 2013).

İstər peşəkar həyat, istərsə də real həyat üçün, insanlara həyatlarında ehtiyac duyduqları bütün məlumatları formal və qeyri-rəsmi yollarla, bərabər, ədalətli, çevik və dinamik bir quruluşda təmin etdikdə, onlar öz-özünü təmin edən aktiv fərdlərə çevrilirlər. Distant təhsilin məqsədi passiv öyrənənlər olmaq əvəzinə öz məsuliyyətidir. Bu məqsədə çatmaq üçün distant təhsil anlayışını fərdin öz ehtiyaclarına, gözləntilərinə, istəklərinə və qabiliyyətlərinə uyğun olaraq öyrənmə fəaliyyətini tərtib edə və həyata keçirə biləcəyi, öyrənmə fəaliyyətini dörd hissəyə sığışdırmayan ünsiyyət prosesinin dizaynı kimi qəbul edir. Divarlar və müəyyən zaman dövrlərində və mövzu mütəxəssisləri tərəfindən nəzəriyyələrlə formalaşır. Moore və Kearsley (2012) bu prosesin müəyyən bir əsas məqsədə xidmət etdiyini bildirdi.

Onu müxtəlif tədris materialları və ünsiyyət formaları ilə qarşılıqlı əlaqədə olan hissələrdən ibarət sistem yanaşması kimi müəyyən etməklə, Bozkurt (2019) distant təhsili sistem yanaşması çərçivəsində həyata keçirilən planlı və məqsədyönlü təcrübələr toplusu kimi müəyyən edir. Bu çərçivədə distant təhsilin əhatə dairəsi, öyrənənlərin bir-birindən uzaq olduğu və zaman və yaxud məkan baxımından öyrənmə resurslarının olduğu, onların bir-biri ilə və öyrənmə resursları ilə qarşılıqlı əlaqəsinin kommunikasiya sistemlərinə əsaslandığı öyrənmə prosesi kimi müəyyən edilir (Aydın, 2011).

21-ci əsr, davamlı ünsiyyət və qarşılıqlı əlaqə ilə paylaşılan elmi biliklər ətrafında inkişaf edən, xüsusilə rəqəmsal kommunikasiya texnologiyaları ilə məlumatlara əlçatan, sürətli dəyişiklikləri və inkişafı gətirən bir dövr olaraq təyin olunur. Bu dövrdə çərçivəyə salınmış qaydalara, qısamüddətli məqsədlərə əsaslanan mərkəzləşdirilmiş təcrübələrə və çoxölçülü olmayan yanaşmalara əməl edən bütün sistemlər, şübhəsiz ki, öz dəyərini itirəcək (Şentürk, 2008).

Ənənəvi təhsildə olduğu kimi, müəyyən müddət ərzində müəyyən yerdə olmaqla yalnız müəyyən fənlər üzrə verilən təlimlər və real həyatda nəticələri uyğun gəlməyən öyrənmə təcrübələri 2000-ci illərin real həyatda öyrənmə ehtiyaclarına uyğun gəlmir. Çünki bütün dünyada informasiyanın universallaşması və onun rəqəmsal kommunikasiya texnologiyaları ilə daim paylaşılması sayəsində öyrənmə ünsiyyət prosesinə çevrilmişdir. Bundan əlavə, informasiya əldə etmək üçün qeyri-məhdud imkanların mövcud olduğu 21-ci əsrdə demokratik, bərabər, ədalətli, çevik, davamlı və fərdiləşdirilmiş təhsil mühitlərinə ehtiyac var.

Bu çərçivədə, demokratik, ədalətli, bərabər və çevik olmaqla yanaşı, dinamik bir quruluşda inkişaf edən və öyrənmə ehtiyaclarını ödəmək istəyən heç bir fərd maddi və ya mənəvi, zaman və məkan səbəblərindən bu hüquqdan məhrum edilməyəcək. Distant təhsil rəqəmsal kommunikasiya texnologiyalarının inkişafını izləyərək, onlara uyğunlaşaraq fərdiliyi və davamlılığı təmin edən bir təhsil sistemi kimi daim önə çıxacaq.

Ədəbiyyat

1. Ahmed, A. K. (2013). Teacher-centered versus learner-centered teaching style. *Journal of Global Business Management*, 9(1), 22.
2. Aydın, C. H. (2011). Açık ve uzaktan öğrenme: Öğrenci adaylarının bakış açısı. Ankara: Pegem.
3. Bomsdorf, B. (2005). Adaptation of Learning Spaces: Supporting Ubiquitous Learning in Higher Distance Education. *Mobile Computing and Ambient Intelligence*. <https://www.semanticscholar.org/paper/Adaptation-of-Learning-Spaces%3A-Supporting-Learning-Bomsdorf/85b86ce32750defca68419d25d3d9559efb44aeb#citing-papers>
4. Baumeister, R. F., ve Leary, M. R. (1997). Writing narrative literature reviews. *Review of General Psychology*, 1(3), 311-320.
5. Bozkurt, V. (2001). Enformasyon toplumu ve eğitim. *Türk Dünyası Araştırma Vakfı, Bilgi ve Toplum*, 4 (3), 15-22.
6. Bozkurt, A. (2019a). Intellectual roots of distance education: A progressive knowledge domain analysis. *Distance Education*, 40(4), 497-514. <https://doi.org/10.1080/01587919.2019.1681894>
7. Bozkurt, A. (2019). From distance education to open and distance learning: a holistic evaluation of history, definitions, and theories. In Sisman-Uğur, S., ve Kurubacak, G. (Eds.), *Handbook of Research on Learning in the Age of Transhumanism* (pp. 252-273). Hershey, PA: IGI Global.
8. Cho, S. K. (2007). Current status and future of mall. *Multimedia Assisted Language Learning*, 10 (3), 197-211.
9. Connelly, L. M. (2016). Trustworthiness in qualitative research. *Medsurg Nursing*, 25(6), 435-437.
10. Douglass, B. G., ve Moustakas, C. E. (1985). Heuristic inquiry: The internal search to know. Center for Humanistic Studies. <https://doi.org/10.1177/0022167885253004>
11. Drucker, P. F. (1994). Yeni Gerçekler. (B. Karanakçı, Çev.). (4. Baskı). Ankara: İş Bankası Yayını.
12. Duckworth, E. (2009). Helping students get to where ideas can find them. *The New Educator*, 5(3), 185-188.
13. Eby, G. (2013). Uzaktan eğitim (uze) ortam tasarımı: yazılım mühendisliği yaşam döngüsü yaklaşımı. Ankara: Kültür Ajans Yayınları.
14. Güçlü, N., ve Sotirofski, K. (2006). Bilgi Yönetimi. *Türk Eğitim Bilimleri Dergisi, Güz*, 4 (4), 351-371.
15. Moore, M. ve Kearsley, G. (2012). Distance education: A system view of online

learning. (Third Edition). Belmont, CA: Wadsworth.

Обзор и систематическое исследование современных веб-атак, эксплойтов и киберугроз 2025 года

Танатар Нурғали

Студент 2 курса магистратуры, Казахский национальный исследовательский технический университет имени К.И. Сатпаева, Алматы, Казахстан

Аннотация: в условиях 2025 года веб-приложения остаются ключевым элементом цифровой инфраструктуры и одновременно основной целью для злоумышленников. Рост числа атак, включая SQL-инъекции, межсайтовый скриптинг, удалённое выполнение кода, Zero-Day уязвимости, ботнет-атаки и Credential Stuffing, требует систематического анализа их природы и методов противодействия. Настоящий обзор посвящён классификации современных веб-угроз, выявлению тенденций их развития и сопоставлению традиционных и интеллектуальных подходов к защите. Особое внимание уделено использованию искусственного интеллекта злоумышленниками, автоматизации атак и многоступенчатым сценариям эксплуатации, а также роли социальной инженерии в комбинированных атаках. В работе рассмотрены возможности WAF и IDS/IPS, их ограничения, а также применение AI-моделей (AutoEncoder, LSTM, Random Forest, Isolation Forest) для анализа аномалий и повышения эффективности защиты. Сравнение по метрикам Precision, Recall и F1-score демонстрирует преимущества гибридных архитектур SOC, интегрирующих SIEM и SOAR системы с AI-модулями. Обзор подчёркивает практическую значимость интеллектуальных решений и обозначает перспективные направления дальнейших исследований в области проактивной киберзащиты.

Ключевые слова: веб-атаки, киберугрозы, Zero-Day, ботнеты, DDoS, AI-защита, SOC, аномалии.

Введение.

В 2025 году веб-приложения остаются ключевым элементом цифровой экосистемы, обеспечивая функционирование электронной коммерции, государственных сервисов и корпоративных платформ. Их широкое распространение делает их приоритетной целью для злоумышленников, использующих как классические методы атак, так и новые, более сложные техники. Актуальность исследования веб-угроз в текущем году определяется ростом числа Zero-Day уязвимостей, активным применением ботнетов для проведения DDoS-атак, а также использованием искусственного интеллекта самими атакующими для автоматизации и маскировки вредоносной активности. Дополнительным фактором риска является усложнение архитектуры веб-приложений, включающих микросервисы, облачные решения и API-интерфейсы, что расширяет поверхность атаки и требует новых подходов к защите.

Традиционные средства безопасности, такие как WAF и IDS/IPS, демонстрируют высокую эффективность при обнаружении известных угроз, но их возможности ограничены при работе с неизвестными паттернами и многоступенчатыми сценариями эксплуатации. Это создаёт необходимость в применении интеллектуальных систем, способных адаптироваться к динамично меняющейся среде угроз и выявлять аномалии в поведении пользователей и приложений.

Целью исследования является систематизация современных веб-атак и киберугроз 2025 года, а также оценка эффективности различных методов защиты. Задачи исследования включают:

- классификацию актуальных типов атак (SQLi, XSS, RCE, Zero-Day, ботнеты, Credential Stuffing);
- анализ тенденций развития угроз и их взаимосвязи с применением AI злоумышленниками;
- сопоставление традиционных средств защиты с AI-подходами;
- формирование рекомендаций по интеграции интеллектуальных систем в архитектуру SOC.

Таким образом, обзор направлен на выявление ключевых вызовов и перспективных направлений развития киберзащиты веб-приложений в условиях 2025 года.

1. Классификация современных веб-атак.

Современные веб-приложения являются ключевым элементом цифровой инфраструктуры, и именно поэтому они становятся приоритетной целью для злоумышленников. В 2025 году наблюдается рост разнообразия атак, их автоматизации и использование искусственного интеллекта самими атакующими. Рассмотрим основные классы веб-угроз, наиболее актуальные для корпоративных систем и сервисов.

SQL-инъекции (SQL Injection / SQLi) остаются одним из наиболее распространённых методов атак на веб-приложения. Суть заключается во внедрении вредоносных SQL-запросов через формы ввода или URL-параметры. Это позволяет злоумышленнику получить доступ к базе данных, извлечь конфиденциальную информацию или изменить её содержимое. Несмотря на развитие средств защиты, SQLi остаются актуальными из-за ошибок валидации данных и недостаточной фильтрации пользовательского ввода.

Межсайтовый скриптинг (Cross-Site Scripting / XSS) направлен на внедрение вредоносного JavaScript-кода в веб-страницы. Пользователи, открывающие заражённые страницы, становятся жертвами кражи Cookies, сессий или перенаправления на фишинговые сайты. В 2025 году XSS активно используется для обхода аутентификации и проведения атак на пользователей корпоративных порталов.

Удалённое выполнение кода (Remote Code Execution / RCE) представляет собой одну из самых опасных категорий атак. Эксплойты позволяют злоумышленнику выполнять произвольный код на сервере или клиентской стороне. Это может привести к полной компрометации системы, установке вредоносного ПО или созданию «бэкдоров».

В 2025 году эксплойты часто нацелены на популярные веб-серверы (Apache, Nginx), CMS-системы (WordPress, Joomla) и API-интерфейсы. Особую угрозу представляют эксплойты для библиотек и фреймворков, которые широко используются в разработке. Их эксплуатация позволяет атакующим проникать в корпоративные сети и распространять вредоносное ПО.

Zero-Day атаки связаны с эксплуатацией уязвимостей, которые ещё не известны разработчикам и не имеют патчей. Это делает их крайне опасными, так как традиционные средства защиты (WAF, IDS/IPS) не способны их обнаружить.

В 2025 году Zero-Day активно применяются в целевых атаках на финансовые организации, государственные порталы и облачные сервисы. Их особенностью является высокая стоимость на теневых рынках и использование в рамках APT-кампаний (Advanced Persistent Threats). Для противодействия Zero-Day всё чаще применяются методы машинного обучения и анализ аномалий, позволяющие выявлять подозрительные паттерны поведения.

Ботнеты представляют собой сети заражённых устройств, управляемых злоумышленниками. Они используются для проведения распределённых атак отказа в обслуживании (DDoS), перегружающих серверы огромным количеством запросов.

В 2025 году ботнеты становятся более интеллектуальными: они используют AI для адаптации к защитным механизмам и имитации легитимного поведения пользователей. Помимо DDoS, ботнеты применяются для массового сканирования уязвимостей, рассылки спама и проведения Credential Stuffing атак. Для защиты от ботнетов применяются поведенческий анализ трафика, алгоритмы Isolation Forest и LSTM, которые позволяют выявлять аномальные последовательности запросов.

Credential Stuffing – это атаки, основанные на использовании украденных или утекших учётных данных. Злоумышленники применяют автоматизированные скрипты для массовой проверки комбинаций логинов и паролей на различных сервисах.

В 2025 году такие атаки усилились благодаря доступности утечек данных и применению автоматизации. Credential Stuffing часто используется для компрометации корпоративных аккаунтов, что может привести к масштабным инцидентам. Автоматизированные атаки включают использование скриптов и ботов для обхода CAPTCHA, проведения Brute Force, сканирования уязвимостей и эксплуатации API. Их особенность заключается в высокой скорости и масштабируемости, что делает традиционные методы защиты малоэффективными.

Классификация современных веб-атак показывает, что угрозы становятся всё более разнообразными и сложными. SQL-инъекции и XSS остаются массовыми, RCE и эксплойты приводят к полной компрометации систем, Zero-Day используются в целевых атаках, а ботнеты и Credential Stuffing усиливают автоматизацию атак [1-2].

2. Текущие тенденции развития киберугроз.

Рост использования AI злоумышленниками. В 2025 году искусственный интеллект перестал быть исключительно инструментом специалистов по защите и активно используется самими злоумышленниками. Алгоритмы машинного обучения применяются для автоматизации поиска уязвимостей, генерации эксплойтов и обхода традиционных средств защиты. Генеративные модели позволяют создавать уникальные вредоносные скрипты, которые не распознаются сигнатурными системами. Кроме того, AI используется для имитации легитимного поведения пользователей, что усложняет задачу выявления атак. Особенно опасным становится применение искусственного интеллекта в фишинговых кампаниях: персонализированные письма и сайты создаются автоматически, повышая вероятность успешного обмана.

Автоматизация атак и использование ботнетов. Автоматизация стала ключевой тенденцией в развитии киберугроз. Современные ботнеты способны самостоятельно адаптироваться к защитным механизмам, изменять паттерны поведения и распределять нагрузку между тысячами заражённых устройств. Это делает DDoS-атаки более масштабными и устойчивыми к традиционным методам фильтрации. Помимо отказа в обслуживании, ботнеты активно применяются для массового сканирования веб-приложений, поиска уязвимостей и проведения Credential Stuffing атак. Автоматизация также проявляется в использовании скриптов для обхода CAPTCHA, Brute Force-атак и эксплуатации API-интерфейсов. В результате злоумышленники получают возможность атаковать системы в режиме «24/7» без участия человека.

Сложные многоступенчатые сценарии эксплуатации. Современные атаки всё чаще строятся по многоступенчатым сценариям, объединяющим несколько техник. Например, первоначальный доступ может быть получен через фишинг, затем используется эксплойт для повышения привилегий, а финальной стадией становится внедрение вредоносного ПО или создание бэкдора. Такие атаки известны как АРТ-кампании (Advanced Persistent Threats), и их цель – длительное присутствие в системе без обнаружения. В 2025 году наблюдается рост использования комбинаций Zero-Day уязвимостей и RCE для проникновения в

корпоративные сети. Сложность этих сценариев заключается в том, что каждый этап атаки может выглядеть как легитимная активность, а выявить их можно только с помощью комплексного анализа поведения.

Социальная инженерия и комбинированные атаки. Несмотря на технологический прогресс, социальная инженерия остаётся одним из самых эффективных инструментов злоумышленников. В 2025 году она всё чаще комбинируется с техническими атаками. Например, фишинговые письма используются для доставки ссылок на эксплойты, а успешное введение пользователя в заблуждение становится первым шагом многоступенчатой атаки. Комбинированные атаки включают использование утечек данных для Credential Stuffing, подкреплённых социальной инженерией, когда жертве внушают необходимость срочной авторизации или смены пароля. AI усиливает этот процесс, позволяя создавать персонализированные сообщения, имитирующие стиль общения конкретных организаций или людей [3-4].

3. Традиционные методы защиты веб-приложений.

Межсетевой экран для веб-приложений (Web Application Firewall / WAF) и системы обнаружения/предотвращения вторжений (Intrusion Detection System (IDS) / Intrusion Prevention System (IPS)) являются основными инструментами защиты веб-приложений. WAF работает на уровне HTTP/HTTPS и фильтрует входящие запросы, блокируя попытки SQL-инъекций, XSS и других распространённых атак. IDS/IPS анализируют сетевой трафик и выявляют подозрительные активности, сопоставляя их с известными шаблонами атак. Эти решения обеспечивают базовый уровень безопасности и широко применяются в корпоративных инфраструктурах. Их преимущество заключается в высокой точности при обнаружении известных угроз и возможности интеграции с SIEM-системами для централизованного мониторинга.

Сигнатурные подходы и их ограничения. Основой работы WAF и IDS/IPS являются сигнатуры – заранее определённые правила, описывающие характерные признаки атак. Такой подход эффективен против известных угроз, но имеет ряд ограничений. Во-первых, сигнатуры требуют постоянного обновления, что увеличивает нагрузку на специалистов SOC. Во-вторых, они не способны выявлять Zero-Day уязвимости и сложные многоступенчатые атаки, которые не имеют заранее известных паттернов. В-третьих, сигнатурные системы часто страдают от ложных срабатываний, особенно при работе с нестандартными веб-приложениями. Это снижает их практическую ценность и требует дополнительных усилий по настройке.

Практические кейсы применения. На практике WAF и IDS/IPS остаются важными элементами защиты. Например, в банковских системах WAF используется для фильтрации запросов к онлайн-банкингу, предотвращая SQL-инъекции и XSS. В государственных порталах IDS/IPS помогают выявлять попытки несанкционированного доступа и блокировать подозрительные IP-адреса. В корпоративных сетях эти решения интегрируются с SIEM, что позволяет централизованно отслеживать инциденты и формировать отчёты для аналитиков. Однако опыт показывает, что при столкновении с новыми угрозами, такими как Zero-Day или интеллектуальные ботнет-атаки, традиционные методы оказываются недостаточными. Именно поэтому всё чаще применяются гибридные архитектуры, где WAF и IDS/IPS выполняют роль первой линии обороны, а искусственный интеллект обеспечивает выявление аномалий и неизвестных атак.

4. AI-подходы к защите веб-приложений.

Машинное обучение и анализ аномалий. В условиях 2025 года традиционные методы защиты веб-приложений, основанные на сигнатурах и статических правилах, всё чаще

оказываются недостаточными. Злоумышленники применяют новые техники, включая Zero-Day уязвимости, ботнет-атаки и автоматизированные эксплойты, которые не имеют заранее известных паттернов. В этой ситуации ключевую роль начинают играть методы искусственного интеллекта, способные выявлять аномалии и адаптироваться к динамично меняющейся среде угроз.

Машинное обучение позволяет строить модели нормального поведения пользователей и приложений, а затем фиксировать отклонения, которые могут сигнализировать о потенциальной атаке. Алгоритмы Random Forest и Isolation Forest применяются для классификации сетевых событий и выявления подозрительных запросов. AutoEncoder используется для обнаружения скрытых паттернов в логах веб-серверов, а LSTM-модели анализируют временные зависимости в трафике, что особенно эффективно при выявлении DDoS и ботнет-активности.

Анализ аномалий является ключевым направлением применения AI в киберзащите. В отличие от сигнатурных систем, которые реагируют только на известные угрозы, методы аномалий способны выявлять новые и неизвестные атаки. Например, резкое увеличение числа запросов от одного IP-адреса или необычная последовательность действий пользователя может быть классифицирована как потенциальная атака. Такой подход снижает риск пропуска Zero-Day и сложных многоступенчатых сценариев эксплуатации.

Практическая значимость AI-подходов заключается в их интеграции с SIEM и SOAR системами. Это позволяет автоматизировать реагирование на инциденты, сокращать время анализа и снижать нагрузку на SOC-аналитиков. В результате формируется интеллектуальная система защиты, которая не только фиксирует известные угрозы, но и выявляет новые, обеспечивая проактивную безопасность веб-приложений.

AutoEncoder, LSTM, Random Forest, Isolation Forest. Современные методы искусственного интеллекта играют ключевую роль в защите веб-приложений, позволяя выявлять аномалии и неизвестные угрозы. Рассмотрим четыре наиболее применяемых алгоритма: AutoEncoder, LSTM, Random Forest и Isolation Forest.

AutoEncoder – это нейронная сеть, обучающаяся восстанавливать входные данные. Её задача заключается в том, чтобы сжимать информацию в скрытое представление и затем восстанавливать её обратно. Если входные данные отличаются от нормального поведения (например, необычные запросы к серверу), ошибка восстановления будет высокой, что сигнализирует о возможной атаке. AutoEncoder особенно эффективен для обнаружения скрытых паттернов и Zero-Day атак, так как он не требует заранее известных сигнатур.

LSTM (Long Short-Term Memory) – разновидность рекуррентных нейронных сетей, способная анализировать временные зависимости. В контексте веб-безопасности LSTM применяется для анализа последовательности запросов и выявления аномалий во временных рядах. Например, резкое увеличение числа запросов за короткий промежуток времени может указывать на DDoS или ботнет-атаку. LSTM хорошо справляется с задачами, где важно учитывать контекст и порядок событий.

Random Forest – ансамблевый алгоритм машинного обучения, основанный на построении множества деревьев решений. Он используется для классификации сетевых событий и обладает высокой точностью при работе с разметкой данных. Random Forest эффективен для выявления известных атак, таких как SQL-инъекции или XSS, и отличается устойчивостью к переобучению. Его преимущество – интерпретируемость и возможность оценивать важность признаков.

Isolation Forest – алгоритм для обнаружения аномалий, который изолирует наблюдения, отличающиеся от большинства. Он особенно полезен при анализе больших потоков данных, где необходимо быстро выявить подозрительные активности. Isolation Forest применяется для обнаружения ботнет-трафика, Credential Stuffing и других

автоматизированных атак. Его сильная сторона – высокая скорость работы и способность выявлять редкие события.

В совокупности эти алгоритмы формируют интеллектуальную систему защиты, где AutoEncoder и LSTM выявляют новые угрозы, а Random Forest и Isolation Forest обеспечивают точную классификацию и фильтрацию. Такой гибридный подход позволяет значительно повысить устойчивость веб-приложений к современным атакам.

Таблица 1 – Методы машинного обучения и их роль в обнаружении аномалий

Метод / Алгоритм	Назначение	Сильные стороны	Ограничения	Примеры применения
Random Forest	Классификация сетевых событий, выявление подозрительных запросов	Высокая точность, устойчивость к переобучению, интерпретируемость	Требует размеченных данных, менее эффективен для неизвестных атак	Обнаружение SQL-инъекций, XSS, классификация логов
Isolation Forest	Выявление аномалий в больших потоках данных	Высокая скорость, эффективен для редких событий	Может давать ложные срабатывания при сложных паттернах	Обнаружение ботнет-трафика, Credential Stuffing, автоматизированные атаки
AutoEncoder	Обнаружение скрытых паттернов и отклонений в логах	Не требует сигнатур, эффективен против Zero-Day	Высокая вычислительная нагрузка, сложность настройки	Анализ логов веб-серверов, выявление неизвестных атак
LSTM	Анализ временных зависимостей и последовательностей событий	Учитывает контекст, эффективен для DDoS и многоступенчатых атак	Требует больших объемов данных, сложность обучения	Выявление ботнет-активности, анализ последовательности запросов
Анализ аномалий (общий)	Выявление отклонений от нормального поведения	Способен обнаруживать новые и неизвестные угрозы	Возможны ложные срабатывания, требует корректной настройки порогов	Обнаружение Zero-Day, сложных многоступенчатых сценариев эксплуатации
Интеграция с SIEM/SOAR	Автоматизация реагирования и снижение нагрузки на SOC	Сокращение времени анализа, проактивная защита	Требует ресурсов и квалифицированных специалистов	Автоматическая блокировка IP, изоляция узлов, фильтрация подозрительных процессов

Сравнение AI-подходов с традиционными методами по метрикам Precision, Recall, F1-score. Эффективность систем защиты веб-приложений традиционно оценивается с помощью метрик Precision, Recall и F1-score, которые позволяют объективно сравнить различные подходы. Эти показатели отражают способность системы правильно классифицировать события, минимизировать ложные срабатывания и выявлять реальные угрозы.

Традиционные методы защиты – такие как WAF и IDS/IPS – демонстрируют высокую точность (Precision) при работе с известными атаками. Сигнатурные правила позволяют эффективно блокировать SQL-инъекции, XSS и другие распространённые угрозы. Однако их Recall (полнота) остаётся низким, так как они не способны обнаруживать новые или неизвестные паттерны атак. В результате многие Zero-Day и сложные многоступенчатые сценарии эксплуатации остаются незамеченными. F1-score, как гармоническое среднее Precision и Recall, показывает ограниченную сбалансированность: высокая точность компенсируется низкой полнотой, что снижает общую эффективность.

AI-подходы обеспечивают более высокий уровень полноты (Recall), так как алгоритмы машинного обучения и анализа аномалий способны выявлять отклонения от нормального поведения даже без заранее известных сигнатур. Например, AutoEncoder фиксирует ошибки восстановления при появлении аномальных запросов, а LSTM выявляет подозрительные временные зависимости в трафике. Это позволяет обнаруживать Zero-Day и ботнет-атаки. При этом Precision у AI-моделей может быть ниже, чем у традиционных систем, из-за большего числа ложных срабатываний. Однако использование ансамблевых методов, таких как Random Forest, помогает повысить точность классификации.

F1-score для AI-подходов обычно выше, чем у традиционных методов, так как они обеспечивают более сбалансированное соотношение Precision и Recall. В практических кейсах интеграция AI-модулей в SOC показывает рост F1-score на 20-30% по сравнению с классическими средствами защиты. Это подтверждает, что интеллектуальные системы лучше справляются с динамично меняющейся средой угроз.

Таким образом, традиционные методы остаются важной первой линией обороны, но их эффективность ограничена рамками сигнатурного подхода. AI-модели обеспечивают более высокий уровень адаптивности и проактивной защиты, а их интеграция в гибридные архитектуры позволяет достичь оптимального баланса между точностью и полнотой [5-8].

Таблица 2 – Сравнение AI-подходов с традиционными методами по метрикам Precision, Recall, F1-score

Подход	Precision (точность)	Recall (полнота)	F1-score (сбалансированность)	Особенности
Традиционные методы (WAF, IDS/IPS)	Высокая при известных атаках (SQLi, XSS)	Низкая – пропускают Zero-Day и сложные сценарии	Средний – высокая точность компенсируется низкой полнотой	Эффективны против известных угроз, требуют обновления сигнатур, страдают от ложных срабатываний
AI-подходы (AutoEncoder, LSTM, Random Forest, Isolation Forest)	Средняя – возможны ложные срабатывания, но улучшается ансамблевыми методами	Высокая – выявляют новые и неизвестные атаки	Высокий – более сбалансированное соотношение Precision и Recall	Обнаруживают Zero-Day, ботнет-активность, аномалии. Интеграция с SIEM/SOAR повышает эффективность

5. Интеграция AI в SOC-архитектуру.

Современные центры мониторинга безопасности (Security Operations Center / SOC) сталкиваются с огромным объёмом событий, поступающих от различных источников: сетевых устройств, серверов, приложений и облачных сервисов. Традиционные методы анализа часто оказываются недостаточными для своевременного выявления сложных атак, особенно Zero-Day и многоступенчатых сценариев эксплуатации. В этой связи интеграция искусственного интеллекта в архитектуру SOC становится ключевым направлением развития киберзащиты.

Системы SIEM (Security Information and Event Management) обеспечивают сбор, корреляцию и анализ событий безопасности. Однако их эффективность напрямую зависит от правил корреляции, которые требуют постоянного обновления. Интеграция AI-модулей позволяет автоматизировать выявление аномалий, анализировать большие объёмы логов и находить скрытые паттерны атак.

Системы SOAR (Security Orchestration, Automation and Response) ориентированы на автоматизацию реагирования. Внедрение AI в SOAR позволяет не только ускорить обработку инцидентов, но и принимать более точные решения на основе анализа поведения. Например, алгоритмы машинного обучения могут автоматически классифицировать инциденты по уровню критичности и инициировать соответствующие сценарии реагирования.

Автоматизация реагирования на инциденты. AI значительно повышает уровень автоматизации SOC. Вместо ручного анализа тысяч событий в день, интеллектуальные модели способны фильтровать шум, выделять действительно опасные активности и инициировать автоматические действия: блокировку IP-адресов, изоляцию узлов, приостановку подозрительных процессов. Это сокращает время реакции с часов до минут и снижает нагрузку на SOC-аналитиков.

Примеры практической реализации. На практике интеграция AI в SOC уже демонстрирует эффективность. В финансовых организациях AI-модули используются для анализа транзакций и выявления подозрительных действий в реальном времени. В телеком-компаниях AI помогает обнаруживать ботнет-трафик и предотвращать DDoS-атаки. В государственных структурах интеллектуальные системы интегрируются с SIEM для выявления аномалий в логах веб-порталов и критической инфраструктуры.

Таким образом, AI становится неотъемлемой частью SOC-архитектуры, обеспечивая проактивную защиту и автоматизацию реагирования. Гибридная модель, где SIEM и SOAR дополняются интеллектуальными алгоритмами, формирует основу для устойчивой киберзащиты в условиях 2025 года [9-10].

6. Обсуждение.

Интерпретация результатов анализа. Сравнение традиционных методов защиты веб-приложений с AI-подходами показывает, что интеллектуальные алгоритмы обеспечивают более высокую полноту (Recall) при выявлении атак, включая Zero-Day и сложные многоступенчатые сценарии. При этом точность (Precision) традиционных систем выше для известных угроз, но они часто пропускают новые паттерны. Итоговый F1-score у AI-моделей демонстрирует более сбалансированное соотношение, что подтверждает их практическую ценность в условиях динамично меняющейся среды угроз.

Ограничения и вызовы внедрения AI. Несмотря на преимущества, интеграция AI в SOC сталкивается с рядом проблем. Во-первых, обучение моделей требует больших объёмов качественных данных, что не всегда доступно. Во-вторых, существует риск ложных срабатываний, особенно при недостаточной настройке алгоритмов. В-третьих, внедрение AI требует значительных вычислительных ресурсов и квалифицированных специалистов, что увеличивает затраты. Дополнительным вызовом является необходимость объяснимости решений (Explainable AI), чтобы аналитики могли доверять результатам.

Этические и правовые аспекты. Применение AI в киберзащите связано с вопросами конфиденциальности и правомерности обработки данных. Алгоритмы должны соответствовать требованиям законодательства о защите персональной информации и не нарушать права пользователей. Этический вызов заключается в том, что автоматизированные системы могут принимать решения о блокировке или ограничении доступа без участия человека, что требует прозрачности и контроля. В перспективе развитие AI в киберзащите должно сочетать техническую эффективность с соблюдением правовых и этических норм.

Заключение.

Проведённый анализ показал, что современные веб-атаки в 2025 году становятся всё более разнообразными и сложными. Классические угрозы, такие как SQL-инъекции и XSS, сохраняют актуальность, но всё чаще дополняются Zero-Day уязвимостями, ботнет-атаками и многоступенчатыми сценариями эксплуатации. Традиционные методы защиты (WAF, IDS/IPS) обеспечивают базовый уровень безопасности, однако их эффективность ограничена сигнатурным подходом. Интеллектуальные алгоритмы машинного обучения и анализа аномалий демонстрируют более высокую полноту выявления угроз и позволяют обнаруживать новые паттерны атак.

Результаты обзора подтверждают необходимость интеграции AI-модулей в SOC-архитектуру. Использование AutoEncoder, LSTM, Random Forest и Isolation Forest позволяет повысить F1-score систем защиты и сократить время реагирования на инциденты. Практическая ценность заключается в возможности автоматизировать анализ логов,

фильтровать шум и выявлять скрытые угрозы, что снижает нагрузку на SOC-аналитиков и повышает устойчивость корпоративных систем.

Будущее киберзащиты связано с развитием гибридных архитектур, где традиционные средства и AI-подходы работают совместно. Перспективными направлениями являются разработка Explainable AI для повышения доверия специалистов, применение генеративных моделей для прогнозирования новых атак, а также исследование этических и правовых аспектов автоматизации реагирования. В условиях растущей сложности угроз именно комплексные интеллектуальные системы способны обеспечить проактивную защиту веб-приложений и критической инфраструктуры.

Список литературы:

1. Alansary, S. A., Ayyad, S. M., Talaat, F. M., & Saafan, M. M. (2025). Emerging AI threats in cybercrime: A review of zero-day attacks via machine, deep, and federated learning. *Knowledge and Information Systems*, 67, 10951–10987. <https://doi.org/10.1007/s10115-025-02556-6>
2. Negrão de Andrade, T., Gobbi, M. C., Carvalho da Silva, T., Holouka, G., Leopoldino, I. M., Barbosa, L. A., ... Bueno de Moraes, F. R. (2025). Zero-Day vulnerabilities and the clandestine exploits market: A hermeneutic and critical approach. *IOSR Journal of Humanities and Social Science*, 30(1), 11–20. <https://www.iosrjournals.org/iosr-jhss/papers/Vol.30-Issue1/Ser-7/B3001071120.pdf>
3. MazeBolt. (2025). 2025 DDoS Trends Report. MazeBolt Research. https://mazebolt.com/wp-content/uploads/2025/05/MazeBolt_2025-DDoS-Trends_RP504.pdf
4. Holthouse, R., Owens, S., & Bhunia, S. (2025). The 23andMe data breach: Analyzing credential stuffing attacks, security vulnerabilities, and mitigation strategies. *arXiv preprint arXiv:2502.04303*. <https://arxiv.org/pdf/2502.04303>
5. Mohamed, N. (2025). Artificial intelligence and machine learning in cybersecurity: A deep dive into state-of-the-art techniques and future paradigms. *Knowledge and Information Systems*, 67, 6969–7055. <https://doi.org/10.1007/s10115-025-02429-y>
6. Radanliev, P., Santos, O., & Ani, U. D. (2025). Generative AI cybersecurity and resilience. *Frontiers in Artificial Intelligence*, 8, Article 1568360. <https://doi.org/10.3389/frai.2025.1568360>
7. KELA. (2025). AI Threat Report 2025. KELA Research. <https://info.kela.com/hubfs/Reports/KELA%20Report%20-%202025%20AI%20Threat%20Report.pdf>
8. Reis, M. J. C. S. (2025). AI-driven anomaly detection for securing IoT devices in 5G-enabled smart cities. *Electronics*, 14(12), 2492. <https://doi.org/10.3390/electronics14122492>
9. Kohgadai, A. (2025). AI SOC architecture: Integrating with SIEM, SOAR, case management and more. Prophet Security. <https://www.prophetsecurity.ai/blog/ai-soc-architecture-integrating-with-siem-soar-case-management-and-more>
10. Owen-Jackson, C. (2025). Navigating the ethics of AI in cybersecurity. IBM Security Insights. <https://www.ibm.com/think/insights/navigating-ethics-ai-cybersecurity>

Physical and Mathematical Sciences

КОГНИТИВТІ КОНФЛИКТ ӘДІСІНІҢ МӘНІ ЖӘНЕ ОНЫҢ ФИЗИКА САБАҒЫНДАҒЫ РӨЛІ

СУЛТАНОВА ИНАРА АСКАРОВНА

І. Жансүгіров атындағы Жетісу университеті, 1-курс PhD докторанты, Қазақстан, Талдықорған қаласы

КАЗАХБАЕВА ДАНАКУЛЬ МУКАЖАНОВНА

І. Жансүгіров атындағы Жетісу университеті, педагогика ғылымдарының докторы, қауымдастырылған профессор (доцент), Қазақстан, Талдықорған қаласы

Аңдатпа

Қазіргі білім беру жүйесінде оқушылардың жоғары деңгейлі ойлау дағдыларын дамыту физика пәнін оқытудың негізгі міндеттерінің бірі болып табылады. Алайда физиканы оқыту тәжірибесінде оқушылардың тұрақты қате түсініктері күрделі ұғымдарды терең меңгеруге елеулі кедергі келтіреді. Бұл мақалада когнитивті конфликт әдісінің теориялық негіздері, оның физика сабағындағы рөлі және электрлік потенциал, зарядтың электр өрісіндегі потенциалдық энергиясы, электр энергиясы көзінің ЭҚК мен ішкі кедергісі тақырыптарын оқытудағы әдістемелік мүмкіндіктері қарастырылады. Сонымен қатар, когнитивті конфликт әдісіне арналған шетелдік зерттеулерге қысқаша шолу жасалып, оның жоғары деңгейлі ойлау дағдыларын дамытудағы әлеуеті Блум таксономиясы тұрғысынан талданады.

Түйін сөздер: когнитивті конфликт, физиканы оқыту, қате түсініктер, жоғары деңгейлі ойлау дағдылары.

Кіріспе

Физика пәні оқушылардың ғылыми дүниетанымын қалыптастыруда, табиғат құбылыстарын түсіндіруде және логикалық ойлауын дамытуда жетекші орын алады. Бұл пән арқылы оқушылар себеп–салдарлық байланыстарды анықтауға, модельдер құруға, құбылыстарды талдауға және ғылыми негізделген қорытынды жасауға үйренеді. Алайда мектеп тәжірибесі көрсеткендей, физиканы оқыту барысында оқушылардың елеулі бөлігі физикалық ұғымдарды терең түсінбей, формулаларды механикалық түрде қолданумен шектеледі.

Көптеген жағдайларда оқушылар физикалық заңдылықтарды күнделікті өмірлік жағдайларға сүйене отырып түсіндіреді. Мұндай интуитивті пайымдаулар ғылыми түсініктермен сәйкес келмей, тұрақты қате түсініктердің (misconceptions) қалыптасуына әкеледі. Бұл қате түсініктер жаңа білімді қабылдауға кедергі жасап қана қоймай, оқушылардың талдау, дәлелдеу және бағалау сияқты жоғары деңгейлі ойлау дағдыларының дамуын тежейді.

Соңғы жылдары білім беру саласындағы зерттеулер оқушылардың қате түсініктерін жай ғана түзету жеткіліксіз екенін, керісінше, олардың бұрынғы білім құрылымын қайта қарауға мәжбүр ететін педагогикалық жағдайлар қажет екенін көрсетіп отыр. Осы тұрғыдан алғанда, когнитивті конфликт әдісі оқушыларды терең ойлануға жетелейтін тиімді

тәсілдердің бірі ретінде қарастырылады. Бұл әдіс оқушының бұрынғы түсінігі мен жаңа ғылыми ақпарат арасындағы қайшылықты саналы түрде тудыруға негізделеді.

Когнитивті конфликт жағдайында оқушы өз болжамының шындыққа сәйкес келмейтінін байқап, оны қайта қарауға мәжбүр болады. Мұндай танымдық қайшылық оқушылардың пассивті қабылдаушы емес, белсенді зерттеуші рөліне көшуіне мүмкіндік береді. Нәтижесінде оқушы тек жаңа ақпаратты меңгеріп қана қоймай, оны талдайды, салыстырады, дәлелдейді және жаңа жағдайда қолдануға тырысады.

Физика пәнінің мазмұны когнитивті конфликт әдісін қолдануға ерекше қолайлы, себебі көптеген физикалық құбылыстар (инерция, электр өрісі, гравитациялық әсер, энергияның сақталуы және т.б.) оқушылардың күнделікті тәжірибесіне қайшы келеді. Осы себепті физика сабағында когнитивті конфликт әдісін мақсатты түрде қолдану оқушылардың қате түсініктерін анықтауға ғана емес, сонымен қатар олардың жоғары деңгейлі ойлау дағдыларын дамытуға да мүмкіндік береді.

Бұл мақалада когнитивті конфликт әдісінің теориялық мәні, оның физика сабағындағы рөлі және когнитивті-конфликт әдісіне арналған отандық және шетелдік зерттеулерге шолу жасалынды.

Когнитивті конфликт әдісінің теориялық негіздері

Когнитивті конфликт оқушылардың білімді пассивті қабылдауы емес, оны белсенді түрде қайта құру үдерісінде туындайтын танымдық құбылыс ретінде қарастырылады. Жаңа оқу материалы оқушының бұрын қалыптасқан түсініктерімен сәйкес келмеген жағдайда, олардың арасында танымдық қайшылық пайда болады. Бұл қайшылық оқушыны ойлануға, салыстыруға және жаңа ғылыми түсінік қалыптастыруға жетелейді.

Когнитивті конфликт оқушының танымдық құрылымында уақытша тұрақсыздық (дисбаланс) қалыптастырады. Бұл жағдай оқушыны өз ойлау жүйесін қайта қарауға, жаңа түсініктерді іздеуге және білімін қайта ұйымдастыруға итермелейді. Демек, когнитивті конфликт оқу үдерісіндегі кездейсоқ құбылыс емес, керісінше, тұжырымдамалық өзгерісті іске қосатын маңызды психологиялық-педагогикалық механизм болып табылады.

Бұл ұғымның теориялық негізі ең алдымен Жан Пиаже еңбектерінде көрініс тапқан. Ғалым когнитивті дамуды тепе-теңдік (equilibration) үдерісі арқылы түсіндіреді. Оның пайымдауынша, егер жаңа ақпарат оқушының бұрын қалыптасқан түсініктеріне сәйкес келсе, ол білімді еш қиындықсыз қабылдайды, ал жаңа ақпарат бұрынғы түсініктермен үйлеспеген жағдайда, оқушы өз ойлау жүйесін қайта қарауға және өзгертуге мәжбүр болады. Дәл осы сәтте пайда болатын танымдық қайшылық оқушының бұрынғы түсініктерін өзгерту үдерісін іске қосады. Оқушы бұрынғы түсінігінің жеткіліксіз екенін сезініп, жаңа, неғұрлым ғылыми негізделген ұғым қалыптастыруға ұмтылады.

Ал Лев Выготский когнитивті дамуды әлеуметтік өзара әрекет пен тілдік коммуникация арқылы түсіндіреді [1]. Ол білімнің жеке адамның ішкі танымдық құрылымында емес, алдымен әлеуметтік ортада қалыптасатынын атап өткен. Осы тұрғыдан алғанда, когнитивті конфликт тек жеке оқушының ішкі ойлау қайшылығы ретінде ғана емес, сонымен қатар диалог, пікірталас және бірлескен әрекет барысында туындайтын әлеуметтік-танымдық құбылыс ретінде қарастырылады. Мұғалім мен оқушы немесе оқушылар арасындағы ғылыми аргументация когнитивті конфликттің тереңдеуіне және оның нәтижелі шешілуіне ықпал етеді.

Кейінгі зерттеулерде когнитивті конфликт концептуалды өзгеріс теориясының негізгі элементі ретінде қарастырылады. Бұл теорияға сәйкес, оқушы жаңа ғылыми түсінікті қабылдауы үшін оның бұрынғы түсінігі:

- қанағаттанарлықсыз екенін сезінуі;
- жаңа түсініктің түсінікті әрі логикалық болуы;
- жаңа түсініктің қолдануға тиімді болуы қажет.

Аталған шарттардың алғашқысы тікелей когнитивті конфликт арқылы іске асады. Егер оқушы өз түсінігінің қате немесе жеткіліксіз екенін сезінбесе, онда терең оқыту мен концептуалды өзгеріс жүзеге аспайды.

Жоғарыда аталған шарттар когнитивті конфликт арқылы іске асатын концептуалды өзгеріс үдерісінің кезеңдік сипатын көрсетеді. Бұл үдеріс оқушының бастапқы түсінігінен бастап жаңа ғылыми ұғымды саналы түрде қабылдауына дейінгі танымдық өзгерістерді қамтиды. Аталған үдерістің негізгі кезеңдері мен олардың оқушы мен мұғалім әрекеттері тұрғысынан көрінісі төмендегі 1-кестеде жүйеленіп берілген.

1-кесте

Когнитивті конфликт арқылы тұжырымдамалық өзгеріс үдерісінің кезеңдері

Кезең	Оқушы әрекеті	Мұғалім әрекеті	Жоғары деңгейлі ойлау (Блум таксономиясы бойынша)
Бастапқы түсінік	Потенциалды зарядтың қасиеті деп ойлайды	Қате түсінікті анықтайтын сұрақ қояды	Білу
Болжам жасау	«Потенциал бірдей → энергия бірдей» деп болжайды	Болжамды ашық айтуға ынталандырады	Түсіну
Қарама-қайшы нәтиже	Есеп/тәжірибе нәтижесімен келіспейді	Тәжірибе немесе симуляция көрсетеді	Қолдану
Когнитивті конфликт	«Неге сәйкес келмеді?» деп ойлайды	Қайшылықты саналы түрде күшейтеді	Талдау
Талдау, дәлелдеу	Себептерін іздейді, пікірталасқа қатысады	Бағыттаушы сұрақтар қояды	Жинақтау
Жаңа түсінік	Потенциал – өріс қасиеті екенін түсінеді	Ғылыми ұғымды нақтылайды	Бағалау
Рефлексия	Жаңа жағдайда қолданады	Қорытынды жасатады	Метатаным

Кестеде көрсетілген кезеңдер когнитивті конфликттің оқушының қате түсінігін анықтаудан бастап, оны ғылыми тұрғыда қайта құруға дейінгі үдерісті жүйелі түрде сипаттайды. Бұл кезеңдер бірізді жүзеге асқанда ғана оқушының жаңа білімді формалды емес, саналы түрде меңгеруіне және жоғары деңгейлі ойлау дағдыларының қалыптасуына мүмкіндік туады.

Физиканы оқыту контекстінде когнитивті конфликттің маңызы ерекше. Себебі физикалық ұғымдардың басым бөлігі оқушылардың күнделікті тәжірибесіне негізделген интуитивті түсініктермен сәйкес келмейді. Осыған байланысты когнитивті конфликт оқушылардың ғылыми және тұрмыстық түсініктері арасындағы айырмашылықты айқындап, олардың ғылыми ойлауын қалыптастыруға мүмкіндік береді.

Осылайша, когнитивті конфликт әдісінің теориялық негіздері оны физика сабағында жүйелі және мақсатты түрде қолданудың ғылыми-әдіснамалық алғышарттарын айқындайды. Бұл әдіс оқушылардың білімді механикалық түрде меңгеруінен гөрі, оны саналы түрде қайта құруына және жоғары деңгейлі ойлау дағдыларын дамытуына жағдай жасайды.

Физика сабағындағы когнитивті конфликт әдісінің рөлі

Физика сабағында когнитивті конфликт әдісін қолдану, әсіресе электр құбылыстарын оқыту барысында ерекше нәтижелі болып табылады. Себебі электр өрісі, электрлік потенциал, зарядтың потенциалдық энергиясы, электр энергиясы көзінің ЭҚК және ішкі кедергісі сияқты ұғымдар оқушылардың күнделікті интуитивті түсініктеріне тікелей қайшы келеді. Бұл ұғымдар көбіне формула деңгейінде меңгеріліп, олардың физикалық мағынасы жеткілікті деңгейде ашылмайды.

10-сынып оқушыларында жиі кездесетін қате түсініктердің бірі – *электрлік потенциалды зарядтың қасиеті ретінде қабылдау* немесе *потенциал мен потенциалдық энергияны тең ұғым деп санау*. Көптеген оқушылар «потенциал неге теріс болуы мүмкін?» деген сұраққа интуитивті түрде «энергия жоқ болғандықтан» немесе «заряд теріс болғандықтан» деп жауап береді.

Когнитивті конфликт бұл жағдайда келесі жолмен ұйымдастырылады: оқушыларға электр өрісінде бірдей потенциалда орналасқан, бірақ әртүрлі зарядтарға ие денелер ұсынылады. Оқушылардан олардың потенциалдық энергияларын салыстыру сұралады. Көп жағдайда оқушылар «потенциал бірдей болса, энергия да бірдей» деген қате қорытынды жасайды. Алайда есептеу немесе талдау барысында потенциалдық энергияның зарядқа тәуелді екені анықталады.

Осы сәйкессіздік оқушыларда когнитивті конфликт тудырып, оларды *потенциал – өрістің қасиеті*, ал *потенциалдық энергия – заряд пен өрістің өзара әрекеттесуінің нәтижесі* екенін қайта ойластыруға мәжбүр етеді. Бұл үдеріс барысында оқушылар тек формуланы қолданбай, ұғымдардың физикалық мағынасын талдайды.

Электр тізбегін оқытуда да тұрақты қате түсініктер жиі кездеседі. Оқушылардың көпшілігі ЭҚК мен қысқыштардағы кернеуді бір ұғым деп қабылдайды немесе «батарея әрқашан өз ЭҚК-сына тең кернеу береді» деп ойлайды. Ішкі кедергінің рөлі көбіне ескерілмейді немесе тек формула түрінде ғана қарастырылады.

Когнитивті конфликт мұнда келесі жағдайда пайда болады: оқушылардан ашық тізбекте және жүктеме қосылған кездегі вольтметр көрсеткішін болжау сұралады. Көптеген оқушылар екі жағдайда да кернеу бірдей болады деп күтеді. Алайда тәжірибе нәтижесі немесе симуляция кернеудің азаятындығын көрсетеді.

ЭҚК және ішкі кедергі тақырыптары бойынша когнитивті конфликттің қалай іске асатыны төмендегі 2-кестеде көрсетілген.

2-кесте

ЭҚК және ішкі кедергі тақырыптарындағы қате түсініктерді
когнитивті конфликт арқылы қайта құру

Қате түсінік	Когнитивті конфликт	Қайта құрылған түсінік
ЭҚК = қысқыш кернеуі	Жүктеме қосқанда кернеудің азаюы	ЭҚК – бөгде күштердің жұмысы
Ішкі кедергі маңызды емес	Энергияның бір бөлігі ішкі тізбекте жұмсалады	Ішкі кедергі кернеу жоғалтуға әкеледі
Кернеу әрқашан тұрақты	Ток артқанда кернеу азаяды	$V=E-Ir$ физикалық мағынасы

Кестеде келтірілген мысалдар когнитивті конфликттің оқушылардың бастапқы қате түсініктерін қайта қарауға итермелейтінін көрсетеді. Жүктеме қосылған кездегі кернеудің өзгеруі сияқты тәжірибелік жағдайлар оқушыларды себеп-салдарлық байланыстарды талдауға мәжбүр етіп, ЭҚК мен ішкі кедергінің физикалық мағынасын терең түсінуге

мүмкіндік береді. Нәтижесінде оқушылар электр тізбегіндегі кернеу мен энергияның өзгеруін формула деңгейінде ғана емес, ғылыми тұрғыда негіздеп түсіндіре алады.

Осы алдын ала қалыптасқан түсінік пен нәтиже арасындағы қайшылық оқушыларды кернеудің төмендеу себебін талдауға, ішкі кедергінің физикалық мағынасын және энергияның ішкі тізбекте жұмсалатынын түсінуге жетелейді. Бұл жерде когнитивті конфликт оқушылардың себеп-салдарлық ойлауын дамытудың тиімді құралына айналады.

Когнитивті конфликт әдісі Блум таксономиясының жоғары деңгейлі ойлау дағдылармен тікелей байланысты.

➤ **Талдау:**

Оқушылар өз болжамы мен тәжірибе нәтижесін салыстырып, айырмашылықтың себебін анықтайды (мысалы, потенциал мен энергияны ажырату).

➤ **Жинақтау:**

Жаңа жағдайға сәйкес модель немесе түсіндіру құрастырады, мысалы, ішкі кедергісі бар тізбек үшін энергия балансының кестесін ұсынады.

➤ **Бағалау:**

Әртүрлі түсіндірмелерді салыстырып, қайсысы ғылыми тұрғыда дұрыс екенін дәлелдейді (ЭҚК пен кернеудің айырмашылығын бағалау).

Осылайша, когнитивті конфликт оқушыларды тек есте сақтау немесе формуланы қолдану деңгейінде қалдырмай, оларды жоғары деңгейлі ойлау әрекеттеріне тартады.

Когнитивті конфликт кезеңдерінің Блум таксономиясымен өзара сәйкестігі төмендегі 3-кестеде көрсетілген.

3-кесте

Когнитивті конфликт кезеңдері мен Блум таксономиясының деңгейлерінің сәйкестігі

Когнитивті конфликт кезеңі	Блум таксономиясының танымдық деңгейі	Нақты көрінісі
Болжам жасау	Түсіну	Өз интуициясын айту
Қайшылықты байқау	Талдау	Себеп-салдарды іздеу
Дәлелдеу	Бағалау	Ғылыми аргумент келтіру
Қайта құру	Жасау	Жаңа модель/түсінік ұсыну

Кестеде көрсетілгендей, когнитивті конфликт үдерісі оқушыларды біртіндеп түсіну деңгейінен талдау, бағалау және жаңа білім құрастыру деңгейіне дейін жетелейді. Бұл үдеріс барысында оқушылар пассивті білім алушы рөлінен белсенді ойлаушы және дәлелдеуші субъектке айналады. Осылайша, когнитивті конфликт әдісі физика сабағында жоғары деңгейлі ойлау дағдыларын қалыптастырудың тиімді педагогикалық тетігі ретінде қарастырылады.

Когнитивті конфликт әдісі бойынша зерттеулерге шолу

Когнитивті конфликт әдісінің теориялық және әдістемелік негіздері шетелдік педагогикалық және психологиялық зерттеулерде XX ғасырдың екінші жартысынан бастап жүйелі түрде қарастырыла бастады. Бұл әдіс, ең алдымен, оқушылардың қате түсініктерін (misconceptions) анықтау және оларды ғылыми тұрғыда қайта құру үдерісімен байланыстырылады.

Когнитивті конфликт ұғымының психологиялық негізі Жан Пиаже еңбектерінде (1950, 1977) сипатталған когнитивтік тепе-теңдік (equilibration) теориясына сүйенеді. Пиаже когнитивті дамуды ассимиляция мен аккомодация үдерістері арқылы түсіндіре отырып, жаңа білім бұрынғы түсініктермен сәйкес келмеген жағдайда оқушыда когнитивті дисбаланс

пайда болатынын көрсеткен [2]. Дәл осы дисбаланс когнитивті конфликттің психологиялық алғышарты болып табылады.

Ғылымды оқытудағы тұжырымдамалық өзгеріс теориясын педагогикалық тұрғыда дамытқан зерттеушілердің бірі – George J. Posner. Posner және оның әріптестері (1982) ұсынған концептуалды өзгеріс моделінде оқушының жаңа ғылыми түсінікті қабылдауы үшін оның бұрынғы түсінігі қанағаттанарлықсыз екенін сезінуі қажет екені көрсетіледі [3]. Бұл шарт тікелей когнитивті конфликт арқылы жүзеге асады. Аталған модель кейінгі физика және жаратылыстану пәндерін оқытудағы көптеген зерттеулерге теориялық негіз болды.

Физиканы оқыту саласындағы когнитивті конфликт мәселесін жүйелі зерттеген ғалымдардың бірі – Rosalind Driver. Driver және әріптестері (1985, 1994) оқушылардың ғылыми емес түсініктері тұрақты әрі жүйелі сипатқа ие болатынын дәлелдеп, оларды жою үшін тек ақпарат беру жеткіліксіз екенін көрсетті. Авторлар когнитивті конфликт тудыратын проблемалық жағдайлар оқушыларды өз түсініктерін қайта қарауға мәжбүр ететінін және концептуалды өзгеріске алып келетінін тұжырымдайды [4].

Когнитивті конфликт пен білім құрылымының қайта ұйымдасуын зерттеген маңызды еңбектердің бірі Stella Vosniadou тарапынан ұсынылған (1994, 2008). Vosniadou оқушылардың бастапқы түсініктері «фреймворк теориялар» түрінде қалыптасатынын және оларды өзгерту ұзақ әрі күрделі үдеріс екенін көрсетеді. Оның зерттеулерінде когнитивті конфликт оқушының осы танымдық құрылымдарын қайта құрудың негізгі механизмі ретінде түсіндіріледі [5].

Физикадағы нақты ұғымдарды (электр, күш, энергия, қозғалыс) оқытуға бағытталған зерттеулерде когнитивті конфликтке негізделген тәсілдердің тиімділігі бірнеше рет дәлелденген. Мысалы, Richard R. Hake (1998) интерактивті оқыту әдістері, соның ішінде когнитивті конфликт элементтері бар тапсырмалар дәстүрлі оқытумен салыстырғанда оқушылардың танымдық түсінуін айтарлықтай арттыратынын көрсеткен [6].

Сонымен қатар, Duit және Treagust (2003) жүргізген мета-зерттеулерде когнитивті конфликтке негізделген оқыту стратегиялары оқушылардың ғылыми аргументациясын, талдау қабілетін және ұзақ мерзімді есте сақтауын дамытуда тиімді екені атап өтіледі. Бұл зерттеулер когнитивті конфликттің тек тұжырымдамалық өзгеріске ғана емес, жоғары деңгейлі ойлау дағдыларының қалыптасуына да ықпал ететінін айқындайды [7].

Соңғы жылдардағы зерттеулерде когнитивті конфликт әдісі Блум таксономиясының жоғары деңгейлерімен (талдау, бағалау, жасау) тікелей байланыстырылады. Мәселен, Zohar және Dori (2003) когнитивті қайшылыққа негізделген тапсырмалар оқушылардың метатанымдық ойлауын және ғылыми дәлелдеу мәдениетін қалыптастыруда маңызды рөл атқаратынын анықтаған [8].

Отандық педагогикалық зерттеулерде когнитивті конфликт ұғымы көбіне проблемалық оқыту, зерттеушілік тапсырмалар және тәжірибелік жұмыстар контекстінде қарастырылады. Алайда шетелдік еңбектермен салыстырғанда, бұл әдісті физика сабағында жүйелі, модельдік тұрғыда қолдану мәселесі әлі де тереңдетілген зерттеуді қажет етеді.

Қорытынды

Когнитивті конфликт әдісі физика сабағында оқушылардың қате түсініктерін анықтауға және оларды ғылыми тұрғыда қайта құруға мүмкіндік беретін тиімді педагогикалық құрал ретінде қарастырылады. Жасалған теориялық және зерттеушілік шолу бұл әдістің білімді оқушының белсенді танымдық әрекеті арқылы қалыптастыруға негізделгенін және оқушылардың танымдық белсенділігін арттыруда маңызды рөл атқаратынын көрсетті. Когнитивті конфликт оқушыларды дайын білімді қабылдаушыдан белсенді ойлаушы, талдаушы және дәлелдеуші субъект деңгейіне көтереді.

Шетелдік зерттеулерге жасалған талдау (Жан Пиаже, 1950; George J. Posner et al., 1982; Rosalind Driver, 1994; Stella Vosniadou, 2008) когнитивті конфликттің концептуалды өзгерістің

негізгі механизмі екенін дәлелдейді [2,3,4]. Аталған еңбектерде оқушының бұрынғы түсінігінің қанағаттанарлықсыз екенін сезінуі жаңа ғылыми ұғымды қабылдаудың алғышарты ретінде қарастырылады. Бұл жағдай физика пәніндегі көптеген күрделі ұғымдарды (электрлік потенциал, энергия, ЭҚК, ішкі кедергі) меңгеруде ерекше маңызды.

Сонымен қатар, когнитивті конфликт әдісінің Блум таксономиясының жоғары деңгейлі ойлау дағдыларымен (талдау, бағалау, жасау) тікелей байланысы анықталды. Когнитивті конфликт жағдайында оқушылар тек ақпаратты есте сақтаумен шектелмей, болжам жасап, тәжірибе нәтижесін талдайды, әртүрлі түсіндірмелерді салыстырып бағалайды және жаңа түсінік құрастырады. Бұл үдеріс оқушылардың ғылыми аргументация мәдениетін және метатанымдық қабілеттерін дамытуға ықпал етеді, мұны бірқатар зерттеулер де растайды (Richard R. Hake, 1998; Duit & Treagust, 2003) [5,6,7,8].

Жасалған теориялық талдау когнитивті конфликт әдісін физика пәнін оқытуда жүйелі және мақсатты түрде қолданудың маңыздылығын көрсетеді. Бұл әдіс қате түсініктерді жоюдың эпизодтық құралы ғана емес, оқушылардың ғылыми ойлауын қалыптастыруға бағытталған тұтас әдістемелік тәсіл ретінде қарастырылуы тиіс. Әсіресе электр құбылыстарын оқытуда когнитивті конфликтке негізделген тапсырмалар мен оқу жағдаяттары оқушылардың ұғымдарды саналы меңгеруіне мүмкіндік береді.

Осы мақалада ұсынылған тұжырымдар теориялық-шолу сипатында болғандықтан, алдағы зерттеулерде когнитивті конфликт әдісінің тиімділігін эксперименттік жолмен тексеру жоспарлануда. Болашақта бұл әдістің оқушылардың жоғары деңгейлі ойлау дағдыларына әсерін сандық және сапалық деректер негізінде дәлелдеу, сондай-ақ когнитивті конфликтке негізделген тапсырмалар жүйесін әзірлеу көзделеді.

Пайдаланылған әдебиеттер:

1. Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press. (Ескерту: «Thought and Language» еңбегінің халықаралық академиялық нұсқасы осы басылым ретінде жиі қолданылады.)
2. Piaget, J. (1950). *The psychology of intelligence*. London, UK: Routledge & Kegan Paul.
3. Posner, G. J., Strike, K. A., Hewson, P. W., & Gertzog, W. A. (1982). Accommodation of a scientific conception: Toward a theory of conceptual change. *Science Education*, 66(2), 211–227. <https://doi.org/10.1002/sce.3730660207>
4. Driver, R., Asoko, H., Leach, J., Mortimer, E., & Scott, P. (1994). Constructing scientific knowledge in the classroom. *Educational Researcher*, 23(7), 5–12. <https://doi.org/10.3102/0013189X023007005>
5. Vosniadou, S. (2008). *International handbook of research on conceptual change*. New York, NY: Routledge.
6. Hake, R. R. (1998). Interactive-engagement versus traditional methods: A six-thousand-student survey of mechanics test data. *American Journal of Physics*, 66(1), 64–74. <https://doi.org/10.1119/1.18809>
7. Duit, R., & Treagust, D. F. (2003). Conceptual change: A powerful framework for improving science teaching and learning. *International Journal of Science Education*, 25(6), 671–688. <https://doi.org/10.1080/09500690305016>
8. Zohar, A., & Dori, Y. J. (2003). Higher order thinking skills and low-achieving students. *Journal of the Learning Sciences*, 12(2), 145–181. https://doi.org/10.1207/S15327809JLS1202_3

Legal Sciences

International Legal Regulation of Artificial Intelligence and Georgia

Nino Botchorishvili

Professor, Doctor of Law, Georgian International University (GIU)

Abstract

The automation of administrative processes and the use of artificial intelligence are transforming public governance mechanisms worldwide. In Georgia, as in the rapidly growing environment of digital governance, there is a need to legally determine how algorithmic administrative decisions that directly affect fundamental human rights should be regulated. Although the basic principles of administrative law- the rule of law, transparency, justification, fair administrative proceedings- already exist, the current legislation still fails to reflect the specifics of automated decisions, including the justification of an algorithmic administrative act, state control, the need for human involvement and appeal mechanisms.

Global trends, such as the EU AI Act and the increased use of automated credit, social and public service decisions, make us think about the need for changes in national legislation. Accordingly, the study is relevant both from a theoretical and practical point of view, it responds to the modern challenge of finding a balance between technological progress and the protection of human rights.

Keywords:

Automated decision; artificial intelligence; administrative law; legal mechanism.

Introduction

Purpose of the study

The purpose of the study is to develop a theoretical framework for the legal regulation of algorithmic administrative acts and identify ways to improve Georgian legislation. In this process, it is important to determine the legal nature of the algorithmic administrative act, analyze European and international standards, identify gaps in the current legal framework of Georgia, and develop a model of legal regulation for Georgia.

Research objectives

Taking into account the research objectives, the following tasks were set:

- Detailed analysis of the requirements of the EU AI Act, as well as examination of OECD and Council of Europe standards
- Identification of international best practices
- Analysis of the Constitution of Georgia
- Analysis of sectoral legislation
- Identification of legal problems and proposal of solutions

Practical significance

With regard to the practical significance of the research, it should be noted that in Georgia, the tax inspectorate already uses automated risk assessment systems, the customs service uses algorithmic declaration verification mechanisms, the social security system automatically processes citizens' applications, and various analytical tools have been implemented in police systems. Against this background, there are practically no systematic studies on the legal regulation

of algorithmic administration in the Georgian legal space, which complicates both the law-making process and the formation of judicial practice.

Chapter I. Legal Regulation of Algorithmic Administrative Acts at the International Level

In Georgia, which not only declares, but also constitutionally aspires to join the European Union, it is important to ensure full compliance with European norms and standards. It is in this context that the EU AI Act, which is the first comprehensive, legally binding regulation in the field of artificial intelligence across the European Union, is of particular importance. The EU AI Act is based on the fundamental principle that the development and use of artificial intelligence must comply with human rights, standards of administrative justice and transparency of public administration¹. It should also be noted that the use of algorithmic solutions in state governance is becoming inevitable in our country. If Georgia starts to take into account the requirements of the EU AI Act from an early stage, such as human supervision, risk assessment, transparency, data quality, this will create a safe and reliable basis for the digital transformation of administrative processes.

The EU AI Act specifies that AI systems should be classified according to risk, which determines how strictly they should be regulated. AI systems are divided into the following categories:

- Unacceptable risk- this category includes AI practices/systems that, according to the legislation, pose the greatest threat to a person, their rights or values, therefore the use of this type of AI is prohibited.
- High risk- this category includes AI systems that may have a significant impact in terms of health, safety, safe products, fundamental rights, public services or business regulations. The use of such systems is allowed, but it is subject to complex, previously defined and strict requirements.
- Limited risk - AI systems that do not pose a high risk, but may require transparency requirements. In this category, it is mandatory for the user to know that they are dealing with AI.
- Minimal risk- AI systems that pose virtually no risk to human rights and safety — therefore the EU AI Act does not impose special requirements. This includes, for example, the use of AI in quizzes, video games, spam filters, or other technical/detailed “minimum impact” applications.

Although the EU AI Act does not constitute a legally binding regulation for Georgia, Georgia signed the Council of Europe Framework Convention on Artificial Intelligence and Human Rights, Democracy and the Rule of Law on 5 September 2024. The Council of Europe Framework Convention on Artificial Intelligence and Human Rights, Democracy and the Rule of Law is the first international, legally binding treaty in this area, which aims to ensure that activities carried out within the life cycle of artificial intelligence systems are fully compatible with human rights, democracy and the rule of law, while at the same time promoting technological progress and innovation². The Council of Europe Framework Convention, although not an EU AI Act, includes the main principles protected by the EU AI Act. The text of the Framework Convention was developed by all member states of the Council of Europe. All observer states of the Council of Europe, including the United States of America, as well as the European Union, also participated

¹ EU AI Act: first regulation on artificial intelligence The use of artificial intelligence in the EU is regulated by the AI Act, the world's first comprehensive AI law. Published: 08-06-2023, Last updated: 19-02-2025. <https://www.europarl.europa.eu/topics/en/article/20230601STO93804/eu-ai-act-first-regulation-on-artificial-intelligence> (Last viewed 13.11.2025)

² Council of Europe Framework Convention on Artificial Intelligence and Human Rights, Democracy and the Rule of Law chrome. Georgia signed on 5 September 2024. <https://www.coe.int/en/web/artificial-intelligence/the-framework-convention-on-artificial-intelligence> (last accessed 13.11.2025)

in the working process. According to the Framework Convention, member states are obliged to respect fundamental principles such as human dignity and individual autonomy; equality and non-discrimination; Privacy and data protection; Transparency and oversight; Accountability and liability³.

EU legislation includes some provisions to address risks to workers, in particular by increasing the transparency of algorithms, such as in the case of the GDPR, the Directive on transparent and predictable working conditions and the Information and Consultation Directive⁴.

The EU and Council of Europe countries have regulated the use of artificial intelligence domestically, based on the EU AI Act and the Council of Europe Framework Convention on Artificial Intelligence and Human Rights, Democracy and the Rule of Law. Based on the content of the study, it is worth noting those countries, whether EU member or non-member, that have best practices in regulating algorithmic administrative acts.

In terms of legal control of algorithmic decisions, the Dutch model stands out, which is based on strengthening transparency and institutional oversight. The Dutch government has created an algorithm registry so that all government agencies can store information about their algorithms in one place. The registry is accessible to everyone and aims to ensure transparency about whether government algorithms comply⁵ with the rules. In addition, the Netherlands Data Protection Authority is defined as a coordinating supervisory authority responsible for the use of algorithms and artificial intelligence, which creates the legal prerequisites for the effective protection of fundamental rights in the context of algorithmic administrative acts.

The practice of Spain shows a different approach. The country has established a specialized Artificial Intelligence Supervisory Agency (AESIA), whose mandate includes the implementation of the EU AI Act and the legal control of AI systems⁶. In addition, collective agreements require that the use of algorithmic systems be subject to human control, transparency and security principles.

In France, regulation is partly carried out by general legal norms. The state-supported think tank LaborIA has developed guidelines for the implementation of artificial intelligence, which emphasize the importance of human involvement, information and professional training⁷. This approach is particularly important in cases where formal legislative regulation is still in the process of being developed.

Italy is considered one of the first countries in the EU to adopt a model for regulating AI through a separate, specific normative act⁸. In the context of algorithmic administrative acts, Italy's approach is notable in that it does not limit AI regulation to labor or data protection law, but seeks to create a horizontal, systemic legal framework that also covers administrative decisions. This

³ Council of Europe Framework Convention on Artificial Intelligence and Human Rights, Democracy and the Rule of Law chrome. Council of Europe Treaty Series - No. 225, 5.09.2024 https://www.coe.int/en/web/artificial-intelligence/the-framework-convention-on-artificial-intelligence?utm_source=chatgpt.com (last accessed 13.11.2025)

⁴ Chiara Litardi, Dragoș Adăscăliței, Sarah Widera, Regulatory responses to algorithmic management in the EU, Published: 20 May 2024 https://www.eurofound.europa.eu/en/publications/all/regulatory-responses-algorithmic-management-eu?utm_source=chatgpt.com

⁵ Netherlands: Algorithmic management, LAST UPDATE 2023 <https://apps.eurofound.europa.eu/legislationdb/algorithmic-management/netherlands?scroll-to=regulation-details> (last accessed 13.11.2025)

⁶ Spain: Algorithmic management, Royal Decree-Law 9/2021, of 11 May, <https://apps.eurofound.europa.eu/legislationdb/algorithmic-management/spain>

⁷ France: Algorithmic management, Legal code of relations between the administration and the public, article L311-3-1 Labor Code, article L. 7342-1 Transport Code, article L. 1326-4, <https://apps.eurofound.europa.eu/legislationdb/algorithmic-management/france>

⁸ Italy: Algorithmic management, Legislative Decree of 27 June 2022, n.104 Legislative Decree 48 of 2023, <https://apps.eurofound.europa.eu/legislationdb/algorithmic-management/italy?scroll-to=regulation-details>

approach is considered a best practice for countries aiming to effectively implement the standards of the EU AI Act at the national level.

Recent studies conducted at the EU level show that despite the adoption of the GDPR and the law on artificial intelligence, significant regulatory gaps remain regarding algorithmic decision-making, in particular in terms of transparency, prior assessment, human oversight and the right to explanation. The European Parliamentary Research Service underlines that these gaps justify the consideration of a separate legislative instrument specifically addressing algorithmic management and decision-making systems⁹.

Taking into account the EU AI Act and the Council of Europe Framework Convention, Georgia has already taken the first steps. On April 3, 2025, the Georgian Government approved the Digital Governance Strategy of Georgia for 2025-2030, which is the first officially approved strategy in the field of digital governance¹⁰. The implementation of the strategy will ensure issues such as increasing the efficiency of public administration and optimizing resources, standardizing the digital delivery of state services, strengthening the security of information systems, and improving Georgia's international positioning in the field of digital governance. However, it should be noted that the strategy does not contain specific regulations on administrative decisions made by algorithmic or artificial intelligence. Although the strategy is focused on improving digital services, developing infrastructure, and strengthening cybersecurity, it does not regulate the legal aspects of automated/algorithmic decision-making. The Digital Governance Strategy of Georgia for 2025-2030, despite its importance and comprehensiveness, does not provide an answer to the issue of regulating algorithmic administrative acts. Accordingly, it is necessary to amend the General Administrative Code of Georgia in order to regulate the process of administrative decision-making by artificial intelligence and automated systems, protect citizens' rights, and ensure transparency and accountability.

Chapter II. Legal Regulation of Algorithmic Administrative Acts in Georgia chrome-

2.1. Constitutional Framework and Fundamental Rights of Georgia

The study of the legal regulation of algorithmic administrative acts must necessarily begin with an analysis of the constitutional foundations of Georgia, since any administrative activity must comply with the fundamental rights and principles protected by the Constitution of Georgia. Article 4 of the Constitution of Georgia establishes the principle of the rule of law, which is interpreted as "the foundation of a legal state"¹¹. This principle implies the requirement that all actions of state bodies, including algorithmic decision-making, must be based on the law and be controllable. "The principle of a legal state implies that the government must rely on the Constitution, the law and the law as a whole."¹² This principle assumes particular importance in the context of algorithmic decisions, where the decision-making process may be opaque.

⁹ Digitalisation, artificial intelligence and algorithmic management in the workplace: Shaping the future of work, EPRS | European Parliamentary Research Service European Added Value Unit PE 774.670 – October 2025, [chromeextension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.europarl.europa.eu/RegData/etudes/STUD/2025/774670/EPRS_STU\(2025\)774670_EN.pdf](chromeextension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.europarl.europa.eu/RegData/etudes/STUD/2025/774670/EPRS_STU(2025)774670_EN.pdf)

¹⁰ Resolution of the Government of Georgia No. 100 of April 3, 2025 on the approval of the "Georgian Digital Governance Strategy 2025-2030" and the "Georgian Digital Governance Strategy 2025-2030 Action Plan 2025-2026". <https://matsne.gov.ge/ka/document/view/6467487?publication=0> (last viewed 13.11.2025)

¹¹ Constitution of Georgia, Institutions of the Parliament of Georgia, 31-33, 24/08/1995, Article 4 <https://matsne.gov.ge/ka/document/view/30346?publication=36> (last viewed 13.11.2025)

¹² Georgian Young Lawyers Association and Georgian Citizen Ekaterine Lomtadze v. Parliament of Georgia, №1/3/407, December 26, 2007 <https://constcourt.ge/en> (last viewed 13.11.2025)

Article 11 of the Constitution of Georgia guarantees the right to equality and prohibits discrimination¹³. The Constitutional Court has repeatedly emphasized that “the principle of equality requires not only formal equality before the law, but also de facto equality and the prohibition of all forms of discrimination”.⁴ The problem of so-called “algorithmic discrimination” in algorithmic decisions poses a serious challenge precisely in the context of this constitutional guarantee.

Article 15 of the Constitution of Georgia protects the right to privacy, as well as the right to privacy and communication¹⁴, which includes the protection of personal data. Algorithmic systems that process large amounts of personal data and create profiles directly affect this constitutional right.

Of particular importance is Article 18 of the Constitution of Georgia, which protects the right to a fair administrative proceeding¹⁵. The right to a fair administrative proceeding includes procedural guarantees, including the right to be heard, the obligation to provide reasons for the decision, and the possibility of an effective appeal. These guarantees are called into question when a decision is made by an algorithm.

The legal regulation of algorithmic administrative acts in Georgia is currently fragmentary and is mainly based on the doctrine of traditional administrative law, which is not adapted to the specifics of automated decisions. Although the Constitution of Georgia contains all the fundamental principles necessary for the legal control of algorithmic governance, these principles cannot be transformed into effective guarantees in practice without special normative regulation.

The principle of the rule of law, as the basis of the constitutional order, requires that the administrative decision-making process be defined by law, transparent and predictable. In the case of algorithmic decisions, the realization of these requirements is at risk, since the logic of decision-making often remains unclear to both the citizen and the bodies exercising legal control. Thus, algorithmic governance creates a risk that administrative activities will remain formally within the legal framework, although they will lose controllability in terms of content.

The constitutional guarantee of equality and the prohibition of discrimination acquires particular importance in the context of algorithmic decisions. Data-driven systems may reinforce existing social inequalities or give rise to so-called algorithmic discrimination, which contradicts the doctrine of de facto equality established by the Constitutional Court. Thus, the use of algorithmic systems in administrative proceedings requires prior and constant control precisely in the context of protecting the principle of equality.

The right to privacy and the protection of personal data is one of the most vulnerable aspects of algorithmic decisions. The processing of large amounts of data, profiling and predictive analytics increase the risk of excessive restrictions of rights, which requires a strict application of the constitutional test of proportionality. In this regard, the introduction of algorithmic systems cannot be justified solely on the grounds of efficiency if it does not meet the criteria of legitimate aim, necessity and moderation.

The right to a fair administrative hearing is the constitutional core that most acutely conflicts with fully automated decisions. The right to be heard, the obligation to provide reasons, and effective appeals are traditionally based on human decision-making. When a decision is made by an algorithm,

¹³ Constitution of Georgia, Institutions of the Parliament of Georgia, 31-33, 24/08/1995, Article 11 <https://matsne.gov.ge/ka/document/view/30346?publication=36> (last viewed 13.11.2025)

¹⁴ Constitution of Georgia, Bodies of the Parliament of Georgia, 31-33, 24/08/1995, Article 15 <https://matsne.gov.ge/ka/document/view/30346?publication=36> (last viewed 13.11.2025)

¹⁵ Constitution of Georgia, Bodies of the Parliament of Georgia, 31-33, 24/08/1995, Article 18, 31 <https://matsne.gov.ge/ka/document/view/30346?publication=36> (last viewed 13.11.2025)

These procedural guarantees are in danger of losing their real content and may become mere formal requirements.

2.2. Analysis of the General Administrative Code of Georgia

The General Administrative Code of Georgia is the main normative act regulating administrative activities, although it does not contain special regulations on algorithmic administrative acts.

The doctrine of the individual administrative legal act

Article 2, paragraph “d” of the General Administrative Code of Georgia states that “an individual administrative legal act is an individual legal act issued by an administrative body on the basis of administrative legislation, which establishes, amends, terminates or confirms the rights and obligations of a person or a limited circle of persons.”¹⁶

Based on this definition, the essential elements of an administrative act are issuance by an administrative body, public-legal character, individuality and the occurrence of legal consequences. The problem in the context of algorithmic acts is that traditionally “issuance by an administrative body” implies a decision-making by a human.

Article 53, paragraph 1 of the General Administrative Code of Georgia states that “an individual administrative-legal act issued in writing shall contain written justification”¹⁷. The obligation to justify an individual administrative-legal act is one of the fundamental requirements of the rule of law, which ensures the possibility of appealing the decision. In the case of algorithmic decisions, the traditional form of justification is problematic, especially when using “black box” algorithms.

The problem in the justification of an administrative-legal act is when we talk about a fully automated legal act, but it should be noted that today public administration in Georgia is not a fully automated process. It is possible that its future will be fully automated over time, following the improvement of electronic governance systems, although the exclusion of the human factor is still unthinkable¹⁸.

Electronic administrative act

In accordance with Article 2, paragraph “d1” of the General Administrative Code of Georgia, an electronic individual administrative-legal act is an individual administrative-legal act issued in electronic form using automatic management tools, which meets the requirements of the Law of Georgia “On Electronic Documents and Electronic Reliable Services”¹⁹. An electronic administrative act is only a matter of technical form, not a change in legal nature. An electronic act has the same legal consequences as an act issued on paper. Accordingly, an electronic administrative act and an algorithmic administrative act are two different concepts- the first refers only to the form, and the second to the decision-making process.

Procedure for Issuing an Administrative Act

Article 95 of the General Administrative Code of Georgia establishes the right to be heard by a party, according to which “an administrative body is authorized to involve an interested party in administrative proceedings upon his request, and in cases specified by law is obliged to ensure

¹⁶ General Administrative Code of Georgia Code, Parliament of Georgia GSC, 32(39), 15/07/1999. Article 2. <https://matsne.gov.ge/document/view/16270?publication=44> (last viewed 13.11.2025)

¹⁷ General Administrative Code of Georgia, Parliament of Georgia GSC, 32(39), 15/07/1999. Article 53. <https://matsne.gov.ge/document/view/16270?publication=44> (last viewed 13.11.2025)

¹⁸ Turava Paata. Pirtskhalashvili Ana and Kardava Ekaterine. 2020. Administrative Proceedings in the Public Service. <https://www.scribd.com/document/501272665/2020> (last accessed 13.11.2025)

¹⁹ General Administrative Code of Georgia, Parliament of Georgia, 32(39), 15/07/1999. Article 2, paragraph “d1”. <https://matsne.gov.ge/document/view/16270?publication=44> (last accessed 13.11.2025)

his participation in administrative proceedings”²⁰. The right to be heard by a party is one of the most important guarantees of administrative proceedings and is an integral part of the right to fair administrative proceedings. This right implies that a person must be given a real opportunity to influence the decision. In the case of algorithmic decisions, when the system automatically processes data and makes a decision, this procedural guarantee may remain formal.

Appealing an administrative act

Article 177 of the General Administrative Code of Georgia defines the right to appeal an administrative-legal act, whereby “an interested party has the right to appeal an administrative-legal act issued by an administrative body.”²¹ Article 178 of the General Administrative Code of Georgia defines the right of an interested party to appeal an administrative-legal act adopted by an administrative body to a subsequent administrative body or to a court. The full jurisdiction of a higher administrative body or court in reviewing an administrative act means that the administrative body/court not only verifies the legality of the administrative act, but also assesses its appropriateness. The administrative body/court must have the ability to fully review the decision of the administrative body. In the context of algorithmic decisions, the exercise of this power by the court is problematic, as the court may not have the technical capabilities to verify the operation of the algorithm.

2.3. Legal Gaps and Challenges

The main gaps identified in the General Administrative Code of Georgia are that the Administrative Procedure Code of Georgia does not contain a definition and regulation of fully automated decisions. It is not clearly spelled out what information should be provided to the party in the case of an algorithmic decision. The General Administrative Code of Georgia does not determine under what conditions a fully automated decision can be used and in what cases human involvement is necessary, and there are no special procedures for appealing algorithmic decisions.

The analysis of the General Administrative Code of Georgia confirms that the current legal framework does not provide answers to the substantive issues of algorithmic administrative acts. The doctrine of an individual administrative-legal act, the obligation to justify and the appeal mechanisms are formulated on the assumption that a person makes a decision. The regulation of electronic administrative acts, however, concerns only formal and technical issues and cannot cover the legal specifics of the algorithmic decision-making process.

The issue of judicial control is particularly problematic. Under conditions of full jurisdiction, the court should be able to verify both the legality and expediency of the administrative act. In the case of algorithmic decisions, this function is practically limited if the court does not have the ability to assess the logic of the algorithm's operation, data sources, and risks.

Conclusion

The analysis of the considered international legal framework demonstrates that the regulation of algorithmic administrative acts has become one of the most important challenges of modern public administration. The increasing integration of artificial intelligence systems into public administration is inevitable, and this process entails not only the prospect of increasing efficiency, but also real risks of possible impact on human rights, the principles of administrative justice, and the rule of law. It is against this background that the EU AI Act and the Council of

²⁰ General Administrative Code of Georgia, Parliament of Georgia, 32(39), 15/07/1999. Article 95. <https://matsne.gov.ge/document/view/16270?publication=44> (last viewed 13.11.2025)

²¹ General Administrative Code of Georgia, Parliament of Georgia, 32(39), 15/07/1999. Article 177. <https://matsne.gov.ge/document/view/16270?publication=44> (last viewed 13.11.2025)

Europe Framework Convention create a legal standard that links technological progress with the protection of fundamental rights.

The risk-based model of the EU AI Act represents a systematic and preventive approach that allows states to assess in advance the impact of algorithmic systems and link the appropriate regulatory stringency to their scope of use. Of particular importance are the requirements imposed on high-risk AI systems that directly affect administrative decisions, access to public services and the rights of citizens. This approach clearly emphasizes that automation cannot replace legal responsibility and the role of humans in the decision-making process.

Although the EU AI Act is not legally binding for Georgia, the country's constitutional aspiration for integration into the European Union and its signing of the Council of Europe Framework Convention entail an obligation to gradually and systematically approximate the national legal framework to European standards. The principles enshrined in the Framework Convention – human dignity, equality, transparency, oversight and accountability – are directly correlated with the basic principles of administrative law and create a solid foundation for the regulation of algorithmic administrative acts.

A comparative analysis shows that those countries that, along with an AI strategy, have introduced special regulatory bodies or made changes to administrative and sectoral legislation have been able to ensure a higher level of legal control over algorithmic decisions. This practice confirms that strategic documents alone cannot respond to the legal challenges of algorithmic governance and that binding normative regulation is necessary.

In this context, the Digital Governance Strategy of Georgia for 2025–2030 represents a significant step forward, although it fails to provide legal regulation of algorithmic administrative acts. The declarative and political-planning nature of the strategy does not create sufficient guarantees for the protection of citizens' rights in the context of automated decisions and does not define the scope of responsibility of administrative bodies. Based on the above analysis, it is advisable to move the regulation of algorithmic administrative acts in Georgia from the level of doctrinal interpretation to a clear normative framework. First of all, it is necessary to introduce the concept of a fully or partially automated administrative decision into the General Administrative Code of Georgia and clearly separate it from an electronic administrative act. On the other hand, the law should define the cases when fully automated decision-making is permissible and the areas where human involvement should be mandatory.

It is also recommended to establish special procedural guarantees in the case of algorithmic decisions, including: information security

It is called an extended obligation on the logic of the algorithm, the data used and the possible risks; the right to review the decision by a person; and special mechanisms for appealing algorithmic acts. In addition, it is important to institutionally strengthen the courts and administrative bodies so that they can actually exercise legal control over algorithmic decisions.

In conclusion, it can be said that the constitutional and administrative-legal framework of Georgia contains the fundamental principles on the basis of which effective regulation of algorithmic administrative acts is possible. However, this potential cannot be realized without special and modern normative regulation that ensures the necessary balance between technological progress and the protection of human rights.

References

1. EU AI Act: first regulation on artificial intelligence The use of artificial intelligence in the EU is regulated by the AI Act, the world's first comprehensive AI law. Published: 08-06-2023, Last updated: 19-02-2025.
<https://www.europarl.europa.eu/topics/en/article/20230601STO93804/eu-ai-act-first-regulation-on-artificial-intelligence> (Last accessed 13.11.2025)
2. Council of Europe Framework Convention on Artificial Intelligence and Human Rights, Democracy and the Rule of Law chrome. Georgia signed on 5 September 2024.
<https://www.coe.int/en/web/artificial-intelligence/the-framework-convention-on-artificial-intelligence> (Last accessed 13.11.2025)
3. Council of Europe Framework Convention on Artificial Intelligence and Human Rights, Democracy and the Rule of Law chrome. Council of Europe Treaty Series- No. 225, 5.09.2024
https://www.coe.int/en/web/artificial-intelligence/the-framework-convention-on-artificial-intelligence?utm_source=chatgpt.com (last accessed 13.11.2025)
4. Chiara Litardi, Dragoș Adăscăliței, Sarah Widera, Regulatory responses to algorithmic management in the EU, Published: 20 May 2024
https://www.eurofound.europa.eu/en/publications/all/regulatory-responses-algorithmic-management-eu?utm_source=chatgpt.com
5. Netherlands: Algorithmic management, LAST UPDATE 2023
<https://apps.eurofound.europa.eu/legislationdb/algorithmic-management/netherlands?scroll-to=regulation-details> (last accessed 13.11.2025)
6. Spain: Algorithmic management, Royal Decree-Law 9/2021, of 11 May,
<https://apps.eurofound.europa.eu/legislationdb/algorithmic-management/spain>
7. France: Algorithmic management, Legal code of relations between the administration and the public, article L311-3-1 Labor Code, article L. 7342-1 Transport Code, article L. 1326-4,
<https://apps.eurofound.europa.eu/legislationdb/algorithmic-management/france>
8. Italy: Algorithmic management, Legislative Decree of 27 June 2022, n.104 Legislative Decree 48 of 2023, <https://apps.eurofound.europa.eu/legislationdb/algorithmic-management/italy?scroll-to=regulation-details>
9. Digitalisation, artificial intelligence and algorithmic management in the workplace: Shaping the future of work, EPRS | European Parliamentary Research Service European Added Value Unit PE 774.670 – October 2025,
[chromeextension://efaidnbmninnibpcapjpcglclefindmkaj/https://www.europarl.europa.eu/RegData/etudes/STUD/2025/774670/EPRS_STU\(2025\)774670_EN.pdf](chromeextension://efaidnbmninnibpcapjpcglclefindmkaj/https://www.europarl.europa.eu/RegData/etudes/STUD/2025/774670/EPRS_STU(2025)774670_EN.pdf)
10. Resolution of the Government of Georgia N100 of April 3, 2025 on the approval of the “Georgian Digital Governance Strategy 2025-2030” and the “Georgian Digital Governance Strategy 2025-2030 Action Plan 2025-2026”.
<https://matsne.gov.ge/ka/document/view/6467487?publication=0> (last viewed 13.11.2025)
11. Constitution of Georgia, Bodies of the Parliament of Georgia, 31-33, 24/08/1995, Article 4
<https://matsne.gov.ge/ka/document/view/30346?publication=36> (last viewed 13.11.2025)
12. Georgian Young Lawyers Association and Georgian Citizen Ekaterine Lomtadidze v. Parliament of Georgia, №1/3/407, December 26, 2007 <https://constcourt.ge/en> (last viewed 13.11.2025)
13. General Administrative Code of Georgia, Parliament of Georgia CC, 32(39), 15/07/1999.
<https://matsne.gov.ge/document/view/16270?publication=44> (last viewed 13.11.2025)
14. Turava Paata. Pirtskhalashvili Ana and Kardava Ekaterine. 2020. Administrative Procedure in the Public Service. <https://www.scribd.com/document/501272665/2020> (last viewed 13.11.2025)

The Criterion of Originality in Works Created by Artificial Intelligence

Dr. Lika Sajaia

Professor, Georgian International University (GIU), New Vision University

Introduction

The rapid technological development of artificial intelligence has fundamentally transformed almost every sphere of social life and has had a particularly significant impact on creative activity. Systems that were previously regarded merely as auxiliary tools are now capable of independently generating texts, images, and musical works, thereby profoundly challenging the traditional understanding of copyright law.

The core international conventions governing intellectual property law have proven outdated in addressing these new challenges. In a special policy document on intellectual property and artificial intelligence, the World Intellectual Property Organization (WIPO) emphasized the necessity of modernizing existing legal frameworks so that updated regulations would encompass both the possibility of AI co-authorship and the legal treatment of works independently generated by artificial intelligence.²²

To date, however, no amendments have been introduced into the principal international conventions and treaties. While certain states have attempted to address the issue at the level of national legislation, there remains no unequivocal answer to the question of whether works created by artificial intelligence should be protected by copyright. In order to answer this question, it is necessary to determine whether AI-generated works satisfy the core criterion of copyright protection- originality- or whether originality can be attributed exclusively to works created by humans.

The purpose of this research is to analyze the copyright status of works generated by artificial intelligence or created with its participation and to assess whether such works may satisfy the criterion of originality. The study also aims to develop recommendations on how legislation might be adapted to ensure effective protection of the creative industries while simultaneously supporting technological progress.

The research examines the extent to which the existing legal frameworks of the European Union, Georgia, and other jurisdictions respond to the challenges of the AI era. The findings demonstrate that copyright systems require both conceptual and structural transformation in order to remain effective in the age of artificial intelligence.

The study evaluates the principal international legal frameworks as well as best practices from selected jurisdictions, including the United States, the United Kingdom, China, and others. An analysis of these sources makes it possible to identify whether traditional copyright principles can

²² WIPO Conversation on Intellectual property (IP) and artificial intelligence (AI), revised issues paper on intellectual property policy and artificial intelligence, prepared by the WIPO Secretariat, May 21, 2020 https://www.wipo.int/edocs/mdocs/mdocs/en/wipo_ip_ai_2_ge_20/wipo_ip_ai_2_ge_20_1_rev.pdf

be adapted to the AI era, what limitations and challenges exist, and in which direction international legal practice is evolving. On the basis of an analysis of legal sources and recent case law, the research seeks to answer the following question: is it possible to protect AI-generated works within the traditional copyright system, and if so, who should be regarded as the author?

The research is based on doctrinal and empirical methods. It assesses the extent to which the Berne Convention, WIPO instruments, and the TRIPS Agreement respond to contemporary technological challenges and considers the directions in which these instruments may require reform. Modern global trends are analyzed through the method of comparative law, highlighting the advantages and shortcomings of different regulatory approaches.

Keywords: Copyright, technological innovation, authorship status, co-authorship, international standards.

Chapter 1

The Criterion of Originality and Its Interpretation in Continental European and Common Law Jurisdictions

The Berne Convention for the Protection of Literary and Artistic Works²³ grants Member States discretion in determining which works, fixed in a material form, qualify for copyright protection. Pursuant to Article 2(2) of the Convention, Member States retain the right to require that literary and artistic works, or certain categories thereof, be fixed in a material form as a condition of protection. The Berne Convention establishes originality as the minimum standard for protection, while additional criteria are defined by national legislation.

The question of what constitutes literature and art and what should be regarded as artistic or literary expression, extends beyond the scope of legal science and falls within the domain of aesthetics. From a legal perspective, it is not possible to establish an exhaustive and precise definition of the criteria for copyright protection. In order to prevent copyright law from extending beyond the protection of literary, artistic, and scientific works, the law seeks to evaluate the creative and intellectual contribution involved in the creation of a work and to establish a minimum threshold for protection.

Different criteria for copyright protection have developed in common law and continental legal systems, and courts interpret the originality requirement of the Berne Convention in divergent ways. In common law jurisdictions, originality is the primary criterion of protection and is generally understood to mean that a work must not be a copy.²⁴

In contrast, continental European copyright systems impose a higher standard: the work must constitute an expression of the author's individuality and personality.²⁵ Consequently, originality remains the most widely recognized criterion of copyright protection, yet its meaning and interpretation vary significantly across legal systems.

²³ Berne Convention for the Protection of Literary and Artistic Works, (as amended on September 28, 1979) < <https://www.wipo.int/wipolex/en/text/283698> >

²⁴ Torremans, Copyright Law, USA, 2007, 54.

²⁵ Strömholm, International encyclopedia of comparative Law, Volume 14, part 2 of International encyclopedia of comparative Law: Copyright and Industrial property, 1990, 3-23.

In English-speaking jurisdictions, the term “original” emphasizes not the artistic or literary novelty of a work but its independent origin. Courts in England, the United States, and Canada have developed differing interpretations of originality, resulting in distinct national approaches. Under section 1(1)(a) of the UK Copyright, Designs and Patents Act 1988, copyright subsists in original literary, dramatic, musical, and artistic works.²⁶

English courts adhere to the traditional common law approach, according to which all copyable works may be protected. As early as 1916, in “University of London Press Ltd v. University Tutorial Press Ltd”, the court held that originality does not require novelty in form of expression, but merely that the work should not be copied and should originate from the author.²⁷

The criterion of originality is not explicitly articulated in European Union directives. Instead, they require that a work constitute the result of intellectual creation.²⁸

French and German copyright law do not formally define originality as a criterion of protectability. Article L112-1 of the French Intellectual Property Code provides that copyright subsists in all works of the mind, regardless of genre, form of expression, merit, or purpose.²⁹

French judicial practice strictly distinguishes between works resulting from intellectual creativity and those produced by purely mechanical processes. A work must reflect the author’s vision and ideas in order to qualify for protection. For example, a recording of birdsong, regardless of how original it may appear, is not protected because it does not express the creator’s personality.³⁰

The distinction between creative and non-creative output is particularly evident in photographic works. According to French case law, the author of a photograph is the person who determines the subject, angle, lighting, and timing of the shot, rather than the individual who merely presses the shutter. Protection depends on whether the author exercised objective influence over the environment and left a discernible imprint of creative choice.³¹

German scholar Adolf Dietz has observed that European courts often reach divergent outcomes in similar cases, sometimes adopting such liberal interpretations that copyright risks extending to works with little connection to literature, music, or art.³²

Accordingly, while originality is the principal criterion in common law jurisdictions, continental European systems emphasize individuality and personal expression. Under this approach, the manifestation of human individuality within a work is essential for originality. From this perspective, artificial intelligence cannot be regarded as an author, and works generated autonomously by AI cannot qualify for copyright protection.

²⁶ UK, Copyright, Designs and Patents Act, 1988,
http://www.opsi.gov.uk/acts/acts1988/ukpga_19880048_en_1.htm

²⁷ Adusei, Modern challenges to moral rights protection under copyright law: the way forward, Edmonton, Alberta, 2005, 19.

²⁸ Torremans, *Holyoak and Torremans Intellectual Property Law*, Fourth Edition, Oxford, 2005, 176.

²⁹ France, Code de la propriété intellectuelle, 3 juillet, 1992.
<http://www.lexinter.net/ENGLISH/intellectual_property_code.htm>

³⁰ Bonnet, Code de la Propriété Intellectuelle, 4th ed, Paris, 2004, 10.

³¹ Adeney, *The Moral Rights of Authors and Performers, An international and comparative analysis*, Oxford University press, USA, 2006, 178.

³² Diets, *Copyright Law in the European Community*, The Netherland, 1978, 34.

Nevertheless, the question arises whether, in light of technological progress, the criterion of originality itself should be reconsidered in order to avoid hindering innovation while ensuring adequate protection for works created using advanced technologies. Since AI lacks will, creative freedom, and personal identity, works generated solely by AI, despite their novelty or uniqueness, do not satisfy the originality requirement.

Where artificial intelligence is used as a creative tool and humans retain substantial control, originality may be manifested in the formulation of concepts, the selection and modification of prompts, the critical evaluation and selection of generated material, and the determination of the final structure and form of the work. In this context, originality is closely linked to the curatorial model.

The United Kingdom's approach partially relaxes the classical understanding of originality, whereas the European Union and the United States continue to emphasize human intellectual creativity as decisive. This approach seeks to preserve the normative foundations of copyright law and to prevent the monopolization of automatically generated content.

Chapter 2

Overview of Judicial Practice

The copyright protection of works created by artificial intelligence constitutes one of the most complex and topical issues in contemporary legal discourse. This challenge is reflected in both U.S. and Chinese judicial practice, which has developed differing yet principled approaches.

Particular attention should be paid to the decision of the Shenzhen court in “Shenzhen Tencent v. Yingxun Technology”³³, often regarded as one of the first significant international precedents concerning copyright protection for works created with the participation of artificial intelligence.

In this case, Tencent's AI system, “Dreamwriter,” automatically generated a financial news article that was published on Tencent's platform. The article was subsequently reproduced without authorization by Shanghai Yingxun Technology, prompting Tencent to bring a copyright infringement claim. The central issue was whether an AI-generated text could qualify as a copyright-protected work and, if so, who should be recognized as the author.

The Shenzhen court held that although the text was generated automatically, human intellectual participation played a decisive role in its creation. The court emphasized that Dreamwriter operated on the basis of algorithms, data selection rules, structural frameworks, and linguistic models predetermined by humans. Furthermore, the human role in configuring the system, defining its purpose, and deciding on publication was deemed crucial. Consequently, the court concluded that the work was not the product of entirely autonomous machine creativity and that human creative control and organizational contribution were present.

³³ Shenzhen Tencent v. Shanghai Yingxun, Case No. Y0305MC No. 14010, <<https://www.wipo.int/wipolex/en/text/283698>>

On this basis, the court recognized that the work satisfied the minimum originality threshold and could qualify for copyright protection, while explicitly denying author status to the AI system itself. Authorship was attributed to the entity that defined and controlled the creative process Tencent.

This approach contrasts with U.S. practice, where the Copyright Office and courts have consistently emphasized the necessity of direct human creative contribution. In “Stephen Thaler’s”³⁴ case involving the “Creativity Machine,” copyright protection was denied on the grounds that the work lacked human authorship. A similar approach has been applied to works generated using Midjourney, where protection has been limited to those elements reflecting direct human creative choices.

The 2023 U.S. Copyright Office decision in “Theatre D’opera Spatial”³⁵ further illustrates this position. The Office concluded that although the artist initiated the process through textual prompts, the essential visual elements of the work were generated by AI, and the human contribution did not meet the threshold of creative control required under U.S. copyright law. As a result, registration was refused.

These decisions draw a clear distinction between AI as a creative tool and AI as an autonomous creator, reaffirming the principle that copyright protection is inseparable from human creative authorship.

Chapter 3

Legislative Protection of AI-Generated Works: Contemporary Approaches

Most international and national legal frameworks do not currently recognize copyright protection for works generated autonomously by artificial intelligence. Nonetheless, modern legal discourse emphasizes the crucial distinction between AI-generated works and works created by humans with the assistance of AI.

Classical copyright doctrine links authorship to human intellectual and creative activity, with decisive importance attributed to creative control. Contemporary doctrine increasingly relies on the curatorial model, under which human creativity may be expressed through the selection, organization, and transformation of AI-generated materials, provided that humans retain meaningful creative control.

In contemporary doctrine, the so-called “*curatorial model*” is widely applied, according to which human creative contribution is not limited solely to traditional creative acts (such as writing a text, composing music, or creating a painting). Under this approach, human creativity may be expressed through the identification, review, selection, and organization of material generated by artificial intelligence, as well as through its processing and the shaping of a final unique form. Accordingly, authorship is determined not by the mere fact of using a technical tool, but by the extent to which a human being retains creative control and makes essential creative decisions.

³⁴ Copyright Review Board, United States Copyright Office, 14 February, 2022 <
<https://www.copyright.gov/rulings-filings/review-board/docs/a-recent-entrance-to-paradise.pdf>>

³⁵ US Copyright Office and AI: Notice of Inquiry and the Théâtre D’opéra Spatial case <
<https://ipkitten.blogspot.com/2023/09/us-copyright-office-and-ai-notice-of.html>>

According to a 2025 report by the European Parliament's Policy Department for Justice, Civil Liberties and Institutional Affairs, a clear distinction must be drawn between works created by humans with AI assistance, which may qualify for protection, and works generated by AI without human intellectual creation, which fall outside the scope of copyright law.³⁶

The U.S. legal system recognizes only human authorship, whereas the UK Copyright, Designs and Patents Act 1988 provides protection for computer-generated works and attributes authorship to the person who undertook the necessary arrangements for their creation. A different approach is adopted by the United Kingdom: the *Copyright, Designs and Patents Act*³⁷ 1988 provides for the protection of "computer-generated works" and regards as the author the person who has undertaken the arrangements necessary for their creation. This provision is often considered an early legal response to technological progress.

Conclusion

Contemporary technological development, particularly the rapid integration of artificial intelligence into creative processes, poses significant challenges to the international copyright law system. Existing international instruments and national legislations, in most cases, do not adequately reflect the reality in which works are created through the active use of AI or by means of autonomously generated AI outputs. This situation gives rise to the need for legal clarity and harmonization, so that international legal frameworks may be aligned with modern technological progress.

In this context, it is advisable to establish a specific legal protection regime for works created both with the assistance of AI and by AI itself. Particular importance is attached to determining which AI-generated works should be subject to copyright protection and how one of the fundamental criteria of protectability, originality, should be interpreted. Despite technological transformation, the criteria of authorship and originality are not eliminated in the era of artificial intelligence; on the contrary, they retain their essential significance, though they require a renewed and more developed interpretation.

According to the contemporary legal approach, artificial intelligence is regarded not as an author, but as a technological tool. Consequently, copyright belongs to those natural or legal persons, users or commissioners, who exercise genuine creative control, make essential creative decisions, and determine the final form of the work. Thus, the protectability of a work depends not on the technology employed, but on the existence and quality of human intellectual and creative contribution.

As a result, one of the principal objectives of the development of international and national copyright law should be the establishment of a normative framework that ensures a balance between the promotion of innovation and the preservation of traditional copyright principles, while at the same time responding to the new legal realities arising in the era of artificial intelligence.

³⁶ European parliament, Requested by JURI Committee, Generative AI and Copyright, July 2025

³⁷ the *Copyright, Designs and Patents Act 1988*

Bibliography

1. WIPO Secretariat. *Revised Issues Paper on Intellectual Property Policy and Artificial Intelligence*. WIPO Conversation on Intellectual Property and Artificial Intelligence, 2020.
2. Berne Convention for the Protection of Literary and Artistic Works (as amended on 28 September 1979).
3. Torremans, P. *Copyright Law*. USA, 2007.
4. Strömholm, S. *Copyright and Industrial Property*. In: *International Encyclopedia of Comparative Law*, Vol. 14, Part 2. 1990.
5. United Kingdom. *Copyright, Designs and Patents Act*. 1988.
6. Adusei, E. *Modern Challenges to Moral Rights Protection under Copyright Law: The Way Forward*. Edmonton, Alberta, 2005.
7. Torremans, P. *Holyoak and Torremans Intellectual Property Law*. 4th ed., Oxford, 2005.
8. France. *Code de la Propriété Intellectuelle*. 1992.
9. Bonnet, J. *Code de la Propriété Intellectuelle*. 4th ed., Paris, 2004.
10. Adeney, E. *The Moral Rights of Authors and Performers: An International and Comparative Analysis*. Oxford University Press, USA, 2006.
11. Dietz, A. *Copyright Law in the European Community*. The Netherlands, 1978.
12. *Shenzhen Tencent v. Shanghai Yingxun*, Case No. Y0305MC No. 14010.
13. United States Copyright Office. *Copyright Review Board Decision*. 2022.
14. United States Copyright Office. *Notice of Inquiry on Artificial Intelligence and Copyright and the "Théâtre D'opéra Spatial" Case*.
15. European Parliament. *Generative AI and Copyright*. Requested by the JURI Committee, 2025.

Digital Transformation of Justice in the Age of Artificial Intelligence

Giorgi Svianadze

Associate Professor, Georgian International University GIU

Abstract

The rapid development of information technologies and artificial intelligence (AI) has significantly influenced modern justice systems, making digital transformation an inevitable process. This article examines the role of artificial intelligence in the modernization of justice, focusing on its potential to enhance efficiency, accessibility, and decision-making within judicial systems. It analyzes the practical applications of AI in courts, including administrative automation, legal research, risk assessment, and decision-support tools, with reference to experiences from various countries such as the United States, the United Kingdom, China, and Estonia. Alongside its benefits, the article highlights the major ethical and legal challenges associated with the integration of AI into judicial decision-making, including risks to judicial independence, transparency, accountability, equality before the law, data protection, and privacy. Particular attention is given to issues of algorithmic bias, the “black box” nature of AI systems, and the limits of automation in evaluating the unique factual circumstances of individual cases. The study emphasizes that while AI can serve as an effective auxiliary tool, it must not replace human judgment. The article concludes that successful integration of AI into the justice system requires a balanced approach that preserves fundamental principles of justice, ensures human oversight, strengthens regulatory frameworks, and promotes multidisciplinary cooperation to address ethical risks.

Introduction

Against the backdrop of ongoing technological changes in the world, the process of introducing information technologies and digital tools is of essential importance in terms of the modernization of justice. Nowadays, everyone agrees that justice cannot remain behind the development of information technologies, since the latter has a significant impact on the society in which the system operates.³⁸

AI is a branch of computer science that focuses on the development of computer systems and algorithms that can perform tasks that normally require human intellectual input.³⁹ It should be noted that the history of artificial intelligence dates back to the early 20th century. According to scientific sources, Alan Turing (a British mathematician) is considered the author of the first study of artificial intelligence. In 1950, Alan Turing published a scientific article in the scientific journal “Mind” titled “Computational Mechanisms and Intelligence,” in which he asked the question: “Can machines think?” Alan Turing also developed the “Imitation Game,” which is now known as the “Turing Test.”⁴⁰

³⁸ European Commission for the Efficiency of Justice (CEPEJ) <https://rm.coe.int/guidelines-on-how-to-drive-change-towards-cyberjustice-georgian/1680aa21cb>

³⁹ Transforming Justice: Implications of Artificial Intelligence in Legal Systems, 433 <https://www.richtmann.org/journal/index.php/ajis/article/view/13719/13275>

⁴⁰ History of Artificial Intelligence: the 1950s <https://www.pigro.ai/post/history-of-artificial-intelligence-the-1950s-from-alan-turing-to-john-mccarthy>

Later, in the summer of 1956, at a conference held at Dartmouth College (a private academic institution in Hanover, New Hampshire, USA), John McCarthy first used the term "artificial intelligence" and went down in history as the author of the term.⁴¹

Initially, the term "artificial intelligence" had a more philosophical than practical meaning. Scientists wondered what artificial intelligence could be.⁴² Today, artificial intelligence is distinguished by its powerful capabilities and is no longer just a philosophical concept. Today, robots can create, analyze, and transmit information like humans. They are interactive, have bodies, and have emotions. Scientists create them with high emotional intelligence and capabilities, which blurs the line between humans and computers.⁴³

Artificial intelligence has the ability to provide insight and in-depth analysis for cutting-edge research in various fields, from medicine to social sciences. In addition, AI has such positive aspects as: increased efficiency; better decision-making; AI can make learning more accessible, adaptable, and engaging for students around the world; and AI can change the specifics of human work.⁴⁴

Thus, we can safely conclude that as of today, the world is in the process of a technological revolution that is changing the economies of states, industries, and social life.

1. Artificial Intelligence and Justice

In the context of the ongoing technological revolution around the world, research shows that digital tools are increasing the efficiency of the justice system and the accessibility of the courts, but the successful integration of digital technologies into the judicial system depends on its strategic use. AI can make the justice system both efficient and effective. It can also undermine the fundamental values of the system. Therefore, it is crucial to understand its benefits and risks to ensure that justice, human rights and the rule of law are promoted.⁴⁵

The use of AI in the justice system includes not only the automation of routine administrative tasks, it also provides analytics and legal research support.⁴⁶ In the era of artificial intelligence development, the workflow of judges, attorneys, and lawyers will undergo significant changes. Paper files will be replaced by virtual files. Procedural documents, such as motions, protocols, and decisions, will be created in digital form, and as for judges, they will be available in digital format based on pre-established templates, which would be partially filled in with data retrieved by the system, such as the names of the parties, registry number, case type, decision structure, and elements of justification.⁴⁷

It should be noted that today, AI is used in many countries around the world. For example, over the past decade, police forces in the United Kingdom have been actively using artificial intelligence. In addition, judges have already used ChatGPT in the process of preparing court decisions. In addition to judges, AI is used by lawyers to perform various tasks: document verification, legal research, drafting documents, etc.

⁴¹ Nuriddinov, A. The Role and Importance of Artificial Intelligence in The development of Society <https://www.academicpublishers.org/journals/index.php/ijai/article/view/5469/6398>

⁴² Napetvaridze, V. Philosophical and Practical Foundations of Artificial Intelligence, p. 8 Scientific Journal "Politics", 2022.

⁴³ Gorgoshadze, M. Mgeladze, M. Gogoshadze "Issues of legal regulation of the extension of certain human rights to artificial intelligence and robots" p. 66 <https://constcourt.ge/files/2/Journal2019.1/M.Mgeladze-M.Gorgoshadze-2019.1ka.pdf>

⁴⁴ Pirveli, S. Sikharulidze, M. "Artificial Intelligence or Revolution in the World" Journal "Academlab" №4 <https://neu.edu.ge/uploads/common/files/cf75529a-af51-4bb5-9749-e8c5b5618e17.pdf>

⁴⁵ Hafiz Gaffar, „Implications of Digitalization and AI in the Justice System: A Glance at the Socio-legal Angle“ <https://lawandworld.ge/index.php/law/article/view/585>

⁴⁶ AI in justice administration and access to justice https://www.oecd.org/en/publications/governing-with-artificial-intelligence_795de142-en/full-report/ai-in-justice-administration-and-access-to-justice_f0cbe651.html#OEC2313_6f09aca72d

⁴⁷ ARTIFICIAL INTELLIGENCE, JUDICIAL DECISION-MAKING AND FUNDAMENTAL RIGHTS https://ssm-italia.eu/wp-content/uploads/2025/02/JuLIA_handbook-Justice_final.pdf

In addition to the United Kingdom, judges in America routinely use artificial intelligence in the risk assessment and sentencing process.⁴⁸ In particular, one of the artificial intelligence systems used by American judges is “Compas” (Correctional Offender Management Profiling for Alternative Sanctions) to determine whether to grant bail to a defendant, while in the state of Wisconsin, the system helps judges determine the length of sentences.⁴⁹

Court systems are also using artificial intelligence in Australia, China, Estonia, Brazil, and Mexico. For example, in China, AI systems are used to inform judges if their decision differs from other precedent data in a central database.⁵⁰

Thus, against the backdrop of ongoing processes in the world, it can be said that in terms of the integration of artificial intelligence, there is a growing dynamic in the justice system, however, in parallel with the development of technologies, the justice system faces a significant challenge. In particular, the court must adapt traditional legal proceedings to new technologies and at the same time ensure the protection of the fundamental values of justice.

2. Challenges and prospects for justice in the process of integrating AI

As it stands, the use of AI in justice is an emerging field, accompanied by a number of ethical challenges. In particular, in addition to the fact that judges use non-legal technologies (e.g. ChatGPT) in the process of making judicial decisions, there are risks of obtaining uniform legal outcomes as a result of the consideration of cases. The integration of AI poses a threat to the analysis and assessment of the factual circumstances of the case based on the judge’s inner convictions. It is believed that not everything can be provided for by law and cannot be automated. A uniform approach to the factual circumstances of a case and the use of non-legal technologies may threaten the independence of the court and the individual decision-making in each case.⁵¹

In addition to the independence of the judiciary, the risks of discrimination are increasing. In particular, it is recognized that AI systems depend primarily on the data that is reflected in them. Accordingly, there is a possibility that, for example, data processing may be carried out on incorrect or discriminatory grounds in relation to certain ethnic minorities, which threatens the principle of equality before the law and the right to a fair trial in general. One of the clearest examples of discriminatory AI systems is the aforementioned COMPAC (Correctional Offender Management Profiling for Alternative Sanctions) system, which was shown by studies to make biased decisions against African Americans.⁵²

In addition to the risks of bias and discrimination, a significant challenge in integrating AI into the justice system is the issue of transparency, since AI systems mainly operate according to the so-called “black box” principle. Accordingly, they are often not transparent and difficult to understand, which may complicate public trust in the justice system.

According to the analysis of court practice, it is often the case when the factual circumstances of two cases are very similar to each other and even a small detail may lead to a significant difference in terms of legal consequences. In the case of using artificial intelligence, when assessing a large volume of facts, the system may not fully determine the details that are individually characteristic of the case and issue an incorrect recommendation. Accordingly, it is important to maintain a high standard of transparency in the process of integrating AI systems into the justice system.

⁴⁸ AI in our Justice System, A JUSTICE report led by Sophia Adams Bhatti January 2025, p. 11
<https://files.justice.org.uk/wp-content/uploads/2025/01/29201845/AI-in-our-Justice-System-final-report.pdf>

⁴⁹ Chris, R. Artificial Intelligence: Ethical Issues

⁵⁰ Beruashvili, M. The Capabilities and Challenges of Artificial Intelligence in the Justice System, Law and Ward (N35/2025) <https://lawandworld.ge/index.php/law/article/view/848>

⁵¹ Artificial intelligence at the bench: Legal and ethical challenges of informing—or misinforming—judicial decision-making through generative AI

⁵² Ethical Challenges of Using Artificial Intelligence in Judiciary
https://arxiv.org/html/2504.19284v1?utm_source=chatgpt.com

Adherence to the principle of transparency will allow the public to verify whether the system has fully taken into account the circumstances of the case and how the information reflected in the system has influenced the decision-making process.⁵³

In parallel with transparency, the issue of accountability also arises. In particular, there is a question in society about who is responsible when an AI system participates in the decision-making process of a court? Or when the system makes a mistake? The main approach of the existing regulations in this regard is that although judges use AI systems in the decision-making process of the court, they cannot delegate their responsibilities to someone else, including artificial intelligence. For example, the Constitutional Court of Colombia decided that although judges can use AI tools, such as ChatGPT, the final decision should still belong to the judge. In practice, this means that humans should be constantly involved in the decision-making process and the results of the AI should be advisory information. The CEPEJ Ethics Charter requires that AI should always remain under the control of the user.⁵⁴

Similar to the Ethics Charter, new US regulations require lawyers and judges to verify information provided by AI. For example, the state of Illinois has strictly stipulated that any AI-generated content must be reviewed and verified for accuracy before being presented to the court.⁵⁵

Similar to the issues discussed above, we must definitely address the importance of confidentiality and personal data protection and the threats associated with it. According to a number of international and national documents, confidentiality belongs to the category of fundamental human rights, which represents the ability of an individual or group of individuals to protect their private life, including personal information about themselves.⁵⁶

With the development of technology, the importance of personal data protection and the threats associated with it are increasing, as it is recognized that artificial intelligence systems mainly rely on databases that contain a lot of information, including personal data about persons participating in court proceedings. For example, defendants, witnesses, victims, etc.

Against this background, it is important to avoid the inappropriate and reckless use of personal data, which could lead to serious breaches of privacy and data protection.⁵⁷ It is recognized that data collection techniques are often invisible to the individuals from whom the data is obtained, making it difficult to control information and leading to breaches of confidentiality.⁵⁸ Accordingly, when using technology, lawyers must ensure that AI systems strictly comply with data protection regulations. It is also essential that the data is used for the specific justice purposes for which it is collected in the system.⁵⁹

⁵³ Ethical Challenges of Using Artificial Intelligence in Judiciary

https://arxiv.org/html/2504.19284v1?utm_source=chatgpt.com

⁵⁴ (CEPEJ) European Ethical Charter on the Use of Artificial Intelligence in Judicial Systems and their environment <https://rm.coe.int/ethical-charter-en-for-publication-4-december-2018/16808f699c>

⁵⁵ Desmond, O. Ethical Challenges of using Artificial Intelligence in the Judiciary

https://papers.ssrn.com/sol3/papers.cfm?abstract_id=5377863

⁵⁶ Challenges of the digital age for privacy and personal data protection

https://www.aimspress.com/article/id/5544?utm_source=chatgpt.com

⁵⁷ Ethical Challenges of Using Artificial Intelligence in Judiciary

https://arxiv.org/html/2504.19284v1?utm_source=chatgpt.com

⁵⁸ The Right to Privacy in the Age of Artificial Intelligence: Challenges and Legal Frameworks

https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4908340&utm_source=chatgpt.com

⁵⁹ AI and Law: What are the Ethical Considerations? https://www.clio.com/resources/ai-for-lawyers/ethics-ai-law/?utm_source=chatgpt.com

Conclusion:

The integration of artificial intelligence (AI) systems into the justice system can have a highly positive effect. AI can significantly increase the efficiency of the justice system. Provide fast and accessible justice. However, along with the positive effect, there are a number of ethical challenges.

The integration of artificial intelligence into the justice system requires special caution. In case of improper use of AI, there is a high probability that its possible positive effect will be lost and significant damage will be caused to justice. Therefore, in the process of developing and integrating AI systems, it is essential to maintain a balance between the traditional form of justice and new technologies. Unconditional automation of the process may threaten the adoption of fair decisions.

It is important to thoroughly analyze the ethical risks of AI and develop effective mechanisms for their prevention. This process, in turn, requires multidisciplinary cooperation (judges, lawyers, IT specialists, ethics experts, etc. should be involved).

In addition, I believe that much stronger regulatory norms should be established in the coming years, which will regulate the ethical issues of using artificial intelligence in the justice system.

References:

1. European Commission for the Efficiency of Justice (CEPEJ) <https://rm.coe.int/guidelines-on-how-to-drive-change-towards-cyberjustice-georgian/1680aa21cb>
2. Transforming Justice: Implications of Artificial Intelligence in Legal Systems, 433 <https://www.richtmann.org/journal/index.php/ajis/article/view/13719/13275>
3. History of Artificial Intelligence: the 1950s <https://www.pigro.ai/post/history-of-artificial-intelligence-the-1950s-from-alan-turing-to-john-mccarthy>
4. Nuridinov, A. "The Role and Importance of Artificial Intelligence in the Development of Society" Nuriddinov, A. The Role and Importance of Artificial Intelligence in The development of Society <https://www.academicpublishers.org/journals/index.php/ijai/article/view/5469/6398>
5. Napetvaridze, V. Philosophical and Practical Foundations of Artificial Intelligence, p. 8 Scientific Journal "Politics", 2022. <file:///C:/Users/g.svanadze/Downloads/274-1240-1-PB.pdf>
6. Gorgoshadze, M. Mgeladze, M. High "Issues of Legal Regulation of the Extension of Certain Human Rights to Artificial Intelligence, Robots" p. 66 <https://constcourt.ge/files/2/Journal2019.1/M.Mgeladze-M.Gorgoshadze-2019.1ka.pdf>
7. First, S. Sikharulidze, M. "Artificial Intelligence or Revolution in the World" Journal "Academplab" №4 <https://neu.edu.ge/uploads/common/files/cf75529a-af51-4bb5-9749-e8c5b5618e17.pdf>
8. Hafiz Gaffar, "Implications of Digitalization and AI in the Justice System: A Glance at the Socio-legal Angle" <https://lawandworld.ge/index.php/law/article/view/585>
9. AI in justice administration and access to justice https://www.oecd.org/en/publications/governing-with-artificial-intelligence_795de142-en/full-report/ai-in-justice-administration-and-access-to-justice_f0cbe651.html#OEC2313_6f09aca72d
10. ARTIFICIAL INTELLIGENCE, JUDICIAL DECISION-MAKING AND FUNDAMENTAL RIGHTS https://ssm-italia.eu/wp-content/uploads/2025/02/JuLIA_handbook-Justice_final.pdf
11. AI in our Justice System, A JUSTICE report led by Sophia Adams Bhatti January 2025, p. 11 <https://files.justice.org.uk/wp-content/uploads/2025/01/29201845/AI-in-our-Justice-System-final-report.pdf>
12. Chris, R. Artificial Intelligence: Ethical Issues
13. Beruashvili, M. /Beruashvili, M. The Capabilities and Challenges of Artificial Intelligence in the Justice System, Law and Ward (N35/2025) <https://lawandworld.ge/index.php/law/article/view/848>
14. Artificial intelligence at the bench: Legal and ethical challenges of informing—or misinforming—judicial decision-making through generative AI

15. Ethical Challenges of Using Artificial Intelligence in Judiciary
https://arxiv.org/html/2504.19284v1?utm_source=chatgpt.com
16. Ethical Challenges of Using Artificial Intelligence in Judiciary
https://arxiv.org/html/2504.19284v1?utm_source=chatgpt.com
17. (CEPEJ) European Ethical Charter on the Use of Artificial Intelligence in Judicial Systems and their environment <https://rm.coe.int/ethical-charter-en-for-publication-4-december-2018/16808f699c>
18. Desmond, O. Ethical Challenges of Using Artificial Intelligence in the Judiciary
https://papers.ssrn.com/sol3/papers.cfm?abstract_id=5377863
19. Challenges of the digital age for privacy and personal data protection
https://www.aimspress.com/article/id/5544?utm_source=chatgpt.com
20. Ethical Challenges of Using Artificial Intelligence in Judiciary
https://arxiv.org/html/2504.19284v1?utm_source=chatgpt.com
21. The Right to Privacy in the Age of Artificial Intelligence: Challenges
22. and Legal Frameworks
https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4908340&utm_source=chatgpt.com
23. AI and Law: What are the Ethical Considerations? https://www.clio.com/resources/ai-for-lawyers/ethics-ai-law/?utm_source=chatgpt.com

Philological Sciences

A Theoretical Study of Intertextuality and Cultural Code in American Cinema

Aimysheva Tomiris Suleimenkyzy

Master's degree student, L.N. Gumilyov Eurasian National University

Abstract. This theoretical article examines intertextuality as a central mechanism through which cultural codes are formed, transmitted, and transformed in American cinema. Treating film as a multimodal cultural text embedded in a dense network of prior discourses, the study aims to clarify how intertextual relations function at narrative, genre, stylistic, and semiotic levels to shape culturally conditioned meaning. The article synthesizes key approaches from semiotics, cultural theory, and film studies to conceptualize intertextuality not as an auxiliary stylistic device, but as a constitutive principle of cinematic discourse. Attention is given to how intertextual strategies operate in representations of identity, genre memory, and cultural otherness, as illustrated by scholarly interpretations of films such as *The Last Samurai*, *Memoirs of a Geisha*, and *Jackie Brown*. These examples demonstrate how American cinema activates shared cultural knowledge; reworks inherited genre conventions and produces recognizable ideological and emotional frameworks for audiences. The study argues that intertextuality simultaneously stabilizes cultural codes through repetition and transforms them through reinterpretation, allowing cinema to function as both a repository of cultural memory and a dynamic space of cultural meaning-making within a global context.

Keywords: intertextuality, American cinema, cultural code

Introduction

In recent decades, cinema has become a central object of interdisciplinary research at the intersection of film studies, linguistics, semiotics, and cultural studies. English-language, and particularly American, cinema occupies a dominant position in global media circulation, which makes the study of its meaning-making mechanisms especially significant. One of the most productive analytical concepts for examining how films generate and transmit cultural meaning is intertextuality, understood as the interaction of a cinematic text with prior literary, cinematic, historical, and popular-cultural discourses.

The theoretical foundations of intertextuality were laid by J. Kristeva, who conceptualized the text as a “mosaic of quotations,” and further developed by R. Barthes, whose notion of the cultural code foregrounds shared knowledge as a key condition of interpretation. U. Eco's theory of culture as an interlocking system of codes and Y. Lotman's model of the semiosphere provide a broader semiotic framework for understanding cinema as a mechanism of cultural information storage and transmission. Within film studies, scholars such as L. Jenny have contributed to the differentiation of intertextual relations, while E. Ivanova has demonstrated that intertextuality constitutes a defining property of the film text, operating simultaneously on content-related, genre-stylistic, and formal-semiotic levels.

Despite extensive scholarly attention to intertextuality in cinema, existing research has predominantly focused either on cataloguing intertextual references in specific films or on applying individual theoretical models in isolation. Less attention has been paid to intertextuality as an integrative cultural mechanism that systematically participates in the formation and

transformation of cultural codes in American cinema. The originality of the present article lies in its theoretical synthesis of semiotic, cultural, and film-discourse approaches in order to reconceptualize intertextuality as a central means of cultural coding rather than as a secondary aesthetic technique. By bringing together diverse theoretical perspectives and illustrative film-based scholarship within a unified conceptual framework, the article clarifies how intertextual relations structure culturally shared meanings across cinematic texts.

The aim of this article is to theoretically substantiate intertextuality as a key mechanism of cultural code formation in American cinema and to demonstrate how intertextual practices enable films to reproduce, negotiate, and transform culturally embedded meanings within contemporary film discourse.

Research Methods

This article adopts a descriptive and analytical research design based on the critical reading, comparison, and synthesis of existing scholarly works devoted to intertextuality, cultural codes, and cinematic discourse. The study does not involve original film analysis or empirical data collection; instead, it relies on secondary analysis of academic sources, including theoretical monographs, peer-reviewed articles, and doctoral dissertations in the fields of semiotics, cultural studies, film studies, and media discourse analysis. The methodological focus is therefore meta-analytical: the article examines how intertextuality has been conceptualized, applied, and interpreted by different scholars in relation to American cinema.

The primary method employed in this study is theoretical synthesis, which allows for the integration of diverse conceptual approaches into a coherent explanatory framework. Comparative analysis is used to identify convergences and divergences among key theories of intertextuality and cultural coding, particularly those developed within semiotic and cultural traditions.

In addition, the article takes into account the research methods used by the authors whose works are examined. These include semiotic analysis of film texts, discourse analysis of cinematic narratives, genre analysis, and culturally oriented film interpretation. Studies addressing representations of cultural identity and otherness employ comparative cultural analysis, while research on genre memory and film reception relies on intertextual and reception-based methodologies. By systematizing these methodological approaches, the article demonstrates how intertextuality has been operationalized in film scholarship and clarifies its theoretical potential as a mechanism of cultural code formation.

Literature review

Rajabi et al. provide a comprehensive overview of intertextuality as it developed from first-generation theorists such as Kristeva and Barthes to the more applied, cinema-oriented perspectives of Jenny, establishing a theoretical basis highly relevant for studying cultural code formation in film [1]. They emphasize Kristeva's conception of the text as a "mosaic of quotations," framing cinema as an artistic system inherently shaped by prior discourses and cultural artifacts, and therefore always engaged in reproducing or transforming existing cultural meanings [1]. Barthes' contribution, particularly his notions of the death of the author and the readerly/writerly distinction further situates intertextuality as a process in which viewers actively construct meaning from recognisable cultural codes embedded in filmic texts [1]. Rajabi et al. also highlight Jenny's concepts of weak and strong intertextuality, which offer a practical framework for distinguishing between superficial cultural references and more substantive structural or thematic transformations within cinema.

Building on this theoretical foundation, Ivanova deepens the understanding of intertextuality within the cinematic discourse. In the theoretical part of her dissertation, she

defines intertextuality as one of the constitutive properties of the film text. She emphasizes that cinema, as a type of artistic text, is inherently built upon textual interconnections: “intertextual relations within the artistic film text are expressed at the content-related, genre-stylistic, and formal-semiotic levels” [2]. This means that intertextuality permeates every structural layer of film from narrative motifs and thematic structures to genre conventions and the semiotic organization of visual and auditory elements. Ivanova stresses that intertextuality is not merely an additional stylistic device but “an integral and possibly, defining characteristic of film” [2]. In this view, intertextuality forms the foundational principle by which cinematic meaning is constructed and interpreted, positioning film as a multimodal text embedded within a network of cultural references.

The broader theoretical understanding of cultural codes further reinforces this perspective. Eco defines cultural codes as the basic “systems of signification” through which societies organize and interpret signs, noting that “a culture is a universe of interlocking codes” [3]. Barthes’ formulation of the cultural (gnomic) code establishes it as the reservoir of shared knowledge that anchors meaning, since “the cultural code is made up of all those items whose function it is to anchor the meaning of a narrative to a commonly held body of knowledge” [1]. Lotman complements these views by emphasizing that culture functions as “a mechanism for the creation, storage, and transmission of information”, and that “every culture begins by creating a set of codes” that operate within the broader semiosphere of meaning [3]. Together, these perspectives position cinematic texts as culturally coded structures whose intelligibility depends on shared semiotic systems – systems that themselves become activated through intertextual processes.

The concept of cultural code in cinema is further elaborated in Poluehtova’s dissertation *American Cinema as a Means of Cultural Expansion*, where cultural code emerges through the deep interrelation between film production and the sociocultural environment in which American cinema historically developed [4]. Drawing on broader cultural theory, Tuganova’s differentiation between high, popular, and mass culture provides a useful framework for understanding the sources of these codes [5]. Each layer transmits specific norms, behavioural patterns, and value orientations that film texts draw upon and reproduce. Popular culture, as Tuganova notes, is closely tied to national psychology and everyday experience, embedding stable cultural norms and mythic narratives such as national ideals, heroic archetypes, and sentimental moral frameworks that American cinema amplifies through recurring narrative patterns and symbolic imagery [5]. In contrast, mass culture, as described by Ashin, Midler, Kuzheleva, and others, is highly commercialized, standardized, and ideologized. It simplifies cultural meanings into stereotypes and formulaic behavioural models, producing a codified system of easily consumable signs that Hollywood circulates globally [4].

Within this multilevel system, cultural code becomes the set of ideological, emotional, and symbolic structures embedded in film texts, arising both from inherited cultural traditions and from intertextual engagement with prior cinematic and non-cinematic discourses. [4; 2]. As a result, intertextuality does not merely reference previous works: it becomes a mechanism through which cinema activates, reproduces, and transforms the cultural codes that shape audience interpretation [1; 3].

Based on the analysis of the existing scholarship, the present study argues that although intertextuality is widely acknowledged as a defining feature of cinematic texts, it is most often examined either at the level of textual reference or within the analysis of individual films and genres.

Semiotic models emphasize the multiplicity of textual connections and the viewer’s role in decoding meaning, yet they often treat cultural codes as a stable background rather than as a dynamic construct shaped through intertextual practice. Film-oriented studies, in turn, provide

detailed classifications of intertextual markers and demonstrate their narrative and stylistic functions, but rarely extend this analysis to a broader cultural level. As a result, intertextuality and cultural code are frequently examined in parallel rather than within a unified explanatory framework. This observation indicates the need for an integrative theoretical approach that conceptualizes intertextuality not only as a mechanism of textual reference, but as a systematic means of cultural coding in American cinema.

Results and Discussion

Andre Dechert's study of asynchronous media change between U.S. and West German television in the 1950s offers an illuminating model for understanding how intertextuality operates as a mechanism of cultural translation in American cinema [6]. Drawing on Gabriele Balbi's claim that "new media copy the content of old media" and that such imitation is a "key feature of the society of mass communication" [7], Dechert reveals how cultural forms migrate through repetition and adaptation [6]. His analysis of West German producers who modeled local series on American formats such as *I Love Lucy* and *Dragnet* demonstrates that intertextual borrowing is not a mere act of imitation but a process of negotiating cultural codes across media systems [6]. The German case, in which "television series were created on the basis of U.S.-American ones or the rights of U.S.-American TV series were secured for broadcasting", parallels cinema's re-articulation of Anglo-American myths through remake, genre, and quotation [6]. Moreover, Dechert's emphasis on individual "champions" who act as mediators of innovation suggests that intertextuality itself depends on agents who bridge social and cultural systems [6]. He states that in cinematic terms, this dynamic highlights how directors, producers, and audiences collectively sustain a transnational cultural code: a network of references that both localizes and universalizes American narratives [6].

The cultural foundations that make such intertextual circulation effective are examined in detail by Poluehtova. She shows that from its inception, U.S. cinema grew within a cultural framework defined by individualism, entrepreneurial pragmatism, and the ideology of success – values that became embedded into the aesthetic and narrative structures of film [4]. Early American films, shaped by rapid industrialization, mass immigration, and the rise of "mass society," translated these cultural orientations into accessible visual narratives that served both entertainment and socialization functions [4]. Cinema thus became a tool for the rapid integration of heterogeneous immigrant audiences, offering standardized behavioral models, value hierarchies, and emotional patterns aligned with mainstream American norms. As Poluehtova argues, the cultural code of American cinema is inseparable from its commercial logic: the reliance on mass audiences and genre conventions ensured the encoding of widely shared psychological structures – interest in individual destiny, triumph over adversity, moral dualism while also distributing them globally as part of the United States' cultural outreach [4]. Through this mechanism, American cinema formed a transnational cultural code grounded in universally readable emotional cues and archetypal narratives, allowing Hollywood to operate not only as entertainment but also as an instrument of cultural expansion [4].

The role of intertextuality in shaping representations of cultural Otherness is further exemplified in Karolina Robaczek's analysis of Japan in contemporary American popular cinema. She demonstrates that films such as *The Last Samurai* and *Memoirs of a Geisha* are not authentic portrayals of Japanese culture but rather forms of "pop-cultural packaging" that aestheticize and domesticate difference [8]. Rather than dismissing these distortions as superficial, Robaczek interprets them as part of a broader mechanism of cultural consumption – a specifically American way of "assimilating" otherness by transforming it into a recognizable spectacle [8]. Drawing on U. Eco's concept of the "industry of Absolute Fake," she argues that American culture often reconstructs foreign traditions in hyperreal form to satisfy the "need for visual experience" and

“the truth of emotion,” rather than historical accuracy [8]. Such intertextual recycling thus reveals how cinema shapes collective imaginaries of the East while simultaneously constructing its own cultural identity through appropriation and re-signification of the foreign.

Taken together, the discussed studies demonstrate that intertextuality functions in American cinema as a systematic mechanism of cultural coding rather than as an isolated narrative or stylistic device. Across different media contexts, genres, and cultural representations, intertextual practices enable the circulation, stabilization, and reinterpretation of culturally shared meanings. The analysis shows that through repetition, adaptation, and quotation, intertextuality activates recognizable ideological and symbolic frameworks that guide audience interpretation and contribute to the formation of a transnational cultural code.

The present results also align with Ivanova’s contribution to intertextual methodology. Her typology of criteria for identifying intertextual relations—based on “the source of borrowing, the features of intertextual marking... the type of intertextual reference” demonstrates that intertextuality in cinema ranges from direct quotation to subtle structural resonance [2]. By categorizing intertextual markers into maximum, medium, or minimal visibility, Ivanova highlights the breadth of intertextual mechanisms used by filmmakers, from explicit homage to implicit thematic or stylistic echoes. Her extended typology, which includes “cinematic, literary, visual-artistic, architectural, musical, televisual, religious, scientific... properly intertextual, autotextual, and reproductive... visual and auditory... content-based, structural, and content-structural... quotations and reminiscences... verbal, musical, visual, and narrative” underscores the multimedia nature of film texts [2]. Intertextuality emerges through visual motifs, performance conventions, actor factors, music, sound design, and genre structures, confirming its centrality to cinematic meaning-making.

Furthermore, Ivanova situates intertextuality within the broader field of cultural memory. Citing Zhinkin, she emphasizes that the meaning of a text fragment “is not merely reduced to its immediate content, but also includes what has been said previously and what the author intends to express subsequently” [2]. Canonical works such as the Bible, Dante, Cervantes, Goethe, Homer, Shakespeare, and major Russian authors serve as stable intertextual reservoirs for both literature and cinema, shaping viewer interpretation through shared symbolic knowledge. Intertextuality therefore functions as a mechanism through which films activate cultural memory and engage the viewer in culturally conditioned practices of recognition [2].

These findings align closely with Martynuska’s perspective on intertextual reception. She describes intertextuality as “an approach that analyzes how one text is related to already available texts and discourses” and emphasizes that “the successful perception of intertextual references requires a certain degree of comprehension ability from the film’s audience” [9]. Her analysis of *Jackie Brown* confirms that recognition of prior texts whether literary (*Rum Punch*), cinematic (1970s blaxploitation films), or cultural (1970s music and aesthetics) directs viewers toward culturally coded interpretations of race, gender, and genre. This corresponds to Kristeva’s formulation of the text as a “mosaic of quotations” and Barthes’ conceptualization of the cultural code as shared knowledge structuring narrative meaning [1].

The analysis also demonstrates that intertextuality negotiates cultural hierarchies. Tarantino’s engagement with blaxploitation traditions foregrounds Black cultural identity by centering Pam Grier’s star persona and 1970s Black urban aesthetics [9]. As Martynuska notes, the film’s intertextual dialogue with blaxploitation becomes visible through homage, casting, and soundtrack, generating a dense network of cultural associations that the viewer decodes through culturally shared references [9]. This supports Lotman’s view of culture as a system of codes stored and transmitted through texts: cinema activates and reactivates cultural memory, reinscribing historically embedded structures of race, identity, and social space into new configurations [3].

At the same time, intertextuality functions as a site of cultural transformation. By reworking familiar elements such as the blaxploitation heroine, the caper-film structure, and racial dynamics – Tarantino produces new cultural meanings that both affirm and revise earlier codes. Martynuska's claim that intertextual recognition "creates new imageries" supports this observation and aligns with Ivanova's premise that intertextuality enriches filmic meaning by generating layered semantic relations across texts and traditions. [9; 2]. Thus, intertextuality emerges not only as a system of referencing but as a dynamic process that reshapes cultural codes through cinematic reinterpretation.

The results of the discussion indicate that intertextuality contributes to the formation of multiple types of cultural codes in American cinema, including ideological, genre-based, and identity-related codes. By mobilizing cultural memory, genre traditions, and shared symbolic references, intertextuality structures narrative meaning and shapes representations of self and other. At the same time, intertextual reinterpretation allows inherited cultural codes to be transformed within new aesthetic and ideological contexts. This confirms that intertextuality operates as a dynamic cultural mechanism through which cinema simultaneously preserves and reconfigures culturally embedded meanings.

Overall, the discussion demonstrates that intertextuality operates as an indispensable means of cultural coding in American cinema. By activating shared symbolic knowledge, mobilizing established genre lexicons, and engaging in culturally charged reinterpretations, films transform intertextual relations into mechanisms that shape collective cultural understanding. The interplay between theoretical models and empirical examples confirms that intertextuality functions as both a semiotic strategy and a cultural practice through which cinema negotiates identity, heritage, and ideological frameworks.

Conclusion

This study demonstrates that intertextuality functions as a fundamental mechanism through which American cinema constructs, circulates, and transforms cultural codes. The theoretical perspectives discussed in the article from foundational concepts of intertextuality to semiotic models of cultural coding confirm that cinematic meaning emerges through a film's embeddedness in prior discourses, shared symbolic systems, and culturally conditioned modes of interpretation. Intertextual relations permeate narrative, stylistic, and semiotic levels of the film text, reinforcing the view of cinema as a multimodal cultural structure rather than a self-contained artistic form.

The discussion of existing scholarship confirms these theoretical premises across diverse cultural contexts. Models of media translation reveal how intertextual borrowing mediates cultural transfer between systems, while analyses of American cinema demonstrate how narrative and aesthetic conventions encode dominant ideological and psychological frameworks. Studies of cultural otherness further show that intertextual strategies shape representations of the foreign by transforming inherited cultural forms into recognizable and emotionally accessible images. Research on intertextual reception likewise highlights the role of cultural memory and shared knowledge in guiding audience interpretation.

Across these perspectives, intertextuality emerges not as an optional stylistic device but as a dynamic cultural practice through which cinema negotiates identity, heritage, and ideology. By mobilizing genre traditions, canonical texts, and popular-cultural references, American cinema produces a transnational cultural code grounded in recognizable narrative, emotional, and symbolic structures. At the same time, intertextual reinterpretation enables established cultural codes to be revised and reconfigured within new aesthetic and ideological contexts.

The originality of the present study lies in its theoretical synthesis of semiotic, cultural, and film-discourse approaches, which allows intertextuality to be conceptualized as a systematic

mechanism of cultural code formation in American cinema. This perspective positions cinema as both a repository and a generator of cultural meaning and opens avenues for further theoretical research into intertextual processes across different national cinemas, genres, and media forms.

References

1. Khodabakhshi, S., & Rajabi, V. (2023). *Perspectives of intertextuality in cinema, with special references to the work of Kristeva, Barthes, and Jenny: A comparative study*. Avanca.
2. Ivanova, E.B. (2001). *Intertextual relations in feature films* (Candidate's dissertation in Philology). Volgograd. (In Russian)
3. Lotman Yu. M. *Semiosphere* / Yu. M. Lotman. – SPb. : Iskusstvo-SPB, 2010. – 704 p
4. Poluekhova, I.A. (1993). *American cinema as a means of cultural expansion* (Candidate's dissertation in Sociology). Moscow. (In Russian)
5. Tuganova, O.E. (1991). *American diversity*. In *American character* (pp. 5–28). Moscow. (In Russian)
6. Dechert, A. (2016). *A case of asynchronous media change in the 1950s: How US-American TV series came to early West German television*. *Global Media Journal: German Edition*, 6(2). https://www.dbthueringen.de/servlets/MCRFileNodeServlet/dbt_derivate_00037163/GMJ12_Deichert_final.pdf
7. Balbi, G. (2015). *Old and new media: Theorizing their relationships in media historiography*. In S. Kinnebrock, C. Schwarzenegger, & T. Birkner (Eds.), *Theorien des Medienwandels* (pp. 231–249)
8. Robaczek, K. (2014). *Orient light? The image of Japan in American popular cinema of the last decade*. *Litteraria Copernicana*, 0(2(14)), 284–293. Nicolaus Copernicus University in Toruń. <https://apcz.umk.pl/czasopisma/index.php/LC/article/view/5208>
9. Martynuska, M. (2022). *Intertextuality in Quentin Tarantino's Jackie Brown*. *Polish Journal for American Studies*, 16, 29–42.

Neurobiological Pathways of First Word Acquisition

Asmar Karimli

lecturer at Azerbaijan State Pedagogical University, Sheki branch.

ORCID:0009000624855857

Keywords: Language Acquisition, Neurobiology, First Words, Infant Brain, Neural Plasticity, Auditory Cortex, Semantic Development, Motor Cortex, Functional Connectivity, Developmental Neuroscience.

Abstract: The seemingly effortless transition from coos and babbling to the production of meaningful first words is a profound neurobiological phenomenon. This article delves into the intricate interplay of brain development and linguistic emergence during early childhood. We explore how the infant brain's remarkable plasticity lays the groundwork for phonemic discrimination, how auditory and motor cortices orchestrate the complex dance of speech production, and how the burgeoning semantic networks begin to imbue sound with meaning. Through an examination of current neuroscientific methodologies, we aim to illuminate the neural pathways that guide infants towards their inaugural vocal utterances, offering insights into the fundamental mechanisms of human language acquisition.

Introduction: The Dawn of Utterance

The human capacity for language is arguably our species' most defining trait. While the complex grammars and vast vocabularies of adult language are marvels in themselves, the initial stages of acquisition—the journey from nascent sounds to meaningful first words—represent an equally astounding feat of neurobiological development. Within the first 12 to 18 months of life, infants, armed with little more than innate predispositions and rich sensory input, begin to decode the linguistic world around them, culminating in the magical moment of their first word. This transition is not merely a behavioral milestone; it is a profound testament to the dynamic and adaptive nature of the developing brain. As Dr. Anne Fernald, a leading developmental psychologist, notes, *"The brain of an infant is a landscape of extraordinary potential, rapidly sculpting itself in response to the rich tapestry of language it encounters."* Understanding this process requires us to move beyond behavioral observations and delve into the underlying neurobiological architecture that supports this crucial developmental leap. This article aims to provide a comprehensive overview of the scientific investigations into the neurobiological pathways that underpin the acquisition of a child's first spoken words.

The journey begins with a brain that is inherently primed for linguistic input. Infant brains exhibit an astonishing degree of neuroplasticity, the ability to reorganize itself by forming new neural connections throughout life. This plasticity is particularly pronounced in early development, allowing the infant brain to adapt and specialize in response to environmental stimuli. For language acquisition, this means the brain is meticulously mapping the sounds, rhythms, and structures of the languages it is exposed to. This intricate process involves the coordinated activity of multiple brain regions, from the initial sensory processing of sounds to the intricate motor commands required for articulation, and the complex cognitive networks that bind sounds to concepts. We will explore how these distinct yet interconnected systems converge to facilitate the emergence of intentional vocalizations that carry meaning, marking the true dawn of linguistic communication.

The Auditory Foundation: Perceiving the Sounds of Language

Before an infant can produce a word, they must first be able to perceive and differentiate the myriad of sounds that constitute language. The journey into sound begins even before birth, with fetuses demonstrating sensitivity to the prosody and cadence of their mother's voice (Lecanuet et al., 1995). Postnatally, the infant brain's auditory system undergoes rapid development. The auditory cortex, located in the temporal lobe, is a crucial hub for processing sound information. From birth, infants are remarkably adept at distinguishing between different speech sounds, a skill known as phonemic discrimination. Research utilizing Electroencephalography (EEG) has shown that infants as young as one month can discriminate between phonetic contrasts in their native language, and even at six months, can differentiate between sounds from non-native languages (Kuhl et al., 1992).

This early attunement to speech sounds is a testament to the brain's capacity to learn from experience. As infants are continuously exposed to the language(s) spoken around them, their brains begin to tune into the specific phonemes that are linguistically relevant. This phenomenon, often referred to as perceptual narrowing, means that infants gradually become more attuned to the distinctions in their native language while becoming less sensitive to those not present in their linguistic environment (Werker & Tees, 1984). This selective tuning is a critical neurobiological process, allowing the brain to efficiently focus on the sound system it needs to master. Neuroimaging studies, such as functional Magnetic Resonance Imaging (fMRI), have begun to map the specific neural networks involved in this auditory processing. While initial processing occurs in the primary auditory cortex, higher-level areas in the temporal lobe are recruited for more complex sound pattern recognition and the extraction of phonetic features. The efficiency and specificity of this auditory processing form the bedrock upon which all subsequent linguistic development is built, enabling infants to distinguish the subtle phonetic cues that differentiate one word from another.

Orchestrating Articulation: The Motor Blueprint for Speech

The production of a spoken word involves an intricate coordination of the vocal tract—the lungs, larynx, tongue, lips, and jaw. This complex motor act requires precise and timely muscle movements, orchestrated by the brain's motor control systems. The motor cortex, located in the frontal lobe, plays a pivotal role in planning and executing voluntary movements. For speech, this involves the precise articulation of phonemes. While the development of fine motor control for speech production is a gradual process, occurring alongside other motor milestones like sitting and crawling, the neural pathways for vocalization begin to mature rapidly in infancy.

Early vocalizations, such as cooing and babbling, are initially characterized by more reflexive and less controlled movements of the vocal apparatus. However, as infants gain more control, babbling begins to take on more structured patterns, incorporating the phonemes and intonation contours of their native language (Oller, 2000). This iterative process of vocal exploration and auditory feedback is crucial for refining motor commands. Infants hear themselves make sounds, compare these sounds to the linguistic input they receive, and adjust their motor output accordingly. This feedback loop is a powerful driver of learning, allowing the brain to refine the neural connections responsible for speech production.

Research using advanced neuroimaging techniques, though challenging in awake and mobile infants, is beginning to shed light on the neural correlates of this motor development. Studies suggest that areas within the pre-motor cortex and the cerebellum are involved in the planning and coordination of these complex motor sequences. Furthermore, there is growing evidence for a dynamic interaction between auditory and motor cortices during speech development. This sensorimotor integration allows the infant brain to not only produce sounds but also to monitor and adjust these productions based on auditory feedback. As Dr. Patricia Kuhl, a pioneer in infant speech perception, emphasizes, *"The remarkable thing is not just that babies learn to*

perceive sounds, but that they learn to produce them, linking auditory perception with motor output so fluidly." This intricate dance between perception and action is fundamental to the articulation of a child's first spoken words.

The Genesis of Meaning: Connecting Sounds to Concepts

The production of a word is more than just the precise articulation of sounds; it is the act of imbuing those sounds with meaning. This process, known as semantic development, involves the formation of associations between words and their referents—objects, actions, people, and abstract concepts. In the infant brain, this requires the intricate integration of auditory and motor information with the developing systems of memory and conceptual representation.

The hippocampus, a key structure involved in memory formation, is believed to play a significant role in establishing these early word-meaning associations. As infants hear a word repeatedly in context (e.g., "ball" when shown a ball), their brains begin to form connections between the auditory representation of the word and the visual or conceptual representation of the object. These associations are initially fragile and context-dependent, but with repeated exposure and reinforcement, they become more robust and generalized.

fMRI studies in older children and adults have identified widespread networks involved in semantic processing, including areas in the temporal, parietal, and frontal lobes. While direct imaging of semantic development in infants is complex, research using Event-Related Potentials (ERPs), a type of EEG that measures brain responses to specific stimuli, has provided valuable insights. These studies suggest that even before infants can produce words, they show differentiated brain responses to familiar versus unfamiliar words, indicating some level of semantic understanding (Friedrich & Friederici, 2011). The emergence of first words, therefore, represents a critical point where the infant brain has successfully forged these crucial neural links, allowing for the intentional retrieval and production of a sound sequence associated with a specific meaning. This ability to map arbitrary sounds onto conceptual representations is a fundamental cognitive achievement that underpins all subsequent language learning. As renowned linguist Noam Chomsky posited, *"Language is a creative potentiality inherent in our nature."* This creativity is first manifested in the child's ability to assign meaning to the vocalizations they produce.

Conclusion: A Symphony of Neural Activity for First Words

The acquisition of a child's first word is a remarkable neurobiological symphony, a testament to the intricate coordination of auditory perception, motor control, and semantic mapping within the developing infant brain. The journey from the nuanced discrimination of phonemes in the auditory cortex to the precise articulation orchestrated by the motor cortex, and finally, the forging of meaning through emergent semantic networks, highlights the dynamic and interconnected nature of early language development.

Current scientific inquiry, utilizing a suite of neuroimaging techniques and behavioral methodologies, is steadily unraveling the neural blueprints that guide this transformative process. The concept of neuroplasticity serves as the overarching principle, enabling the infant brain to adapt and specialize in response to linguistic input. The continuous feedback loop between sensory experience and motor output refines the neural circuits responsible for both understanding and producing speech. Moreover, the ability to form robust semantic associations lays the crucial foundation for communicative intent.

While much remains to be understood, the ongoing research in developmental neuroscience promises to further illuminate the complex interplay of genes, environment, and neural mechanisms that contribute to this fundamental human achievement. Understanding these pathways not only deepens our appreciation for the miracle of language acquisition but also holds significant implications for identifying and supporting children facing language-related challenges. The infant brain, with its inherent capacity for learning and adaptation, continues to be a fertile

ground for scientific discovery, reminding us that the genesis of language is as much a biological imperative as it is a social one.

References:

1. Fernald, A. (1985). Sound structure in songs to infants: Scaffolding, attention, and meaning. *Journal of Child Language*, 12(1), 239-248.
2. Friedrich, M., & Friederici, A. D. (2011). The neural basis of syntactic reanalysis in young children. *Developmental Cognitive Neuroscience*, 1(3), 270-279.
3. Chomsky, N. (1972). *Language and Mind*. Harcourt Brace Jovanovich.
4. Kuhl, P. K., Williams, K. A., Lacerda, F., Stevens, K. N., & Lindblom, B. (1992). Phonetic details in the speech of young infants. *Science*, 255(5040), 606-608.
5. Lecanuet, J. P., Granjon, L., & Valsiner, J. (1995). Fetal perception of speech. In *The child: His psychological and social development* (pp. 49-64). Psychology Press.
6. Oller, D. K. (2000). The emergence of the speech form. *Journal of Child Language*, 27(1), 121-150.
7. Werker, J. F., & Tees, R. C. (1984). Cross-language speech perception: Evidence for perceptual reorganization during the first year of life. *Infant Behavior and Development*, 7(1), 49-63.

Comparative Ellipsis in British and American English

Goncha Ahmadova

Lecturer at Azerbaijan State Pedagogical University

Abstract

Comparative ellipsis is a syntactic phenomenon in which elements of a sentence are omitted because they can be inferred from context, particularly within comparative constructions. It serves as a mechanism for linguistic economy, allowing speakers and writers to avoid unnecessary repetition while maintaining clarity and grammaticality. This paper investigates comparative ellipsis in British English (BrE) and American English (AmE), highlighting both similarities and differences in usage, syntactic constraints, and stylistic preferences. Drawing on extensive corpus studies, grammar frameworks, and prior research (Huddleston & Pullum, 2002; Biber et al., 1999; McCawley, 1998), the paper examines how auxiliaries, copulas, and negation influence ellipsis patterns across the two varieties. Findings indicate that BrE generally permits more frequent ellipsis, especially in informal speech, and allows greater syntactic flexibility, whereas AmE demonstrates stricter retention of auxiliaries, particularly in negative and interrogative contexts, to reduce ambiguity. The study also explores register effects, multiple ellipsis constructions, and pedagogical implications for English learners. Understanding these differences is crucial for linguists, translators, and language educators aiming to navigate the subtle variations between BrE and AmE.

Keywords: *Comparative ellipsis, British English, American English, syntax, ellipsis, language variation, auxiliaries, register*

Introduction

Ellipsis is a fundamental grammatical mechanism that enables speakers to omit certain linguistic elements when they are contextually inferable (Leech, 2006). This process enhances linguistic efficiency by reducing redundancy while preserving meaning. One important type of ellipsis is comparative ellipsis, which occurs in comparative constructions where repeated components, often verb phrases or predicates, are left unexpressed. For example, in the sentence “John is taller than Mary [is tall],” the predicate “is tall” is understood from the preceding clause and is therefore omitted. Comparative ellipsis allows sentences to remain concise without losing semantic clarity and is widely observed across various registers in English, including both spoken and written forms. While comparative ellipsis occurs in both British and American English, prior research indicates subtle yet significant differences between the two varieties. In British English (BrE), speakers frequently omit copulas, auxiliaries, and other repeated elements, especially in informal speech, resulting in more streamlined comparative constructions (Biber et al., 1999). In American English (AmE), however, ellipsis is often more conservative. Auxiliary verbs are more likely to be retained, particularly in negative forms and interrogatives, in order to maintain clarity and reduce potential ambiguity (McCawley, 1998). Additionally, AmE relies on “do-support” in many ellipsis contexts, a feature that distinguishes it from BrE.

The study of comparative ellipsis is not only theoretically significant in understanding syntactic economy and grammatical variation but also has practical implications for language teaching, translation, and intercultural communication. English learners, translators, and language professionals must recognize these differences to ensure accurate and natural expression in both varieties.

This paper aims to explore comparative ellipsis in BrE and AmE through a detailed examination of syntactic patterns, auxiliary usage, register effects, and stylistic preferences. The following research questions guide the study:

1. What are the primary types of comparative ellipsis in British and American English?
2. How do syntactic constraints, such as auxiliary retention and negation, differ between BrE and AmE?
3. In what ways do register and stylistic preferences influence the use of comparative ellipsis in both varieties?

By addressing these questions, this paper seeks to provide a comprehensive understanding of comparative ellipsis, highlighting its role in English syntax and the subtle divergences between the two major varieties of English.

Literature Review

Ellipsis, as a syntactic and semantic phenomenon, has been a focal point of linguistic research for decades. It is broadly defined as the omission of elements in a sentence that can be inferred from context, thereby reducing redundancy and enhancing communicative efficiency (Leech, 2006; Pullum & Huddleston, 2002). Among the various types of ellipsis, comparative ellipsis is particularly significant because it occurs in constructions that express comparison between two entities or actions. Such constructions often involve repeated elements such as verbs, adjectives, or entire predicate phrases.

Historically, the study of ellipsis in English can be traced back to early descriptive grammars of the 18th and 19th centuries, where prescriptive rules often discouraged omission of elements in formal writing. Modern linguistic analysis emphasizes the functional and cognitive motivations behind ellipsis, suggesting that speakers rely on shared context and syntactic predictability to communicate effectively without redundancy (Hawkins, 1994; Biber et al., 1999).

Huddleston and Pullum (2002) provide a comprehensive syntactic framework for understanding ellipsis in English. They identify comparative ellipsis as a mechanism in which elements from the first clause are omitted in the second, provided that they can be grammatically and semantically recovered. For example: "Alice reads more books than Bob [reads books]." Here, the verb phrase "reads books" is elided in the comparative clause. Huddleston and Pullum also emphasize the importance of auxiliary verbs and copulas in ellipsis constructions, noting that their presence or absence can influence grammatical acceptability and ambiguity.

Biber et al. (1999) examine ellipsis through a corpus-based approach, comparing spoken and written English across registers. Their findings indicate that British English frequently employs ellipsis, especially in informal spoken discourse. For instance, in conversation, a British speaker may say, "I like chocolate more than she [likes chocolate]," omitting the verb phrase without loss of clarity. In contrast, American English tends to retain auxiliary verbs in comparable contexts, particularly in formal registers, as in: "I like chocolate more than she does [like chocolate]." Biber et al. attribute this divergence to stylistic conventions and the influence of clarity-oriented norms in American English.

McCawley (1998) focuses on the role of *do*-support in American English ellipsis. He observes that negative and interrogative forms in AmE often require auxiliary verbs to maintain grammaticality. For example, "He doesn't run faster than she does" is preferred over "He doesn't run faster than she [runs]," reflecting a stronger tendency to retain auxiliaries in AmE. This contrasts with BrE, where omission of auxiliaries in similar contexts is more acceptable, particularly in casual speech. Comparative ellipsis is also influenced by syntactic and semantic constraints. Hawkins (1994) notes that ellipsis is generally acceptable when the omitted material is syntactically parallel and semantically recoverable. Ambiguity arises when multiple elements could be interpreted as the elided phrase. For example, "He likes football more than she [likes football] [likes basketball]" demonstrates a potential source of ambiguity that is more likely to be resolved in BrE through

context or prosody, whereas AmE speakers may retain auxiliaries or repeat the verb phrase to avoid confusion.

Recent corpus studies, such as those by Leech et al. (2010) and González (2015), reinforce the idea that register plays a crucial role in comparative ellipsis. Spoken English, particularly in informal conversation, exhibits higher frequencies of ellipsis, while written texts, especially academic or formal genres, show more conservative use, often retaining auxiliary verbs and full predicates. The studies highlight that while BrE allows more frequent and flexible omission, AmE emphasizes clarity, particularly in contexts where ambiguity could arise.

In summary, previous research demonstrates that comparative ellipsis is a pervasive feature of English, but its realization varies between British and American varieties due to syntactic, semantic, and stylistic factors. BrE exhibits a greater tolerance for omission, while AmE often retains auxiliaries to avoid ambiguity. Corpus-based evidence, theoretical frameworks, and pedagogical studies collectively provide a comprehensive understanding of comparative ellipsis, offering insight into its syntactic rules, functional motivations, and register-dependent patterns.

Comparative Ellipsis in British English

Predicate Ellipsis

Predicate ellipsis involves omitting the verb phrase from the second clause of a comparison when it is recoverable from the first clause:

“Alice reads more books than Bob [reads books].”

“He works harder than she [works].”

British English allows omission of both auxiliaries and main verbs, particularly in informal spoken registers (Biber et al., 1999).

Adjective Ellipsis

Adjective ellipsis occurs when adjectives are omitted in the second clause:

“This cake is tastier than that one [is tasty].”

“John’s car is faster than Mary’s [is fast].”

Adverbial Ellipsis

Adverbial phrases can be elided in comparative constructions:

“He runs more quickly than she [runs quickly].”

“I can solve problems more efficiently than he [can solve problems].”

Copula Ellipsis

BrE frequently omits copulas in informal comparative constructions:

“She’s taller than I [am].”

“They’re better at chess than we [are].”

Multiple Ellipsis

BrE allows multiple ellipses when context permits:

“He likes football more than she [likes football] [likes basketball].”

Register and Stylistic Considerations

Ellipsis frequency varies with register. Informal speech tolerates high ellipsis, whereas formal writing tends to retain auxiliaries for clarity.

Interpretation and Ambiguity

While ambiguity can arise, BrE speakers rely on prosody, context, and syntactic parallelism to resolve it.

Comparative Ellipsis in American English

4.1 Predicate Ellipsis with Auxiliary Retention

AmE retains auxiliaries more consistently:

“She has more experience than he has [experience].”

“They are happier than we are [happy].”

Do-Support in Ellipsis

Do-support is common in negative and interrogative contexts:

Negative: “He doesn’t run faster than she does [run].”

Interrogative: “Does he write more efficiently than she does [write]?”

Adjective and Adverb Ellipsis

Adjectives and adverbs are elided with auxiliary retention:

“This car is faster than that one is.”

“He solves problems more efficiently than she does.”

Negation Sensitivity

Ellipsis in negative constructions generally requires auxiliary retention:

Correct: “He doesn’t like coffee more than she does [like coffee].”

Multiple Ellipsis and Ambiguity

Multiple ellipses are less frequent in AmE, with auxiliaries repeated to avoid ambiguity.

Register and Stylistic Considerations

Formal AmE consistently retains auxiliaries, whereas informal speech allows minor omission.

Comparison and Syntactic Analysis

Feature	British English (BrE)	American English (AmE)
Predicate ellipsis	Common, frequent omission	Less frequent, auxiliary retained
Auxiliary/coping ellipsis	Often omitted in informal speech	Usually retained, esp. negative/interrogative
Do-support	Rare	Common in negative/interrogative
Multiple ellipsis	Allowed	Less common, auxiliaries repeated
Register effect	Strong in informal speech	Pronounced; formal writing favors retention
Adjective/adverb ellipsis	Frequent	Allowed but less flexible
Ambiguity tolerance	High; context/prosody	Low; redundancy used

Syntactic principles explain these patterns: parallelism, recoverability, and auxiliary licensing. BrE emphasizes context-driven inference; AmE prioritizes explicitness.

Implications for Teaching, Translation, and Linguistics

Language Teaching

Learners must recognize BrE flexibility versus AmE auxiliary retention. Contrastive exercises, corpus examples, and production practice are recommended.

Translation

Translators must adapt ellipsis to target-language norms, restoring auxiliaries or predicates to preserve clarity.

Linguistic Theory

Comparative ellipsis demonstrates interactions between syntax, pragmatics, and register. It informs models of ellipsis licensing, cross-dialect variation, and computational linguistics applications.

Pedagogical Recommendations

1. Explicit contrastive instruction
2. Contextualized examples
3. Production practice
4. Translation awareness
5. Error correction emphasis

Conclusion

Comparative ellipsis is a syntactic mechanism that allows omission of recoverable elements. BrE exhibits greater flexibility and tolerance for multiple omissions, relying on context and prosody. AmE emphasizes auxiliary retention, do-support, and clarity, particularly in formal registers. Awareness of these differences is essential for learners, translators, and linguists. Future research could explore longitudinal changes, register-specific frequencies, and spoken prosody effects.

1. Biber, D., Johansson, S., Leech, G., Conrad, S., & Finegan, E. (1999). *Longman grammar of spoken and written English*. Longman.
2. González, M. (2015). Comparative ellipsis in spoken English: A corpus-based study. *Journal of English Linguistics*, 43(2), 145–168.
3. Huddleston, R., & Pullum, G. K. (2002). *The Cambridge grammar of the English language*. Cambridge University Press.
4. Hawkins, J. A. (1994). *A performance theory of order and constituency*. Cambridge University Press.
5. Leech, G. (2006). *English grammar for today: A new introduction*. Palgrave Macmillan.
6. Leech, G., Hundt, M., Mair, C., & Smith, N. (2010). *Change in contemporary English: A grammatical study*. Cambridge University Press.
7. McCawley, J. D. (1998). *The syntactic phenomena of English*. University of Chicago Press.
8. Swan, M., & Smith, B. (2001). *Learner English: A teacher's guide to interference and other problems*. Cambridge University Press.

Culturology

Fransız dilini niyə öyrənirik?

Əkbərova Əsmayə Bəxtiyar qızı

Baş müəllim, "Dillər və onların tədrisi texnologiyası" kafedrası, ADPU-nun Şəki filialı, Azərbaycan, Orcid id: 0000-0001-9970-0602

Abstract:

French, which has a special place among the languages of the world, is distinguished not only by its romantic sound, but also by its role in culture, science, business and diplomacy. Learning this language not only gives many people a new means of communication, but also opens them the doors to a wide world of possibilities. French is the language of culture. It is in this language that the most famous literature, music, fashion and cinematography of the world are created. Reading the works of such writers as Victor Hugo, Moliere, Balzac in the original is a completely different feeling. In addition, the language of such prestigious events as the Cannes Film Festival is French.

Key words:

Main language, culture language, love language, museums, Cinema Center, tourist country, rivers, mountains and etc

1. Giriş:

Dünya dilləri arasında xüsusi yeri olan fransız dili təkcə romantik səslənməsi ilə deyil, həm də mədəniyyət, elm, biznes və diplomatiyada oynadığı rolu ilə fərqlənir. Bu dili öyrənmək bir çox insana sadəcə yeni ünsiyyət vasitəsi qazandırmır, həm də onlara geniş imkanlar dünyasının qapılarını açır. Fransız dili 32 ölkədə rəsmi statusa malik olan dildir. Hal-hazırda dünyada Fransız dilində danışan əhali 300 milyon nəfərdir. Fransız dili dünyada ən çox yayılmış dillər sırasında 8 – ci yerdədir. 75 milyon insan körpəlikdən başlayaraq fransız dilini öyrənir. Fransanın hazırda təxminən 65 milyon əhalisi var, qalan 10 milyonu isə Belçika, İsveçrə və Fransa ətrafındakı ölkələrdən olan, eyni zamanda fransız dilində danışanlardır. Fransız dili 29 ölkənin rəsmi dilidir. Dünyada ingilis dilindən sonra ən çox öyrənilən dildir. İngilis dili ilə yanaşı 5 fərqli qitədə danışılan yeganə dildir. Birləşmiş Millətlər Təşkilatı, NATO və UNESCO qurumlarının rəsmi yazılı dilidir. Xüsusilə Afrika qitəsində çox rahat səyahət etmək olar. Fransız dilini bilmək digər dillərlə müqayisədə nüfuzunuzu artırır. 5 fərqli qitədə yerləşən Fransız universitetlərində təhsil almaq olar. Fransız dili bütün qitələrin universitetlərində danışılır.

Gəlin birlikdə fransız dilinin öyrənilməsinin əsas səbəblərinə nəzər salaq.

1.1. Dünyada ən çox danışılan dillərdən biri

Fransız dili 5 qitədə danışılan beynəlxalq dil hesab olunur. Hazırda dünyada 300 milyondan çox insan fransız dilində danışır və bu rəqəm ildən-ilə artır. Birləşmiş Millətlər Təşkilatı, Avropa İttifaqı, UNESCO və NATO kimi bir çox beynəlxalq təşkilatlarda da rəsmi dillərdən biridir.

1.2. Karyera və təhsil imkanları

Fransız dili bilmək karyera üçün böyük üstünlükdür. Dünyanın ən nüfuzlu şirkətlərinin çoxu Fransada, Kanadada, İsveçrədə və Belçikada fəaliyyət göstərir. Fransız dili ilə siz:

- Beynəlxalq biznesdə üstünlük əldə edə bilərsiniz.
- Fransanın və digər fransızdilli ölkələrin universitetlərində təqaüdlə təhsil almaq imkanına sahib ola bilərsiniz.

- Turizm, diplomatiya, moda, kulinariya və incəsənət sahələrində daha çox şans qazanarsınız.

1.3. Mədəniyyətin və incəsənətin dili

Fransız dili mədəniyyətin dilidir. Dünyanın ən məşhur ədəbiyyatı, musiqisi, modası və kinematografiyası məhz bu dildə yaradılıb. Viktor Hüqo, Molyer, Balzak kimi yazıçıların əsərlərini orijinalda oxumaq tamamilə fərqli bir hissdır. Bundan başqa, Kann Film Festivalı kimi nüfuzlu tədbirlərin dili də fransızcadır.

1.4. Fransaya səyahət və turizm

Fransa hər il milyonlarla turist qəbul edir. Əgər fransızca bilirsinizsə, yalnız Parisdə deyil, həm də digər bölgələrdə səyahətiniz daha zəngin və maraqlı keçəcək. Dil bilmək sizə yerli mədəniyyəti, yeməkləri və ənənələri daha dərinlən anlamağa kömək edəcək.

1.5. İkinci xarici dil kimi asan öyrənilir

Əgər ingilis dilini bilirsinizsə, fransız dili sizin üçün daha asan olacaq. Çünki ingilis dilində minlərlə söz fransızcadan keçib. Həmçinin, fransız dili latın əsaslı dillərdən olduğu üçün ispan və italyan dillərini öyrənmək istəyənlərə də böyük kömək edir.

1.6. Beynəlxalq ünsiyyət və yeni dostluqlar

Fransız dili öyrənməklə siz müxtəlif ölkələrdən insanlarla dost ola, onlarla ünsiyyət quraraq mədəniyyətlərini yaxından tanıya bilərsiniz. Bu isə şəxsi inkişafınıza böyük təsir göstərir.

1.7. Fransız dili dərsləriylə gələcəyinizə beynəlxalq dəyər qatar

Fransız dili bu gün dünyada ən çox öyrənilən və danışılan dillərdən biridir. UNESCO, Avropa İttifaqı, Beynəlxalq Olimpiya Komitəsi kimi bir çox nüfuzlu təşkilatın rəsmi dili olan fransız dili, həm karyera, həm də təhsil baxımından sayısız imkanlaryaradır. Fransız dilini öyrənərək siz sadəcə bir dil deyil, mədəniyyət, düşüncə tərzı və ünsiyyət bacarığı qazanırsınız. Fransız dili bilmək sizi dünya ilə bir addım daha yaxınlaşdırır. Əgər siz də beynəlxalq səviyyədə fərqlənmək, yeni biliklər qazanmaq və gələcəyinizə sərmayə qoymaq istəyirsinizsə, Fransız dili dərslərinə qoşulun.

2. Fransa haqqında maraqlı faktlar

1. Fransada çox sayda qala mövcuddur - cəmi 4969 ədəd.
2. Fransada kolqotkalar ixtira edilməşdilər. Qadın kolqotkalrı — XX əsrin ən dahi ixtirasıdır.
3. Fransanın rəsmi dövlət dili — fransız dilidir. Amma ingilis dilini bilməsəniz siz iş tapmayacaqsınız, həm də heç bir fransız anlaya bilməyəcək ki siz ingilis dilini bilmirsiniz. Onlar bunu anlaya bilərlər ki, siz fransız dilini bilmirsiniz, amma necə belə ola bilər ki, siz ingilis dilində danışmırsınız?! Əgər onlar aksenti hiss edirlər-sə, dərhal ingilis dilinə keçirlər, hətta əgər siz ingilis dilində danışa bilməsəniz də.
4. Fransızlar gilyotini ixtira etdikləri üçün fəxr edirlər.
5. Məhz fransızlar Avropa Konstitusiyasının layihəsini doldururlar. Daha dəqiq — fransız fermerləri, hansılar ki, anlamırlar, nə üçün onlar bir çəllək unikal şərəbları (minlərlə növün ətrafında) tökməlidir, orada nəyəsə görə pendirləri (460 növ, onların növlərini nəzərə almadan) standartlara uyğun etməlidirlər və niyə bu sidr alkoqollu içki hesab edilməlidir?
6. Fransada ən çox baş çəkilən diqqətəlayiq yerlər: Notr-Dam-de-Pari kilsəsi və Monalar monastırı — Sen-Mişel.
7. Fransa — kənd təsərrüfatı ölkəsidir.
8. Fransa — kinematografiyanın vətənidir.
9. Fransa — hava uçuşunun vətənidir.
10. Fransa — velosipedin vətənidir.
11. Fransa — baletin vətənidir.
12. Fransa — fransız şansonunun vətənidir
13. Fransa — 3 inqilabın beşiyidir.
14. Fransa — Sezanna, Alfons Dode, Ekzyuperi, Dyuma, Molyer, Volterin vətənidir.

15. Fransada böyük şahmatçı Alyoxin, böyük yazıçı İvan Bunin, böyük balerina Matilda Kşesinskaya dəfn edilmişdir və bunlar kimi bir çox dahilər.
16. Qadın uşaqlıq yolu fransız dilində kişi cinsindədir.
17. Fransada yağında yanmayan bir neçə ağac növü var. Ən məşhur yanmayan ağaclar — ardıc və sidrdir.
18. Fransada, Provansda, dünyada tək burğuların muzeyi yerləşir.
19. Fransada ən üfunətli və eyni zamanda dünyada ən bahalı göbələklər bitir — trüfəllər. Hətta trüfəllərin hərracları mövcuddur. Onların bir kiloqramının qiyməti orta hesabla 600 avrodur.
20. Hamısı Fransada eskarqo (üzüm ilbizləri, hansılar ki, sarımsaq sousunda bişirirlər) burqonskimi adlanırlar. Çünki onlar böyük və dadlı ənlə hesab edirlər.
21. Fransada Rusiya nikah agentliylərinin içi çətinidir. Fransız adaxlıları — yalnız gözəl kuklaya bənzər gəlin istəməirlər. Qızlar borş hazırlamağı bacarmalıdırlar (onlar özləri də əla hazırlamağı bacarırlar və sevirilər), heç olmasa ingiliscə danışa bilməlidilər. Bəli, fransızlar — boşboğazdılar.
22. Qarabaşaq Fransada defisit deyil. Bretanda qarabaşaq sahələri qədim hesab edilir, hərçənd orada yalnız təxminən VIII əsrdə çıxdılar. Breton blinçikləri və qaletlər üçün qarabaşaq unu — məşhur, adi məhsuldur. Fransızlar qarabaşağı sıyıq kimi istifadə etməirlər.
23. Fransanın neft və qaz ehtiyatı yoxdur.
24. «Sport en France c'est quelques choses politique!» (hətta tərcümə etməyə və anlamağa çalışmayın).
25. Fransada milli mətbəxlərin böyük miqdarı — 22 (regionların sayı üzrə), hansılar ki, ondan asılıdırlar ki, harada yaşayır və harada böyüyürlər. Fransızlar sadə şeylərdən yemək hazırlamağı sevirilər. Əgər siz hətta hər gün burada biriylə yalnız kartofla qidalanacaqsınızsa, sizdə onsuz da ekzotik qidalanma olacaq. Çünki burada kartoflu yeməklərin növləri çoxdur.
26. Fransada tək qadın-dəmirçi yaşayır. Bir dəfə o pişiyin heykəlini hazırladı və Kaliningrada onu hədiyyə etdi.
27. Fransada şərab yalnız iki növ olur — sizin şəxsən xoşunuza gələn və xoşunuza gəlməyən.
28. Fransada parlament sistemi iki palatadan ibarətdir — Alt və Üst. Üst Parlament Senat adlanır.
29. İclas zalları Senat və Milli Məclis oxşardır. Yalnız «detallar» var. Senatda iclas zalının üstündə plafon, şüşə yarımqübbəsi və təbii işıqlandırma — Günəşlə işıqlandırılır. Amma Burbonskda saray bütünlükdə elektrikle işıqlandırılır.
30. Fransa — Avropanın ən böyük ölkəsidir.
31. Fransada terminlər «quru» və yalnız «bryut» şampan şərabına aiddir. «Quru şərab» anlayışları mövcud deyil, çünki o bütün təyininə görə əsl təbii şərabdır. Spirt qatılmış şərablar birmənalı likörlərin sinifinə keçir və artıq şərab hesab edilmirlər. Şərab — elə şərab kimi də vardır. Qırmızı, ağ, çəhrayı.
32. Yeri gəlmişkən, fransız qırmızı şərabından baş ağrıdır.
33. Fransada anonim əyyaşlar üçün telefon və hər bir yardım xidməti pulsuzdur: +33 0820 32-68-83.
34. Fransada həkimlər sağlamlıq üçün gündəlik və faydalı doza kimi qırmızı şərabın 3 stəkanı kişilərə, 2 stəkanını qadınlara məsləhət görürlər. Bunun üçün hətta avtomobil müfəttişləri cərimə etməirlər.
35. Bütün fransızlar McDonaldsa nifrət edirlər.
36. «Səhər yeməyi» sözləri, «nahar», "şam yeməyi", «yemək» — hamısı eyniköklüdür və fransızlar üçün mənaca müqəddəsdir. Fransıza yemək vaxtı zəng etmək olmaz!

Ədəbiyyat siyahısı:

1. *Bibliothèque nationale de France BNF identifikatoru (fr.): açıq məlumat platforması. 2011.*
2. FDM (*Le Français dans le Monde*) no 342, 338,341
3. FIPF. *Le Français pour demain Dialogues et cultures* no 32 1988.
4. <http://fr.wikipedia.org/wiki/M%C3%A9dia>
<http://www.google.fr/Media>
5. *Histoire et recherches des antiquités de la ville de Paris, 3 tomes, Ffenri Sauvai, Genive: 1973, 480 p*

Psychological Sciences

ОСОБЕННОСТИ ЛОКУСА КОНТРОЛЯ И КОПИНГ-СТРАТЕГИЙ У МУЖЧИН СРЕДНЕГО ВОЗРАСТА С РАЗЛИЧНЫМИ ФОРМАМИ АДДИКТИВНОГО ПОВЕДЕНИЯ

ТОЛЕУХАНОВА ТОМИРИС ЕРЛАНОВНА

магистрант, ORCID ID: 0009-0005-6374-2356

ШИХОВА ОЛЬГА МИХАЙЛОВНА

к. б. н., ассоц. профессор, ORCID ID: 0009-0006-4079-808X

Университет «Туран», г. Алматы, Казахстан

Аннотация

В статье рассматриваются особенности стрессоустойчивости и локуса контроля у мужчин среднего возраста. Цель исследования – провести сравнительный анализ особенностей локуса контроля и копинг-стратегий у мужчин среднего возраста, имеющих различные формы аддиктивного поведения, и мужчин того же возраста без аддикций. В работе решаются задачи, связанные с анализом теоретических подходов к изучению локуса контроля, копинг-стратегий и аддиктивного поведения у мужчин среднего возраста, определением организации и методов эмпирического исследования, проведением сравнительного анализа локуса контроля и копинг-стратегий у мужчин с аддиктивным поведением и без него, интерпретацией полученных результатов и разработкой практических рекомендаций на их основе. Гипотеза исследования – у мужчин среднего возраста с аддиктивным поведением особенности локуса контроля и копинг-стратегий отличаются от аналогичных у мужчин без аддикций. Частные гипотезы: 1. У мужчин с аддиктивным поведением более выражен внешний локус контроля по сравнению с мужчинами без аддикций. 2. Мужчины с зависимостями чаще прибегают к эмоционально-фокусированным и избегательным стратегиям совладания. 3. Мужчины без аддикций склонны использовать проблемно-ориентированные стратегии копинга. Исследование проводилось на выборке из 60 человек с использованием методики "Определение уровня стрессоустойчивости" (ODE-2010), шкалы локуса контроля Роттера и опросника управления стрессом (WCQ). Полученные данные позволяют сделать выводы о психологических ресурсах людей среднего возраста и дать рекомендации по повышению адаптивности и эмоциональной стабильности.

Ключевые слова: стрессоустойчивость, локус контроля, копинг-стратегии, средний возраст, психологическая адаптация.

Введение. В современном обществе наблюдается устойчивая тенденция к росту числа мужчин среднего возраста, проявляющих различные виды аддиктивного поведения. В дополнение к традиционным химическим зависимостям — алкогольной, никотиновой и наркотической — все чаще регистрируются поведенческие формы зависимости:

трудоголизм, интернет-зависимость, игровая и сексуальная зависимость, зависимость от шопинга и фитнеса. Подобные проявления отражают не только социальные изменения, но и глубинные психологические процессы, связанные с трудностями самоопределения, управления эмоциями и личностной регуляции в условиях повышенного стресса [1].

Проблема аддиктивного поведения у мужчин среднего возраста имеет многогранный характер и определяется сочетанием биологических, социально-психологических и личностных факторов. Этот возрастной период (примерно от 35 до 50 лет) Он считается одним из самых стрессовых в жизненном цикле: человек сталкивается с профессиональными перегрузками, сменой социального статуса, семейными заботами и переосмыслением жизненных целей. Существует феномен "кризиса среднего возраста" [2], сопровождающийся внутренней тревогой, неудовлетворенностью результатами деятельности и ощущением потери контроля над происходящим. Именно в этот период возрастает риск аддиктивного поведения как способа избежать фрустрации и эмоционального стресса [3].

С точки зрения психологии личности, ключевым моментом, определяющим чувствительность к аддикциям, является локус контроля — устоявшееся представление человека о том, где сосредоточена ответственность за жизненные события. Люди с внутренним локусом контроля склонны считать себя активными субъектами, способными влиять на обстоятельства, самостоятельно решать проблемы и нести ответственность за результаты своих действий. Напротив, люди с внешним локусом контроля объясняют происходящее внешними причинами — предопределением, случайностью, другими людьми, что ослабляет чувство самоконтроля и внутренней ответственности [4].

Многочисленные исследования показали, что высокий уровень экстернальности коррелирует с низкой стрессоустойчивостью, повышенной тревожностью и склонностью избегать сложных ситуаций, в то время как интернальность связана с конструктивным поведением, внутренней мотивацией и устойчивостью к аддиктивным формам реагирования [5,6].

Копинг-поведение, или умение справляться со стрессом, является не менее важным аспектом психологической регуляции. Копинг-стратегии определяются как набор когнитивных, эмоциональных и поведенческих методов совладания, направленных на восстановление внутреннего равновесия и адаптацию к стрессу [7,8]. При аддиктивном поведении эти стратегии часто приобретают дезадаптивный оттенок: зависимый человек нацелен не на решение проблемы, а на кратковременное снятие стресса с помощью употребления психоактивных веществ, азартных игр, чрезмерной занятости или других форм компенсации [9,10].

Наиболее восприимчивыми являются мужчины среднего возраста, чьи механизмы совладания и саморегуляции формировались в условиях высоких социальных ожиданий и внутреннего противоречия между профессиональной самореализацией и эмоциональными потребностями. Аддиктивное поведение в данном случае выступает своеобразной формой психологической защиты, которая дает возможность временно уйти от ответственности, снизить тревожность и сохранить видимость контроля.

Изучение взаимосвязи между локусом контроля и копинг-стратегиями в контексте аддиктивного поведения позволяет глубже понять психологические механизмы развития зависимости. Выявление того, какие модели совладания и формы контроля преобладают у мужчин с различными типами зависимостей, открывает путь для разработки целенаправленных программ психопрофилактики и коррекции, направленных на развитие интернальности, формирование конструктивных стратегий совладания и усиление личной ответственности.

Таким образом, анализ особенностей локуса контроля и совладающего поведения у мужчин среднего возраста является актуальной задачей современной психологии, имеющей как теоретический, так и прикладной вес. Теоретически это позволяет нам более точно определить роль личностных детерминант в развитии зависимостей, а практически — выявить направления психологической помощи и психопрофилактики, которые повышают эффективность работы с данной группой клиентов.

Методы исследования:

— Анализ научных источников — были изучены отечественные и зарубежные исследования локуса контроля, копинг-стратегий и аддиктивного поведения мужчин среднего возраста [6].

— Для выявления индивидуально-психологических особенностей участников, выраженности аддиктивных тенденций, особенностей локуса контроля и стратегий совладания были использованы анкеты и психодиагностические методики.

— Опросник для диагностики зависимостей (ODE-2010) — автор А. В. Смирнов [14]. Методика позволяет выявить признаки различных форм аддиктивного поведения: алкогольной и наркотической зависимости, азартных игр, адреналиновой зависимости, сексуальной и любовной зависимости, зависимости от людей и отношений, компьютерной и интернет-зависимости, трудоголизма. Баллы интерпретируются как низкие (0-3), средние (4-7) и высокие (8-10).

— Шкала локуса контроля Роттера — Джулиана Роттера (1966), адаптированная К. Муздыбаевым (1979) [16]. Она позволяет определить склонность человека объяснять события внутренними или внешними причинами. Методика содержит 29 утверждений по двум шкалам: интернальности и экстернальности. Баллы по каждой шкале: от 0 до 23.

— Опросник "Методы совладающего поведения" (WCQ) — авторы Р. Лазарус, С. Фолкман (1988), адаптация NIPNI [17]. Это позволяет вам оценить стратегии совладания: конфронтацию, дистанцирование, самоконтроль, поиск социальной поддержки, принятие ответственности, бегство-избегание, планирование решений, позитивную переоценку. Использование стратегий оценивается как редкое (0-39), умеренное (40-60) и выраженное (61-90).

Результаты исследования. На первом этапе анализа результатов по данной методике были рассчитаны средние значения показателей по всем шкалам опросника, что позволило получить обобщённое представление о выраженности различных форм аддиктивного поведения. Полученные данные представлены в таблице и служат отправной точкой для дальнейшего детального анализа, включающего рассмотрение частот выраженных форм аддикций и их сочетаний.

Результаты описательной статистики по опроснику диагностики аддикций представлены в таблице 1.

Таблица 1 – Показатели описательной статистики по шкалам опросника диагностики аддикций (ОДА)

					Шапиро-Уилк	
	Среднее	Медиана	Мода	SD	W	p
Алкогольная зависимость	3.233	3.00	3.00	1.908	0.945	0.009
Наркотическая зависимость	0.767	0.00	0.00	1.845	0.482	<.001
Игровая зависимость	1.117	1.00	1.00	0.940	0.860	<.001
Адреналиномания	2.650	2.50	2.00	1.560	0.937	0.004
Сексуальная зависимость	3.800	4.00	3.00	1.894	0.956	0.031
Любовная зависимость	4.450	4.00	4.00	1.651	0.808	<.001
Зависимость от людей и отношений	4.400	4.00	4.00	1.487	0.921	<.001
Интернет и компьютерная зависимость	3.817	4.00	4.00	1.652	0.957	0.033
Трудоголия	4.950	5.00	5.00	1.741	0.919	<.001

Результаты критерия Шапиро-Уилк показали, что распределения показателей по всем шкалам опросника статистически значимо отличаются от нормального, что обосновывает использование непараметрических методов анализа и указывает на гетерогенность выборки по уровню выраженности аддиктивных проявлений. Наиболее низкие средние значения выявлены по шкалам наркотической ($M=0,77$) и игровой зависимости ($M=1,12$), что свидетельствует об их слабой представленности в выборке. Алкогольная зависимость характеризуется умеренным уровнем выраженности ($M=3,23$), при наличии индивидуальной вариативности показателей. Промежуточное положение занимает адреналиномания ($M=3,82$), а также межличностных форм аддиктивного поведения – любовной зависимости ($M=4,45$) и зависимости от людей и отношений ($M=4,40$), что указывает на их значительную распространенность. Наиболее выраженной формой аддиктивного поведения является трудоголизм ($M=4,95$), отражающий тенденцию к социально одобряемым формам зависимости. По результатам частотного анализа (порог ≥ 8 баллов) к ядру аддиктивного профиля выборки отнесены трудоголизм (40%), сексуальная зависимость (18,3%), любовная зависимость (16,7%) и зависимость от людей и отношений (16,7%), что позволяет говорить о преобладании поведенческих и межличностных аддикций, имеющих социально маскированный характер.

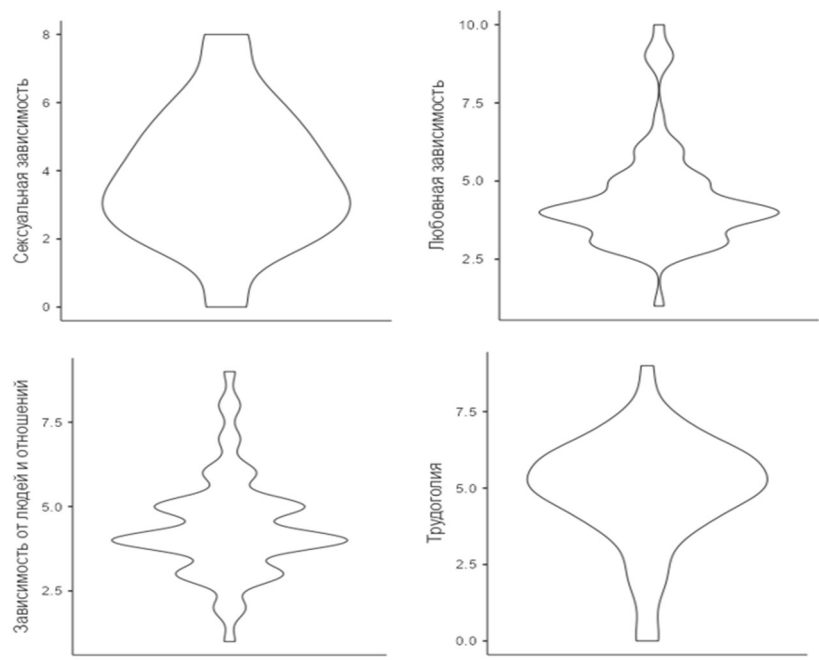


Рисунок 1 – Распределение показателей по наиболее выраженным формам аддиктивного поведения у мужчин среднего возраста

Анализ скрипичных диаграмм показал, что трудоголизм характеризуется устойчивой концентрацией средних и высоких значений, тогда как сексуальная зависимость отличается большей вариативностью и наличием испытуемых с выраженными показателями. Распределение по шкалам любовной зависимости и зависимости от людей и отношений имеют сходную форму, что указывает на их структурную близость. Анализ сочетаний аддиктивных проявлений (порог ≥ 7 баллов) выявил полимодальный характер аддиктивного поведения. Наиболее часто встречаются комбинации любовной зависимости и зависимости от людей и отношений, а также сексуальной зависимости и трудоголизма (по 10%). При этом наркотическая, игровая и алкогольная зависимости в большинстве случаев характеризуются низким или умеренным уровнем выраженности. В целом аддиктивный профиль выборки представлен преимущественно поведенческими и межличностными формами, что подтверждает неоднородность выборки и обосновывает дальнейшее использование непараметрических методов анализа.

В связи с этим далее представлен анализ результатов, полученных с помощью шкалы локуса контроля Дж. Роттера. Результаты представлены в таблице 2.

Таблица 2 – Показатели описательной статистики по шкале локуса контроля Дж. Роттера

	Интернальность	Экстернальность
Среднее	11.7	12.9
Медиана	12.0	13.0
Мода	15.0	9.00 ^a
Стандартное отклонение	3.53	4.17
Шапиро-Уилк W	0.808	0.775
Шапиро-Уилк p	<.001	<.001
^a Существует более одной моды, сообщается только о первой		

В таблице 2 представлены результаты описательной статистики по шкале локуса контроля Дж. Роттера, отражающие выраженность интернальности и экстернальности в исследуемой выборке. Средний уровень экстернальности ($M=12,9$) незначительно превышает показатели интернальности ($M=11,7$), что указывает на умеренное преобладание внешнего локуса контроля. Данная тенденция подтверждается и медианными значениями ($Me=13,0$ и $Me=12,0$ соответственно). Анализ модальных значений свидетельствует о наличии подгруппы испытуемых с выраженной интернальной ориентацией ($Mo=15,0$), тогда как по шкале экстернальности отмечается неоднородность распределения ($Mo=9,0$). Более высокое стандартное отклонение по экстернальности ($SD=4,17$) по сравнению с интернальностью ($SD=3,53$) указывает на большую вариативность внешнего локуса контроля. Результаты критерия Шапиро-Уилка показали статистически значимые отклонения распределений от нормального как по интернальности ($W=0,808$, $p < 0,001$), так и по экстернальности ($W=0,775$, $p < 0,001$), что обосновывает применение непараметрических методов статистического анализа в дальнейшем исследовании.

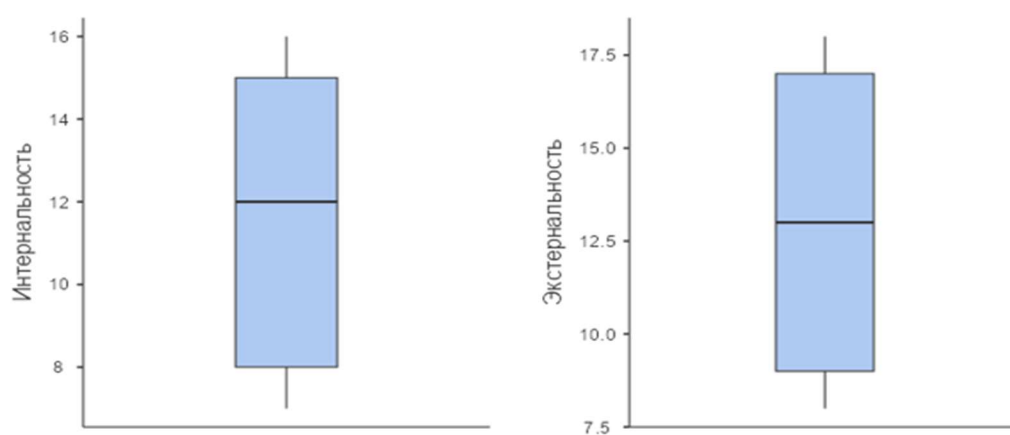


Рисунок 2 – Распределение показателей интернальности и экстернальности по шкале локуса контроля Дж. Роттера

На рисунке 2 представлены диаграммы размаха, отражающие распределение показателей интернальности и экстернальности, в исследуемой выборке мужчин. Визуальный анализ показывает, что медианное значение экстернальности несколько превышает медиану интернальности, при этом обе шкалы характеризуются достаточно широким межквартильным размахом, что указывает на выраженную индивидуальную вариативность локуса контроля.

Более широкий диапазон значений по шкале экстернальности свидетельствует о большей неоднородности внешней ориентации ответственности, что согласуется с результатами описательной статистики. Перекрывание межквартильных интервалов и отсутствие выраженных выбросов подтверждают наличие в выборке лиц с преимущественно внутренним, так и с преимущественно внешним локусом контроля.

В целом результаты указывают на умеренное преобладание экстернальной ориентации при сохранении значительной индивидуальной дифференциации, что позволяет рассматривать локус контроля как значимый личностный фактор, потенциально связанный с особенностями аддиктивного поведения и копинг-стратегий, и обосновывает целесообразность последующего анализа способов совладания со стрессом.

На следующем этапе исследования были изучены копинг-стратегии совладающего поведения с использованием опросника Р. Лазаруса и С. Фолкман, позволяющего выявить предпочтительные способы реагирования на стресс и дополнить анализ локуса контроля данными о поведенческих механизмах адаптации. Данные представлены в таблице 3 и на рисунке 3.

Таблица 3 – Показатели описательной статистики по шкалам копинг-стратегий (опросник Р. Лазаруса – С. Фолкман)

	Среднее	Медиана	Мода	SD	Шапиро-Уилк	
					W	p
Конфронтация	51.5	52.5	45.0 ^a	5.16	0.813	<.001
Дистанцирование	53.4	52.5	44.0 ^a	9.95	0.740	<.001
Самоконтроль	52.6	53.0	65.0 ^a	13.08	0.698	<.001
Соц. поддержка	55.3	55.5	60.0	5.58	0.772	<.001
Принятие ответственности	52.6	52.5	62.0 ^a	9.92	0.702	<.001
Бегство-избегание	53.6	53.5	41.0	12.72	0.696	<.001
Планирование решения	55.3	56.0	70.0 ^a	15.42	0.680	<.001
Положительная переоценка	57.3	57.5	46.0 ^a	11.28	0.687	<.001

^a Существует более одной моды, сообщается только о первой

Результаты критерия Шапиро-Уилка показали, что распределения по всем шкалам копинг-стратегий заметно отклоняются от нормального ($p < 0,001$), что отражает неоднородность выборки и обосновывает использование непараметрических методов анализа. Расхождения между средними и модальными значениями по ряду шкал свидетельствуют о наличии подгрупп испытуемых с различными профилями совладающего поведения.



Рисунок 3 – Средние значения копинг-стратегий по опроснику Р. Лазаруса – С. Фолкман

Средние и модальные значения по шкалам копинг-стратегий демонстрируют выраженные расхождения, что указывает на неоднородность выборки и наличие подгрупп с различными стилями совладания. Так, по шкалам конфронтации и дистанцирования средние показатели находятся на умеренном уровне, однако более низкие модальные значения свидетельствуют о том, что данные стратегии не являются типичными для большинства испытуемых и выражены преимущественно у части выборки. По шкалам самоконтроля, принятия ответственности и планирования решения проблемы выявлены высокие

модальные значения при умеренных средних показателях, что указывает на наличие группы мужчин, устойчиво ориентированных на внутреннюю регуляцию, рациональное осмысление ситуации и активное решение проблем. В то же время по шкале бегства-избегания и положительной переоценки средние значения формируются за счет испытуемых, интенсивно использующих данные стратегии, тогда как для большинства выборки они не являются доминирующими. В целом полученные данные свидетельствуют о поляризации копинг-стратегий в исследуемой выборке. Наряду с проблемно-ориентированными способами совладания представлены эмоционально-фокусированные и избежательные стратегии. Это подтверждает избирательный и контекстуальный характер совладания со стрессом у мужчин среднего возраста и обосновывает целесообразность дальнейшего сравнительного анализа копинг-стратегий у мужчин с аддиктивным поведением и без признаков аддикций, а также их взаимосвязей с локусом контроля. В целях проверки выдвинутых гипотез и выявления различий между мужчинами среднего возраста с аддиктивным поведением и без признаков аддикций далее был проведён сравнительный анализ с использованием U-критерия Манна–Уитни. Данный критерий позволяет корректно оценивать статистическую значимость различий между двумя независимыми выборками при отсутствии нормального распределения данных (Таблица 4).

Таблица 4 – Результаты сравнительного анализа форм аддиктивного поведения у мужчин с аддикциями и без аддикций (U-критерий Манна–Уитни)

	Манн-Уитни U	p
Алкогольная зависимость	227,000	0.001
Наркотическая зависимость	251,000	<.001
Игровая зависимость	324,000	0.074
Адренолиномания	219,000	<.001
Сексуальная зависимость	301,000	0.038
Любовная зависимость	250,000	0.003
Зависимость от людей и отношений	255,000	0.005
Интернет и компьютерная зависимость	357,000	0.217
Трудоголия	241,000	0.002
Примечание. $H_0: \mu_1 = \mu_2$		

Анализ показателей аддиктивного поведения выявил статистически значимые различия между группами: мужчины с аддикциями демонстрируют более высокие значения по шкалам алкогольной зависимости, наркотической зависимости, адренолиномании, сексуальной зависимости, любовной зависимости, зависимости от людей и отношений, а также трудоголизма ($p < 0,05$).

Особенно выражены различия по шкалам трудоголизма, любовной зависимости и зависимости от людей и отношений, что соответствует результатам описательной статистики. По шкалам игровой зависимости и интернет и компьютерной зависимости статистически значимых различий не обнаружен ($p > 0,05$). Эти результаты подтверждают корректность разделения выборки на группы и создают надежную основу для последующего анализа различий по личностным характеристикам, включая локус контроля и копинг-стратегии.

В таблице 5 и на рисунке 4 представлены результаты сравнительного анализа показателей интернальности и экстернальности у мужчин с аддиктивным поведением и без признаков аддикций, выполненного с использованием U-критерия Манна–Уитни.

Таблица 5 – Результаты сравнительного анализа показателей локуса контроля у мужчин с аддикциями и без аддикций (U-критерий Манна–Уитни)

	Манн-Уитни U	p
Интернальность	280,000	0,017
Экстернальность	255,000	0,005
Примечание. $H_a: \mu_1 \neq \mu_2$		

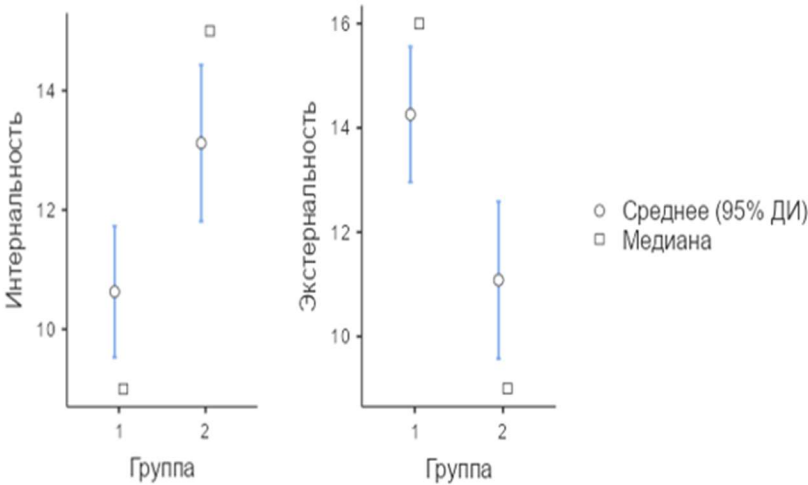


Рисунок 4 – Сравнительный анализ показателей интернальности и экстернальности у мужчин с аддикциями и без аддикций

Анализ показал, что мужчины с аддикциями имеют более высокий экстернальный и низкий интернальный локус контроля по сравнению с мужчинами без аддикций ($U=280,0$; $p = 0,017$; $U = 255,0$; $p = 0,005$). Это подтверждает первую гипотезу и обосновывает дальнейшее изучение реалий по копинг-стратегиям. С целью выявления различий между группами по показателям копинг-стратегий был проведён сравнительный анализ с использованием U-критерия Манна–Уитни.

Полученные данные представлены в таблице 6.

Таблица 6 – Результаты сравнительного анализа копинг-стратегий у мужчин с аддикциями и без аддикций (U-критерий Манна–Уитни)

	Манн-Уитни U	p
Конфронтация	263,000	0.009
Дистанцирование	261,000	0.008
Самоконтроль	266,000	0.009
Соц. поддержка	263,000	0.008
Принятие ответственности	271,000	0.011
Бегство-избегание	242,000	0.003
Планирование решения	264,000	0.008
Положительная переоценка	239,000	0.002
Примечание. $H_a \mu_1 \neq \mu_2$		

Мужчины с аддиктивным поведением характеризуются более низким уровнем интернальности ($M=11,7$) и повышенной экстернальностью ($M=12,9$), что указывает на склонность приписывать ответственность внешним обстоятельствам и снижать субъективное чувство контроля. В то же время мужчины без аддикций демонстрируют более выраженную интернальную ориентацию и готовность брать ответственность за результаты собственного поведения. Анализ копинг-стратегий выявил статистически значимые различия по всем шкалам. Группа без аддикций чаще использует проблемно-ориентированные и когнитивно-адаптивные стратегии, включая планирование решения проблемы, принятие ответственности и поиск социальной поддержки, тогда как мужчины с аддикциями склонны к эмоционально-фокусированным и избегательным стратегиям, направленным на снижение напряжения ($U=239$, $p=0,002$).

Мужчины с аддиктивным поведением склонны к внешнему локусу контроля и дезадаптивным копинг-стратегиям, тогда как мужчины без аддикций ориентированы на внутренний контроль и активное решение проблем, что подтверждает значимость этих характеристик для формирования и поддержания зависимого поведения.

После выявления различий по локусу контроля и копинг-стратегиям следующим этапом исследования стал корреляционный анализ, проведенный отдельно для групп мужчин с аддиктивным поведением и без аддикций. Результаты исследования представлены в таблицах 7-10.

Таблица 7 – Корреляционные связи между показателями локуса контроля, возрастом и формами аддиктивного поведения у мужчин с аддикциями (коэффициент Спирмена)

	Интернальность	Экстернальность	Возраст
Возраст	0.616***	-0.679***	–
Алкогольная зависимость	-0.188	0.016	-0.278
Наркотическая зависимость	-0.130	0.257	-0.386*
Игровая зависимость	0.007	0.094	0.150
Адреналиномания	-0.133	0.239	-0.286
Сексуальная зависимость	-0.069	0.108	0.091
Любовная зависимость	-0.469**	0.348*	-0.478**
Зависимость от людей и отношений	-0.323	0.120	-0.112
Интернет и компьютерная зависимость	0.249	0.007	0.173
Трудоголия	0.134	0.077	0.184

Таблица 8 – Корреляционные связи между копинг-стратегиями и формами аддиктивного поведения у мужчин с аддикциями (коэффициент Спирмена)

	Конфронтация	Дистанцирование	Самоконтроль	Соц. поддержка
Алкогольная зависимость	-0.257	0.292	-0.172	-0.102
Наркотическая зависимость	-0.135	0.214	-0.069	-0.189
Игровая зависимость	-0.054	-0.111	-0.058	0.107
Адреналиномания	-0.080	0.099	-0.060	-0.065
Сексуальная зависимость	-0.181	0.167	-0.038	-0.051
Любовная зависимость	-0.291	0.384*	-0.390*	-0.516**
Зависимость от людей и отношений	-0.086	0.128	-0.000	0.009
Интернет и компьютерная зависимость	0.112	-0.364*	0.072	0.130
Трудоголия	0.318	-0.160	0.364*	0.405*

	Принятие ответственности	Бегство- избегание	Планирование решения	Положительная переоценка
Алкогольная зависимость	-0.131	0.304	-0.286	-0.195
Наркотическая зависимость	-0.396*	0.157	-0.154	-0.149
Игровая зависимость	0.025	-0.105	0.064	0.059
Адреналиномания	-0.196	0.017	-0.145	-0.097
Сексуальная зависимость	0.148	0.071	-0.094	0.027
Любовная зависимость	-0.435**	0.470**	-0.378*	-0.501**
Зависимость от людей и отношений	-0.110	0.171	-0.280	-0.148
Интернет и компьютерная зависимость	0.086	-0.222	0.159	0.136
Трудоголия	0.307	-0.335*	0.469**	0.488**

Таблица 9 – Корреляционные связи между возрастом, показателями локуса контроля и формами аддиктивного поведения у мужчин без аддикций (коэффициент Спирмена)

	Возраст	Интернальность	Экстернальность
Интернальность	0.498*	—	
Экстернальность	-0.552**	-0.819***	—
Алкогольная зависимость	0.367	0.094	-0.114
Наркотическая зависимость	0.043	0.294	-0.044
Игровая зависимость	0.103	-0.121	0.031
Адреналиномания	0.211	0.095	-0.064
Сексуальная зависимость	0.092	-0.027	0.015
Любовная зависимость	-0.106	-0.205	0.275
Зависимость от людей и отношений	0.294	0.206	-0.301
Интернет и компьютерная зависимость	0.170	-0.077	0.002
Трудоголия	0.571**	0.421*	-0.428*

Таблица 10 – Корреляционные связи между копинг-стратегиями и формами аддиктивного поведения у мужчин без аддикций (коэффициент Спирмена)

	Конфронтация	Дистанцирование	Самоконтроль	Соц. поддержка
Алкогольная зависимость	0.268	-0.244	0.241	0.224
Наркотическая зависимость	0.201	-0.115	-0.015	-0.014
Игровая зависимость	0.076	0.050	-0.035	0.018
Адреналиномания	0.030	-0.046	0.091	0.063
Сексуальная зависимость	0.046	-0.099	0.068	0.035
Любовная зависимость	-0.211	0.226	-0.047	-0.039
Зависимость от людей и отношений	0.262	-0.299	0.259	0.225
Интернет и компьютерная зависимость	-0.032	-0.061	-0.033	-0.069
Трудоголия	0.482*	-0.548**	0.516**	0.455*

	Принятие ответственности	Бегство-избегание	Планирование решения	Положительная переоценка
Алкогольная зависимость	0.290	-0.278	0.322	0.155
Наркотическая зависимость	0.015	0.102	-0.044	-0.015
Игровая зависимость	0.131	-0.129	0.089	-0.012
Адреналиномания	0.116	-0.245	0.135	0.008
Сексуальная зависимость	0.069	-0.189	0.162	-0.024
Любовная зависимость	-0.117	-0.164	0.003	-0.095
Зависимость от людей и отношений	0.200	-0.384	0.312	0.196
Интернет и компьютерная зависимость	0.009	-0.085	0.027	-0.133
Трудоголия	0.471*	-0.569**	0.578**	0.480*

Сравнение корреляционных связей показало, что у мужчин с аддиктивным поведением копинг-стратегии тесно связаны с формами зависимости, особенно межличностными (любовная зависимость, зависимость от людей и отношений). Усиление зависимого поведения сопровождается снижением проблемно-ориентированных и когнитивно-адаптивных стратегий (принятие ответственности, планирование, положительная переоценка, самоконтроль) и ростом избегательных форм совладания (дистанцирование, бегство-избегание), что указывает на компенсаторную и защитную функцию копинга. Трудоголизм в этой группе демонстрирует смешанный профиль, связан с аддиктивными

стратегиями, но включен в систему аддиктивного поведения, подчеркивая его двойственную роль.

В группе мужчин без аддикций значимых корреляций между большинством форм аддиктивного поведения и копинг-стратегиями не выявлено, что указывает на автономный и адаптивный характер совладающего поведения. Исключение составляет трудоголизм, который связан с проблемно-ориентированными и когнитивно-адаптивными стратегиями и отрицательно с избеганием, отражая высокую деятельность вовлеченность без дезадаптивного характера. Таким образом, ключевое различие между группами заключается в интеграции копинга в структуру зависимости: у мужчин с аддикциями формируется взаимосвязанная дезадаптивная система, тогда как у мужчин без аддикций копинг остается автономным, обеспечивая психологическую устойчивость.

Заключение. В ходе исследования были выявлены ключевые психологические характеристики мужчин среднего возраста с признаками аддиктивного поведения и без них. Анализ показал, что у мужчин с аддикциями преобладает внешний локус контроля, который выражается в склонности объяснять события внешними обстоятельствами, случайностью или влиянием других людей. Такая когнитивная установка снижает уровень саморегуляции и внутренней ответственности, ограничивает эффективность совладания со стрессовыми ситуациями и способствует формированию неадаптивных стратегий совладания, таких как дистанцирование и бегство-избегание.

Мужчины без признаков аддиктивного поведения характеризуются внутренним локусом контроля, проявляющимся в высокой личной ответственности, уверенности в себе и способности самостоятельно управлять жизненными событиями. Их стратегии управления стрессом направлены на активное решение проблем, планирование действий, самоконтроль, поиск социальной поддержки и позитивную переоценку сложных ситуаций, что обеспечивает стрессоустойчивость и психологическую адаптацию.

Полученные данные подтверждают существование тесной взаимосвязи между типом локуса контроля и склонностью к аддиктивному поведению. Внешние и неадаптивные стратегии преодоления создают условия для сохранения зависимости, в то время как внутренние и адаптивные стратегии преодоления выступают в качестве защитных ресурсов, которые повышают способность к саморегуляции, автономии и конструктивному преодолению жизненных трудностей.

Таким образом, результаты исследования имеют как теоретическое, так и прикладное значение: Они углубляют понимание психологических механизмов развития аддиктивного поведения у мужчин среднего возраста и могут послужить основой для разработки программ профилактики и психологической коррекции, направленных на формирование интернальности и выработку адаптивных стратегий совладания со стрессом.

На основе эмпирических исследований были разработаны рекомендации, направленные на повышение эффективности психологической помощи мужчинам среднего возраста с различными формами зависимого поведения. Они основаны на выявленных связях между типом локуса контроля, копинг-стратегиями и характеристиками зависимостей. Основными целями рекомендаций являются формирование внутреннего локуса контроля, разработка конструктивных способов преодоления стресса и снижения эмоциональных реакций и избегания.

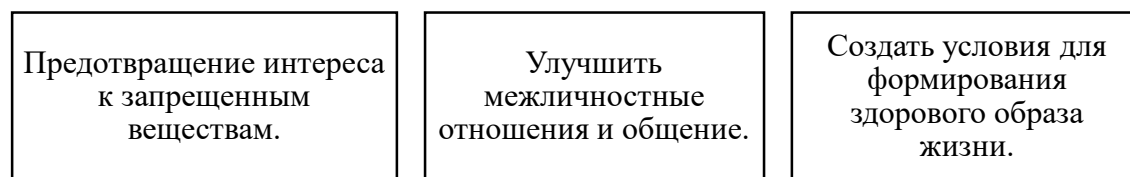


Рисунок 5 – Основные задачи

Примечание – составлено автором

Одной из ключевых задач психологической помощи является формирование осознанного негативного отношения к употреблению психоактивных веществ у мужчин. Важно не только информировать о физиологических и социальных последствиях аддиктивного поведения, но и формировать личностные установки, направленные на поиск альтернативных способов удовлетворения потребностей и снятия стресса. В рамках консультирования целесообразно использовать методы мотивационного интервьюирования, тренинга саморегуляции и эмоционального контроля, а также формирования позитивных жизненных целей и смыслов, снижающих вероятность обращения к зависимому поведению.

Мужчины среднего возраста с аддиктивным поведением часто испытывают трудности в построении близких отношений, проявляют склонность к отчуждению и конфликтам, что усугубляет чувство изоляции и способствует сохранению зависимости. В связи с этим особое внимание следует уделять развитию коммуникативной компетентности, эмпатии и навыков конструктивного разрешения конфликтов. Эффективными методами являются тренинги по групповому общению, терапия в малых группах и семейное консультирование, направленные на восстановление доверительных отношений и расширение социальной поддержки.

Психологическая помощь должна включать мероприятия, способствующие перестройке образа жизни клиента. Сюда входит формирование ответственного отношения к собственному здоровью, развитие навыков самодисциплины, организация режима труда и отдыха, включение физической активности и рационального питания. Важно не только информировать, но и мотивировать мужчин самостоятельно выбирать здоровые привычки. Психолог может способствовать этому с помощью индивидуальных планов саморазвития, поддержки в постановке и достижении конкретных целей, а также с помощью формирования положительного эмоционального подкрепления перемен.

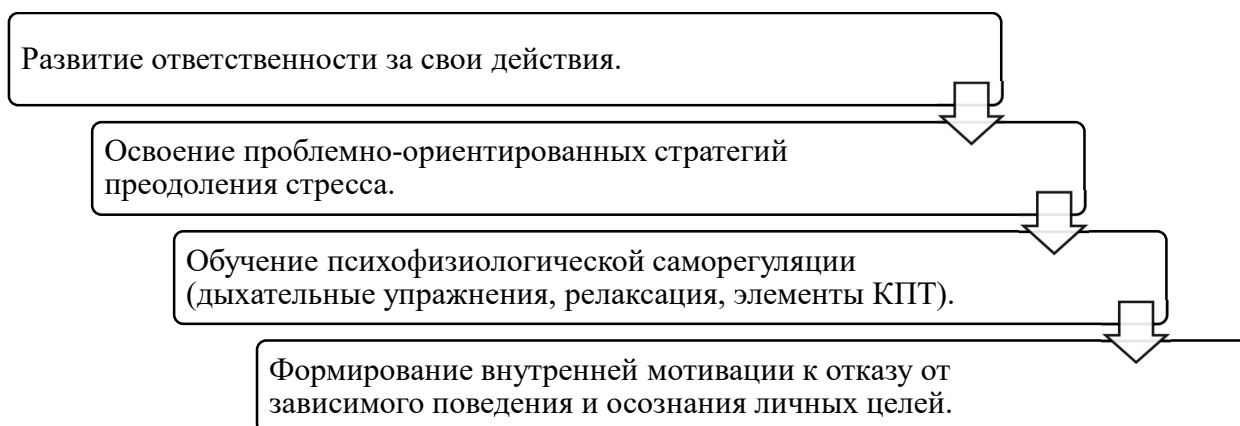


Рисунок 6 - Направления психокоррекционной работы

Примечание – составлено автором

Формирование внутреннего локуса контроля является ключевой задачей коррекционного процесса. Мужчины с зависимым поведением часто склонны приписывать причины своих неудач внешним обстоятельствам, судьбе или другим людям. Психологическая работа в данном направлении предполагает осознание клиентом связи между его действиями и последствиями, развитие способности принимать решения и нести за них ответственность. Эффективными методами являются когнитивно-поведенческие техники, направленные на осознание иррациональных установок, а также упражнения, способствующие формированию реалистичной самооценки и уверенности в собственных силах.

У мужчин с зависимыми формами поведения нередко наблюдается преобладание эмоционально-избегающих копинг-стратегий, направленных на уход от трудностей через употребление психоактивных веществ или иные формы зависимостей. В процессе психокоррекционной работы важно обучать клиентов конструктивным, проблемно-ориентированным способам решения стрессовых ситуаций: анализу проблемы, поиску альтернативных решений, планированию действий и оценке их эффективности. Это способствует повышению стрессоустойчивости, снижению уровня тревожности и формированию чувства контроля над жизненной ситуацией.

Данный компонент направлен на снижение уровня физиологического и эмоционального напряжения, часто выступающего триггером зависимого поведения. Обучение дыхательным техникам, мышечной релаксации, визуализации и методам осознанности позволяет клиентам овладеть инструментами самопомощи в стрессовых ситуациях. Включение элементов когнитивно-поведенческой терапии способствует изменению дезадаптивных мыслительных схем, которые поддерживают зависимость, и формированию более реалистичных и позитивных установок.

Важным направлением является работа с мотивационной сферой клиента. Необходим переход от внешне навязанного отказа (под давлением семьи или социальных структур) к внутренне осознанному выбору здорового образа жизни. Для этого применяются методы мотивационного консультирования, техники постановки и достижения целей, а также упражнения по выявлению личностных смыслов и ценностей. Работа над долгосрочными жизненными перспективами помогает клиенту увидеть альтернативу зависимому поведению и укрепить веру в возможность позитивных изменений.



Рисунок 7 - Принципы работы
Примечание – составлено автором

При оказании психологической помощи необходимо учитывать личностные особенности клиента, его тип зависимости, уровень самоконтроля и специфику жизненного опыта. Индивидуализация позволяет выбрать наиболее эффективные методы психокоррекции и мотивации, исходя из характера личности, степени зависимости и реальных потребностей человека.

Эффективная помощь должна включать в себя сочетание психологических, поведенческих и социальных профилактических мер. Это означает интеграцию индивидуального и группового консультирования, когнитивно-поведенческих методик, тренингов личностного роста, а также взаимодействие с социальными и медицинскими службами. Такой подход способствует устойчивым и многоуровневым изменениям.

Важным условием успешной коррекции является осознание клиентом личной ответственности за происходящие изменения. Психолог стимулирует активное участие мужчин в разработке и реализации индивидуальной программы преодоления зависимости, что способствует формированию внутренней мотивации и уверенности в себе.

Этот принцип направлен на развитие у клиента способности видеть причинно-следственные связи между своими решениями и их последствиями. Формирование внутреннего локуса контроля способствует переходу от позиции жертвы обстоятельств к позиции активного субъекта, способного контролировать свою жизнь и поведение.

Работа в этой области предполагает обучение рациональному анализу проблем, планированию действий, поиску социальной поддержки и использованию эффективных стратегий преодоления. Это помогает клиенту заменить деструктивные формы реагирования (уход, отрицание, употребление психоактивных веществ) более адаптивными и продуктивными способами преодоления стресса.

Психологическая помощь должна включать выявление и укрепление как внутренних (самооценка, воля, жизненные смыслы), так и внешних (семья, друзья, сообщество) ресурсов

клиента. Развитие этих поддерживающих факторов повышает стрессоустойчивость личности и снижает вероятность рецидива аддиктивного поведения.

Одним из приоритетных принципов является предотвращение формирования и закрепления аддиктивного поведения. Это достигается путем обучения навыкам эмоциональной саморегуляции, развития стрессоустойчивости, формирования позитивных жизненных целей и альтернативных способов удовлетворения потребностей.

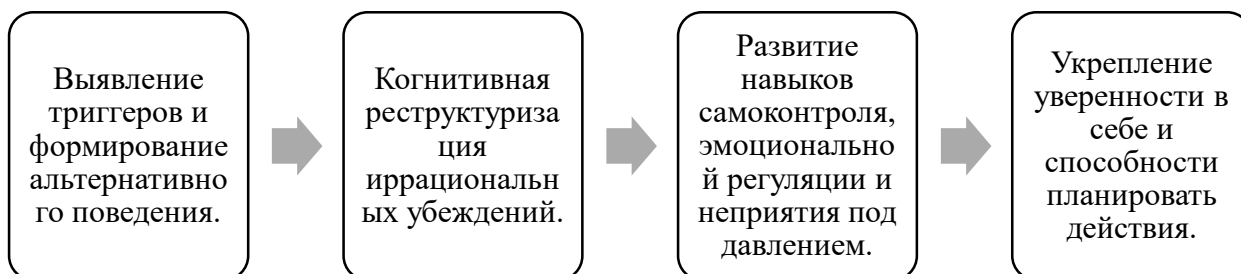


Рисунок 8 - Методы работы (включая когнитивно-поведенческую терапию)

Примечание – составлено автором

На первом этапе работы анализируются ситуации, вызывающие тягу к аддиктивному поведению, так называемые триггеры. Клиент учится распознавать внутренние и внешние раздражители (эмоции, обстоятельства, социальные контакты), которые запускают привычные реактивные паттерны. Далее разрабатываются альтернативные, здоровые модели поведения — поиск замещающих действий, которые позволяют справляться со стрессом, не прибегая к объекту зависимости (например, физическая активность, расслабление, творческая активность).

Один из центральных элементов КПТ направлен на выявление и изменение деструктивных убеждений, поддерживающих зависимость (например: "Я не могу без этого", "Все равно ничего не изменится"). С помощью когнитивных техник клиент учится подвергать сомнению подобные установки, заменяя их более реалистичными и конструктивными мыслями. Это помогает снизить уровень тревожности и усилить чувство контроля над собственными действиями. Развивает навыки самоконтроля, эмоциональной регуляции и устойчивости к давлению.

Аддиктивное поведение часто сопровождается импульсивностью и трудностями в управлении эмоциями. Работа направлена на развитие навыков осознавать свои эмоциональные состояния, регулировать уровень стресса и принимать обоснованные решения. Используются техники самонаблюдения, дневники состояний, а также упражнения по управлению гневом, тревогой и фрустрацией. Особое внимание уделяется умению противостоять внешнему давлению со стороны окружения (группы, обстановки, привычных социальных ролей).

Важным направлением является развитие у клиента уверенности в себе и способности к самостоятельным изменениям. Благодаря постановке достижимых целей, поэтапному планированию и анализу успеха формируется положительный опыт самореализации. Используются методы визуализации будущих достижений, упражнение "план успеха", а также положительная обратная связь от психолога, направленная на поддержание мотивации и самооэффективности.

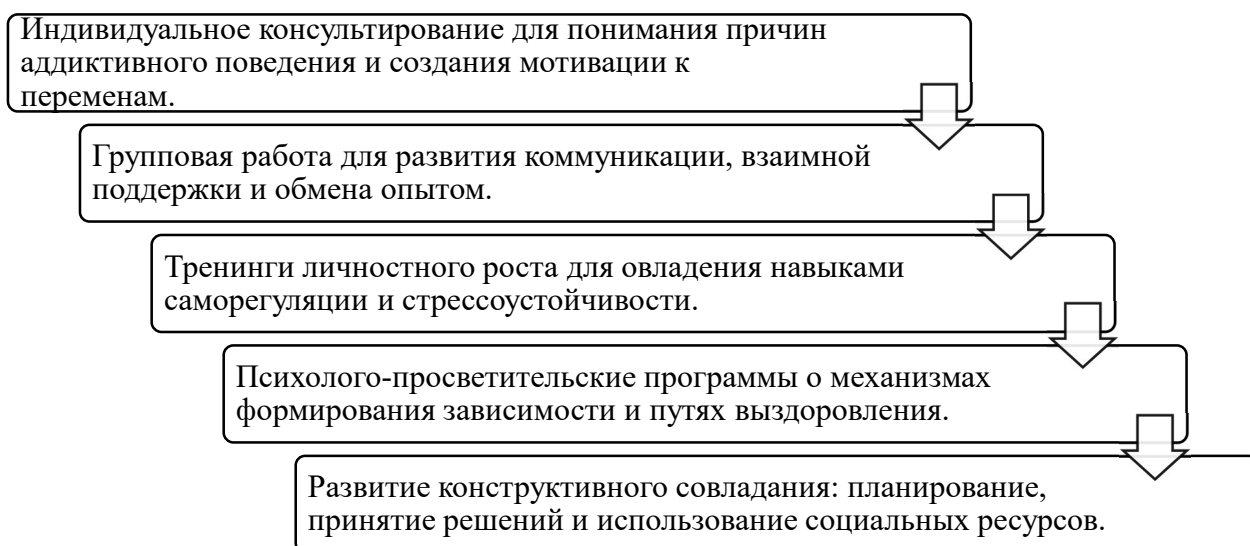


Рисунок 9 - Комплекс мероприятий по психопрофилактике и коррекции
Примечание – составлено автором

Основная цель индивидуальной работы - заставить клиента осознать причины собственного зависимого поведения, выявить внутренние конфликты и факторы, поддерживающие зависимость. На этом этапе формируется мотивация к переменам, происходит переоценка жизненных приоритетов и осознание личностных ресурсов. Психолог помогает клиенту установить связь между его мыслями, эмоциями и действиями, создавая основу для дальнейших позитивных изменений.

Групповые формы психокоррекции позволяют развить коммуникативные навыки, эмпатию и способность к сотрудничеству. В безопасной атмосфере группы участники делятся опытом, получают поддержку и обратную связь, что помогает уменьшить чувство изоляции и повысить мотивацию к выздоровлению. Кроме того, групповая динамика помогает клиентам понять общие механизмы аддиктивного поведения и способы их преодоления.

Этот вид работы направлен на развитие саморегуляции, стрессоустойчивости и уверенности в себе. С помощью упражнений, ролевых игр и рефлексии участники учатся распознавать свои эмоциональные состояния, управлять импульсивными реакциями и формировать позитивное отношение к трудностям. Это помогает укрепить внутренний локус контроля и повышает способность принимать самостоятельные решения.

Образовательный компонент включает в себя информирование клиентов о психологических и физиологических механизмах формирования зависимости, ее стадиях и последствиях. Осознание сути заболевания и факторов, влияющих на его развитие, способствует формированию ответственного отношения к лечению и профилактике рецидивов. Обучение также включает в себя обсуждение вариантов восстановления, эффективных стратегий преодоления трудностей и вспомогательных ресурсов.

Особое внимание уделяется развитию навыков рационального анализа проблем, планирования действий и поиска социальной поддержки. Клиенты учатся заменять деструктивное поведение (уход в себя, отрицание, избегание) конструктивными стратегиями, такими как активное решение проблем, обращение за помощью и использование позитивных ресурсов окружающей среды.

Результаты исследования могут быть использованы при разработке и реализации программ психологической помощи мужчинам среднего возраста с различными формами зависимого поведения. Представленные рекомендации и психокоррекционные подходы позволяют повысить эффективность профилактики и терапии зависимостей за счет формирования

внутреннего локуса контроля, разработки конструктивных стратегий совладания и укрепления личностных ресурсов. Материалы работы могут быть использованы в деятельности психологов-консультантов, специалистов центров реабилитации и социальной поддержки, а также в образовательных и просветительских проектах, направленных на профилактику аддиктивного поведения.

Список литературы:

1. Короленко Ц. П., Донских Т. А. Аддиктивное поведение: общая характеристика и закономерности развития. — Новосибирск: Наука, 2019. — 286 с.
2. Seligman M. New positive psychology. Moscow: Alpina non—fiction, 2021. 432 p.
3. Levinson D. Periods of human life. — New York: Knopf, 2000. - 384 p.
4. Маркова М. В. Психологические аспекты аддиктивного поведения у мужчин среднего возраста // Вестник практической психологии. — 2020. — № 4. — С. 34–42.
5. Markova M. V. Psychological aspects of addictive behavior in middle-aged men // Bulletin of Practical Psychology. - 2020. — No. 4. — pp. 34-42.
6. Rotter J. Generalized expectations regarding internal and external reinforcement control // Psychological monographs. — 1966. — Volume 80, No. 1. — pp. 1-28.
7. Lefkort H. L. Locus of control: current trends in theory and research. — New York: Psychology Press, 2014. — 248 p.
8. Пидкасистый П. И. Психология личности: учебное пособие. — М.: Академический проект, 2018. — 352 с.
9. Lazarus R. S., Folkman S. Stress, assessment and overcoming. — New York: Springer, 1984. — 445 p.
10. Hanzian E. The hypothesis of self-medication in disorders associated with the use of psychoactive substances // American Journal of Psychiatry. - 1997. — Volume 142(11). — pp. 1259-1264.
11. Волков Н. Д., Кооб Г. Ф., Маклеллан А. Т. Нейробиологические достижения, основанные на модели зависимости от заболеваний головного мозга // Медицинский журнал Новой Англии. — 2019. — Том 374. — С. 363-371.
12. Корманик М. Б., Рокко Т. С. Внутренний и внешний контроль: исследование структуры локуса контроля // Обзор развития человеческих ресурсов. — 2009. — Том 8(4). — С. 463-483.
13. Ананьев Б. Г. Человек как объект познания. Избранные психологические труды. М.: Наука, 1980. 384 с
14. Смирнов А. В. Опросник для диагностики зависимостей (ODE-2010). Москва: Психологическая диагностика, 2010. 52 с.
15. Роттер Дж. Б. Обобщенные ожидания в отношении внутреннего и внешнего контроля подкрепления. — Психологические монографии, 1966. — Т. 80, № 1. — С. 1-28.
16. Муздыбаев К. Адаптация шкалы локуса контроля Роттера. Алма-Ата: Изд-во, 1979. - 45 с.
17. Лазарус Р. С., Фолкман С. Стресс, оценка и преодоление. — Нью-Йорк: Springer, 1988. — 445 с.
18. НИПНИ. Адаптация опросника способов совладания (WCQ). — Москва, 2009. — 60 с.
19. Короленко Ц. П., Донских Т. А. Аддиктивное поведение: общие характеристики и закономерности развития. Новосибирск: Наука, 2019. 286 с.

УДК 159.964.2:159.944

МЕХАНИЗМЫ ПСИХОЛОГИЧЕСКОЙ ЗАЩИТЫ: ПСИХИКА ЧЕЛОВЕКА И СТРЕСС

Тулекова Г. Х

К. Ф.Н., ассоциированный профессор

Базарбай Анель Елемескызы

Университет «Туран», г. Алматы

АННОТАЦИЯ

В данной работе комплексно анализируются природа, структура и функции бессознательных механизмов, используемых психикой человека для защиты от стресса.

В исследовании рассматривается роль механизмов психологической защиты в регуляции эмоционального и когнитивного дисбаланса, возникающего при стрессе. Основные типы защитных систем – интеллектуализация, рационализация, проекция, вытеснение и сублимация – раскрываются с учетом особенностей каждой из них, способствующих психической адаптации в условиях стресса. В работе раскрываются способы восприятия психикой сигналов стресса, способы снижения эмоционального напряжения и механизмы восстановления внутреннего равновесия.

Действие психологических защит представлено на схематической схеме, анализируются их взаимосвязь, функциональная роль и значение в поддержании стабильности личности. Результаты исследования доказывают, что защитные механизмы являются важной частью психологического иммунитета человека, и подчеркивают важность бессознательных процессов в защите человека от дистресса в условиях стресса.

Ключевые слова: психологическая защита; стресс; бессознательные механизмы; интеллектуализация; рационализация; проекция; вытеснение; сублимация; эмоциональная регуляция; когнитивная адаптация; психическая устойчивость; психологический иммунитет.

Введение

Стресс – это состояние, которое утомляет психику человека, способствует эмоциональному равновесию одно из самых сложных явлений. Особенно в современном обществе информационный поток, быстрые изменения и усиление межличностных ожиданий угроза психической стабильности, ослабляя внутренние ресурсы человека – я не знаю. В такой ситуации психика специально бессознательна, чтобы сохранить себя запускает системы. Они представляют собой механизмы психологической защиты называется. Кувшинская задача научного текста состоит в том, чтобы последовательное объяснение гласит « " научный текст должен выйти внутренние связи и связи их читателю " [1, с. 21]. Защита анализ механизмов также требует такой же последовательности, потому что стресс в психика автоматически вызывает реакцию на несколько уровней осуществляет. Кажется, что Стресс усиливает человека внешне возможно, но во внутреннем мире психологическая энергия медленная, как песочные часы истощается. Чтобы избежать этого истощения, психика находится на бессознательном уровне перерабатывает эмоциональную тяжесть, смягчает воздействие угрозы или он поворачивается к другой форме. Без этих механизмов человек мог бы это превратилось бы в слабую систему, которая не могла бы справиться со сложной ситуацией. Изучение механизмов психологической защиты – при стрессе человека внутренней динамики, эмоциональной адаптации и дает глубокое понимание того, как он поддерживает теплоту. Психологическая наука

использует эти механизмы для с опытом, поведенческими моделями, физиологическими реакциями- я не знаю. Исследователь С. Боулер изучает психику при стрессе описывает как» систему, которая автоматически создает щит, чтобы защитить себя от травм " [2].

1.Сущность механизмов психологической защиты

Механизмы психологической защиты-определение внутреннего равновесия личности ментальные стратегии, действующие на бессознательном уровне для сохранения.Эти механизмы помогают уменьшить тяжесть эмоций, смягчить событие,помогает человеку чувствовать себя в безопасности.Защита в работах Фрейда когда говорят, что механизмы работают, чтобы сохранить «Я " человека,современные исследования показывают, что эта система используется в эмоция регуляция и когнитивная рециркуляция- я не знаю,- сказал он. ИсследовательНэнси МакВильямс: "защита механизмы-естественные, используемые психикой для защиты себя от травм средства " [3]. Принцип научного анализа кувшинской заключается в где актуально: "анализ требует точности и логичности, иначе смысла развития искажается " [1,с. 17]. Следовательно, защитные механизмы могут быть «плохими» или неправильно делить "хорошо"- их эффективность зависит от контекста, личности зависит от развития и уровня стресса.

2.Основные виды защитных механизмов

Интеллектуализациячтобы не испытывать эмоций, нужно только логически анализ.Например: вместо того, чтобы беспокоиться, человек может, “прикрывает " Деревом.Этот механизм заставляет человека страдать от эмоционального коллапса защищает, но в долгосрочной перспективе может привести к подавлению чувств.Психолог Ф. Баум описал этот процесс как «чтобы избежать ужасных чувств обращение к разуму "[4]

Рационализация объяснение неприятного чувства разумными доказательствами.Например,оправдание неудачи “уже не имело значения".Рационализация человека уменьшает чувство вины, но откладывает столкновение с искренностью.

Проекция направьте негативные чувства к другому человеку.Например, свои чувство тревоги: “он зол на меня".Этот механизм делает человека внутренне защищает от конфликтов, но может разрушить социальные отношения.

Вытеснение от сознания к бессознательному возникают болезненные воспоминания или эмоции вытеснение.В психологии это называется "древнейшим щитом психики".Исследователь Л. Карлсон: "забытые чувства не исчезают, а уходят только в тень» говорит [5].

Сублимация направьте негативную энергию на социально полезную деятельность: Искусство,наука, спорт.Это самый зрелый защитный механизм.Человек подавлен может превратить в творчество.

Психика при стрессе когда начинается Стресс, миндалевидное тело в головном мозге активирует сигнал опасности, кортизол повышается уровень, учащается сердцебиение. Этих физиологических наряду с реакциями психика защищает от регуляции эмоциональной тяжести автоматически запускает механизмы.В нейробиологии этот процесс называется "бессознательная адаптация". Исследователи Герман и Сингер во время стресса память и мыслительные функции человека временно показывает, что ослабевает, а защитные механизмы компенсируют эту слабость [6].

В этот момент психика работает одновременно в трех направлениях:

1. уменьшает эмоциональную тяжесть
2. смягчает опасность
3. стремится поддерживать внутреннюю стабильность

Если объяснить этот процесс уравнением: человеческая психика во время бури как и ива, которая изгибается, не ломаясь –изгибается, но использует защитные механизмы, чтобы не сломаться.

Поддержки работу механизмов психологической защиты при представлении через, прежде всего, стресс и внутренние скрытые связи между реакциями бросаются в глаза. Стресс — не только сложность внешней ситуации, но и одновременность для психики последовательность внутренних процессов, которые активны на нескольких уровнях. Без опоры эта цепь обозначается как центральная точка: когда человек чувствует угрозу, нарастает эмоциональная нагрузка, ослабляется мышление, а психика сохраняет себя автоматически активирует защитные механизмы для.

Первый слой этой структуры — обработка эмоций. Во время стресса когда возникающие негативные чувства слишком серьезны для психики, защитные механизмы снижают эмоциональное давление и смягчают его. Без опоры в своей логике это "первичная сила чувств → способность психики это проявляется в виде:» восприятие, изменяющее эмоции". Механизмы чувства нет, но они приводят его к другому характеру, что приводит к тому, что человек позволяет легко почувствовать ситуацию.

Второй этаж — перестройка мысли. Защитные механизмы только меняет не только эмоцию, но и ее сущность. Например, рационализация интеллектуализация, если она позволяет оправдать действия человека как чисто логическое явление, поднимающее ситуацию с чувственного уровня позволяет рассмотреть. Такая реконструкция «истинное содержание → опасность для психики → упрощенное объяснение". Это природная стратегия самосохранения психики.

Третий слой — это отвод ответа. Как Проекция механизмы направляют внутреннее давление на внешние объекты. Без опоры в текстовой модели это "внутренняя тревога → внешний объект → субъективный упрощение". Здесь психика чувствует боль в себе после замены на другой, внутреннее состояние становится легче. Он не теряет чувств, но воспринимается так, как будто не принадлежит ему напрямую.

Четвертый слой — это перенаправление энергии, то есть сублимация. Это механизм является одним из наиболее конструктивных направлений в системе защиты. Тяжелая энергия стресса способствует творчеству, спорту, интеллектуальному переходу к действию, он дает человеку силы. Здесь направление без опоры "отрицательная эмоция → полезный канал → внутреннее облегчение". Это — одна из редких моделей защитной системы, которая позволяет развиваться и расти.

Последний слой — небоскреба — восстановление психического равновесия — прибытие. Хотя все механизмы работают по-разному, их общие цель — сохранить внутреннюю целостность личности. В текстовой модели этой части "защитный механизм → снижение давления → поддержание стабильности" можно описать последовательностью. Психика наполняет сложные чувства не удаляет, но поддерживает их в удобной для управления форме. Каждый из механизмов несущей защиты, систематизированный таким образом указывает на то, что они не являются индивидуально действующими структурами: они связаны друг с другом соединяется и превращается в единую защитную сеть в состоянии стресса. Иногда, когда несколько механизмов работают бок о бок, иногда психика выбирает. Но у всех их общая конечная миссия — сделать человека вывод из стресса без поломки.

Заключение

Механизмы психологической защиты — невидимость человеческой души, но самая сильная опора. Они работают в глубоком слое сознания, создавая стресс действует как «самовоспроизводящийся щит» против урагана. В повседневной жизни мы не замечаем их существования, но они сложны когда возникает ситуация, психика через эти же механизмы спасает. Новая информация вместо информации, полученной человеком принимает. Но когда приходит другая информация, предыдущая информация не выходит. Они хранятся в мозгу. [7] Как показывает это исследование, внутренний мир человека сложен и гармоничен внутри, хотя внешне он кажется слабым есть система защиты, которая смягчает даже

болезненные ощущения и заставляет человека чувствовать себя подавленным обладает способностью пропускать. Психика при стрессе имеет разные направления работает: уменьшает эмоции, ослабляет воздействие опасности, мышление пытается удержать систему в равновесии. Это-внутренняя природная мудрость. Защитные механизмы, с одной стороны, заставляют человека с другой стороны, он переработал свой жизненный опыт и изменил позволяет адаптироваться. С этой чертой они могут быть эмоциональными составляет неотъемлемую часть иммунитета. Психика такая сложная работа заключается в том, что человеческая натура не слабая, а, наоборот, очень гибкая доказывает. "Психологическая защита-это не бегство от чувств, тонкое искусство борьбы с ними». Человек не подавляет эмоции, однако его поворачивает в безопасное русло; не стирает мысль, но делает ее с другим смыслом не скрывается от искренности, но принимает ее находит себе подходящий путь. Защитные механизмы иногда их основная цель, хотя и привела к искажению реальности – поддержание психической целостности.

Это-для защиты своей жизни бессознательный труд. Каждый механизм связан с прошлым опытом человека, тесно с чувствами, смягченными ранами и устоявшимся характером связанных. Поэтому их понимание-это не просто теоретический шаг, а важный путь к самопознанию. Четверть слова означает, что слово имеет узелок на шиколотке, ударение-это испытание, которое пробуждает не только изнурительную силу, но и ее внутренний потенциал. А механизмы психологической защиты-к преодолению того же испытания невидимый инструмент, который помогает. Человек словно ива, стоящая перед внутренним штормом и снова встает прямо. "Опорой психики является ее адаптация способности". Если человек может понять свои защитные механизмы, он может управление, регулирование эмоций, осознанное отношение к своей жизни осваивает. Психологическая защита не признак слабости человека, доказательство его естественной стойкости к жизни. Он духовный человек часть конструкции, мягкий щит, предохраняющий от неприятностей. И самый важно то, что он присутствует в каждом человеке, только чтобы его можно было распознать, понять и правильно необходимо использовать в направлении.

Список источников

1. Кувшинская, Ю. М. (2019). Академическое письмо: от исследования к тексту (17–23-б.). Мәскеу: Юрайт.
2. Bowler, S. (2020). Stress and the Mind: Adaptive Psychological Responses. Psychology Press.
3. McWilliams, N. (2011). Psychoanalytic diagnosis: Understanding personality structure in the clinical process. Guilford Press.
4. Baumeister, R. (2016). Emotion and Cognitive Control in Stress.
<https://psycnet.apa.org>
5. Carlson, L. (2018). Repression and memory studies. Journal of Clinical Psychology.
<https://onlinelibrary.wiley.com>
6. Herman, J., & Singer, T. (2017). Stress processing in the brain. Nature Reviews Neuroscience. <https://www.nature.com/articles/nrn>
7. Тулекова Г.Қ. Руханияттың мәнін насихаттау // Neophilology. – 2019. – Vol. 5, No. 19. – P. 388–397

159.944.4:159.964.2

ВЛИЯНИЕ СОЦИАЛЬНЫХ СЕТЕЙ НА САМОВОСПРИЯТИЕ ЧЕЛОВЕКА

Тулекова Г. Х.

к. ф.Н., ассоциированный профессор

Ынтымаккызы Сымбат

Студент университета» Туран"

Г. Алматы, Казахстан

Аннотация. В этой статье рассматривается, как социальные сети влияют на самовосприятие, отношение к себе и эмоциональное состояние современной молодежи. Поскольку тема напрямую связана с нашей повседневной жизнью, проблема была изложена простым и понятным языком. Теоретические основы систематизированы исходя из требований Кувшинской к академическому письму, поэтому информация в статье представлена последовательно, опираясь на конкретные доводы.

В исследовании объяснялось, какое влияние психологические механизмы, такие как идеализированный контент в социальных сетях, зависимость от лайков и комментариев, постоянное сравнение с другими людьми, оказывают на восприятие человеком себя. Кроме того, в статье также обсуждались эмоциональные трудности, с которыми часто сталкиваются студенты, школьники и молодые специалисты.

Мысли и выводы, представленные в статье, основаны на национальных и международных научных исследованиях [1-10], поэтому рекомендации основаны на фактических данных.

Ключевые слова: социальные сети, самопринятие, самооценка, социальное сравнение, цифровая грамотность, психология молодежи.

Введение

Сегодня социальные сети стали естественной частью нашей жизни. Большинство людей не могут представить себе день без телефона: кто-то смотрит новости своих друзей, кто-то рисует фотографии, кто-то просто скроллит, чтобы скоротать время. Подобная активность в сети становится не просто привычкой, а важным психологическим фактором, влияющим на настроение, отношение к себе и даже на то, как он себя воспринимает. Поэтому можно сказать, что изучение этой темы очень актуально для сегодняшних студентов, школьников, молодых специалистов.

Самопринятие-это когда человек спрашивает: "Что я?", «что я могу сделать?", "какова моя стоимость?" ответ на внутренние вопросы. На формирование этого чувства влияют многие факторы, такие как семья, окружение, опыт. Но в последние годы к этой системе добавился еще один мощный фактор-социальные сети. Особенно на таких платформах, как Instagram, TikTok, Facebook, все пытаются представить себя с «лучшей версией себя». И мы невольно начинаем сравнивать его с другими и сомневаться в себе.

Как следует из идеи кувшинской об академическом письме, любое исследование должно основываться на реальных доказательствах[1, с. 17–23], поэтому и в этой работе мы опирались на отечественные и зарубежные научные труды, объясняющие психологическое воздействие социальных сетей [1-10]. Большая часть этих исследований демонстрирует двоякое влияние социальных сетей: с одной стороны-мотивирует, знакомит с новыми

людьми, помогает найти поддержку; с другой-вызывает такие проблемы, как чрезмерное сравнение, стремление достичь идеала, зависимость от лайков.

Поэтому в этой статье мы рассмотрим, как именно социальные сети влияют на самовосприятие человека, с помощью каких механизмов происходит этот процесс, и обсудим, какие рекомендации можно дать психологам и студентам. Актуальность темы заключается в том, что этот вопрос непосредственно затрагивает жизнь каждого человека в информационное время.

В последние годы было проведено очень много исследований о влиянии социальных сетей на человеческое самовосприятие. Большинство ученых признают одно: социальные сети могут усилить чувство мотивации, вдохновения у некоторых людей, а теперь наоборот-недовольство собой, беспокойство, сравнение с другими.

Сначала в исследовании Turkle (2011) говорится, что технологии изменяют форму общения людей друг с другом, и иногда виртуальное общение заменяет реальное общение [2]. По мнению ученого, люди начинают чувствовать себя неуверенно, когда они «по-другому» показывают себя в сети и уходят от этого образа.

Валкенбург и Питер (2011) показали, что социальные сети по-разному влияют на эмоциональное состояние подростков. Они говорят, что онлайн-общение помогает человеку не чувствовать себя одиноким, но слишком большое сравнение снижает самооценку [3].

Исследовательская группа Fardouly (2015) обратила внимание на то, что частое наблюдение за «идеальными» людьми в социальных сетях, особенно в Instagram, усиливает недовольство молодых девушек своей внешностью [4]. Такой контент часто пробуждает мысль «я не такой» и ослабляет самовосприятие.

Vogel и его коллеги (2014) также обнаружили аналогичные результаты: многопользовательский Facebook просматривает достижения других и оценивает свою жизнь «ниже» [5]. То есть, поскольку человек видит только хорошие моменты, жизнь других кажется идеальной.

A Kuss и Griffiths (2011) исследовали проблему сетевой зависимости. Они показали, что чрезмерное использование социальных сетей плохо влияет на настроение, поведение во сне и отношение к себе [6].

В целом исследования доказывают, что:

- Важно то, как вы используете сеть-это дает положительный эффект, если вы используете ее с полезной целью.

- Но если ты много видишь или постоянно сравниваешь идеальную жизнь-это может негативно сказаться на твоём восприятии.

- Социальная поддержка, уровень самооценки, Семейная среда-это способствует ослаблению или усилению воздействия.

Согласно этой литературе, влияние социальных сетей не является односторонним. Он варьируется в зависимости от индивидуальных психологических особенностей человека, цели применения и среды

То, как социальные сети влияют на самовосприятие человека, является одной из актуальных проблем, которые часто обсуждаются в современной психологии [7, с. 388–397.]В прошлом отношение человека к себе формировалось в основном через определенные социальные факторы, такие как семья, друзья, школьная среда, сегодня на него особенно влияет онлайн-среда-такие платформы, как Instagram, TikTok, Facebook. Сейчас многие ежедневно смотрят различный контент и принимают информацию непрерывно. Качество, содержание такой информации и то, как мы ее воспринимаем, могут напрямую влиять на самооценку человека.

Самопринятие-это то, как человек видит себя как личность, какие качества он ценит и как он чувствует свои возможности. То есть внутреннее представление человека о «я». Этот

образ не является чем-то постоянным: по мере изменения жизненного опыта, отношений и получаемой информации формируется и самовосприятие. Социальные сети по-прежнему являются основным фактором этих изменений, потому что в сетях люди показывают не свою реальную жизнь, а часто «отредактированную» версию, близкую к идеалу. Такой идеализированный контент в среде заставляет человека сравнивать свою жизнь с ними, и сравнение часто приводит к разочарованию в себе.

Согласно исследованиям, процесс сравнения, происходящий в социальных сетях, считается одним из самых сильных факторов в самооценке человека. Особенно среди молодежи часто формируется мысль «чужая жизнь лучше меня». Потому что фотографии в сети, достижения, красивые сцены способствуют критическому взгляду человека на свою жизнь. Такой эффект проявили и Фардули и его коллеги: у девушек, которые часто смотрели листовки с изображением идеального телосложения, усилилась неуверенность в себе и невнимательность. А исследование Vogel показало, что среди студентов, активно использующих социальные сети, чаще встречаются негативные эмоциональные реакции и низкая самооценка. То есть информация в социальной сети обязательно способствует восприятию человеком самого себя, только ее сила у каждого человека разная.

Усилению этого влияния способствует не только контент, но и такие отзывы, как лайки, комментарии. Для некоторых людей онлайн-реакция «меня принимают или любят?» становится ответом на внутренний вопрос. Чем меньше лайков-тем меньше разочарований, чем больше-тем увереннее. Это ослабляет внутреннюю стабильность, делая самооценку человека зависимой от внешней оценки. Это состояние особенно часто наблюдается у молодых людей с низкой уверенностью в себе.

Также стоит учитывать влияние алгоритмов социальных сетей на самопринятие. Платформы определяют, какой контент они показывают чаще всего, исходя из интересов пользователя. Если человек однажды просматривает «идеальные» видео, алгоритм еще больше представляет тот же контент. Со временем человек чувствует, что вокруг него живут только идеальные люди. Такая виртуальная среда искажает отношение человека к себе, формируя стандарт, не соответствующий реальной жизни.

Однако влияние социальных сетей не у всех одинаковое. Этот эффект легче всего сказывается на людях с стабильной самооценкой, высокой социальной поддержкой и хорошим личностным развитием. А эмоционально чувствительные люди с низкой самооценкой могут чувствовать большее давление со стороны социальных сетей. Возраст также важен: поскольку подростки и студенты эмоционально дестабилизированы, процесс сравнения может быть болезненным.

В книге кувшинской по академическому письму говорится, что любая теория должна быть изложена в логической связи, опираясь на конкретный аргумент. Исходя из этого утверждения, когда мы рассматриваем влияние социальных сетей, мы видим, что нельзя однозначно сказать, что только «социальные сети вредны». Его влияние зависит от психологической специфики человека, того, какой контент он потребляет и что ищет в сети. При правильном использовании социальные сети также могут дать мотивацию, вдохновение, социальную поддержку. Но его чрезмерное использование и сравнение своей жизни с идеальными образами может ослабить самовосприятие.

Таким образом, теоретически социальные сети представляют собой сложную психологическую среду, которая прямо и косвенно влияет на самовосприятие человека. Этот эффект состоит из суммы нескольких механизмов, а не одного фактора: сравнения, идеализации, зависимости от обратной связи, алгоритмического давления и психологических особенностей человека. Поэтому, чтобы полностью понять влияние социальных сетей на человека, необходимо вместе рассмотреть его содержание, мотивы использования и особенности личности.

Заклучение

В этой статье было рассмотрено влияние социальных сетей на самовосприятие человека. Теоретический анализ показывает, что социальные сети влияют на самооценку человека с помощью нескольких механизмов, таких как самовыражение, социальное сравнение, зависимость от обратной связи через лайки/комментарии и влияние алгоритмов. Воздействие происходит у всех по-разному: такие факторы, как первоначальная самооценка, уровень социальной поддержки, возраст и цель применения, могут усилить или ослабить этот процесс.

Что касается практики, будут предложены простые и эффективные меры, такие как развитие цифровой грамотности, ограничение по времени (digital detox), организация групп психологической поддержки и внедрение медиа-благополучия в образовательные программы, чтобы уменьшить вредное воздействие социальных сетей. Вышеуказанные меры помогут сделать взаимодействие учащихся и школьников с социальной сетью более безопасным и осознанным.

В заключение можно прийти к выводу, что вместо того, чтобы рассматривать социальные сети как «полезные» или «вредные»-важно то, как и с какой целью мы их используем. Будущие исследования будут включать более точные измерения эффекта (например, межплатформенное сравнение, возрастной анализ) и экспериментальную проверку эффективности предлагаемых мер вмешательства.

Список литературы:

1. Кувшинская Ю.М. Академическое письмо: От исследования к тексту. Учебник и практикум для академического бакалавриата / Под ред. Ю.М. Кувшинской.-Москва: Юрайт, 2019.-284 с.
2. uchebnik
3. Turkle S. Alone Together: Why We Expect More from Technology and Less from Each Other.-New York: Basic Books, 2011.-384 p.
4. Valkenburg P.M., Peter J. The social consequences of the Internet for adolescents: A decade of research // Current Directions in Psychological Science.-2011.-Vol. 20, No. 1.-P. 1–5.
5. Fardouly J., Diedrichs P.C., Vartanian L.R., Halliwell E. Social comparisons on social media: The impact of Facebook on young women's body image and mood // Body Image.-2015.-Vol. 13.-P. 38–45.
6. Түлекова Г.Қ. Руханияттың мәнін насихаттау // Neophilology. – 2019. – Vol. 5, No. 19. – P. 388–397.
7. Kuss D.J., Griffiths M.D. Online social networking and addiction-A review of the psychological literature // International Journal of Environmental Research and Public Health.-2011.-Vol. 8, No. 9.-P. 3528–3552.
8. Twenge J.M. iGen: Why Today's Super-Connected Kids Are Growing Up Less Rebellious, More Tolerant, Less Happy.-New York: Atria Books, 2017.-352 p.
9. Pew Research Center. Teens, Social Media & Technology 2018.-Washington, D.C.: Pew Research Center, 2018.- (электрондық ресурс).-URL:
10. UNESCO. Digital Learning and Teaching in Mathematics: Global Report.-Paris: UNESCO Publishing, 2023.-124 p.
11. Қазақстан Республикасы Білім және Ғылым министрлігі. Цифрлық білім беру ресурстарын енгізу тұжырымдамасы (2021–2027 жж.).-Астана, 2021.-48 б.
12. Vogel E.A., Rose J.P., Roberts L.R., Eckles K. Social comparison, Facebook use, and depressive symptoms: A study of young adults // Journal of Social and Clinical Psychology.-2014.-Vol. 33, No. 8.-P. 701–731.

Sociological Sciences

SOCIAL, CULTURAL, ECONOMIC AND DEMOGRAPHIC FACTORS INFLUENCING AI REGULATION IN KAZAKHSTAN

Tokhtakhunov Bakhtiyar Nurakhunovich

PhD student, Department of Sociology and Social Work, Al-Farabi, Kazakh National University, Almaty, Kazakhstan

Abstract

The article analyzes the social, cultural, economic, and demographic factors that shape the specifics of artificial intelligence (AI) regulation in Kazakhstan, using the example of the Republic of Kazakhstan Law "On Artificial Intelligence" dated November 17, 2025. The author emphasizes that the new law reflects the transitional nature of Kazakhstani society: the post-Soviet legacy of distrust in institutions, multi-ethnic and nomadic cultural diversity, the economy's dependence on oil, and a young demography with a pronounced digital divide between urban and rural areas. A comparison is made between the Kazakhstani approach and the models of the European Union (EU AI Act, focused on protecting individual rights and strict risk classification) and China (state-centered ethics with an emphasis on social harmony and control). The advantages of Kazakhstan's hybrid model are identified, allowing the combination of innovation with social justice and cultural sensitivity. Threats are discussed the intensification of inequality and decline in trust due to insufficient attention to local specifics and measures to minimize them are proposed: public consultations, cultural audits of AI, digital literacy programs, and independent oversight. The article demonstrates that successful AI regulation in Kazakhstan is possible only when national characteristics are taken into account, making the country a potential leader in Central Asia in creating an inclusive and humane model of digitalization.

Keywords: AI regulation, Kazakhstan, sociology of law, cultural influences, economic diversification, demographic factors, Central Asia.

INTRODUCTION

In November 2025, the President of the Republic of Kazakhstan, Kassym-Jomart Tokayev, signed the Law "On Artificial Intelligence" as well as the Law "On Amendments and Additions to Certain Legislative Acts of the Republic of Kazakhstan on Artificial Intelligence and Digitalization," thereby defining the strategic trajectory of Kazakhstan's transition into a new era of digital transformation. The prerequisites for the adoption of these legislative acts were articulated earlier, in September 2025, in the President's Address entitled "Kazakhstan in the Era of Artificial Intelligence: Current Challenges and Their Solutions through Digital Transformation." Referring to the revolutionary technological advances achieved by leading countries in the field of artificial intelligence (AI), K.-J. Tokayev emphasized the key priorities of this national agenda in his Address: "On the basis of large-scale digitalization and the active introduction of artificial intelligence technologies, we must modernize the economy. As a first step, it is necessary to accelerate the adoption of the Digital Code. This document should define the key directions of digitalization,

including artificial intelligence, the platform economy, the use of big data, and other related areas,” the President stated [1].

Global experience demonstrates that the rapid development of artificial intelligence has compelled many states to establish regulatory frameworks capable of reconciling technological progress with fundamental social imperatives. Kazakhstan, as a key actor in Central Asia with a rapidly developing digital economy, adopted its first AI Law, positioning itself as a regional pioneer in digital transformation. The new legislation, consisting of 31 articles, establishes core principles such as transparency, fairness, and human-centeredness, while prohibiting manipulative AI practices and mandating state oversight in high-risk domains affecting the protection of citizens’ interests, including the judiciary, prosecutorial bodies, and other sensitive sectors. However, as a transition economy overcoming its post-Soviet legacy, Kazakhstan’s AI policy represents not merely a technical regulatory framework, but also a reflection of deeper social, cultural, economic, and demographic processes. At the same time, active discussions are already underway within Kazakhstan’s political institutions concerning the ethical and security dimensions of AI deployment, which require heightened attention. According to the Chairman of the Mazhilis of the Parliament of the Republic of Kazakhstan, Erlan Koshanov, alongside the benefits AI brings to society, there is growing concern that artificial intelligence may substitute genuine knowledge and cognitive engagement. Public opinion surveys indicate that Kazakhstani citizens are increasingly aware of both the opportunities and risks associated with the integration of AI into education. As noted by parliamentary representatives, the precise boundaries of potential threats posed by artificial intelligence have not yet been clearly defined. To counteract the misuse of AI technologies, various regulatory approaches are being proposed. For instance, beginning in September 2025, China required national social media platforms to implement mandatory labeling of AI-generated content, and Kazakhstan has adopted a similar practice. Despite these measures, the Speaker of the lower house of Parliament emphasized that, according to public opinion polls, 40.5% of Kazakhstan’s population assesses the impact of artificial intelligence positively, while 37% tend to perceive it negatively, arguing that AI oversimplifies learning processes and contributes to superficial knowledge acquisition.

In contrast, the Deputy Prime Minister and Minister of Artificial Intelligence and Digital Development of the Republic of Kazakhstan, Zhaslan Madiyev, argues that AI should not be viewed primarily as an object of concern, but rather as a strategic instrument for addressing key national challenges. One of the government’s central objectives for the coming years is to train one million people in AI-related skills over a five-year period. According to him, these educational initiatives target school students, university students, civil servants, businesses, and other relevant stakeholders. In turn, the Minister of Science and Higher Education of the Republic of Kazakhstan, Sayasat Nurbek, stated that the government is systematically supporting AI-oriented research through targeted and grant-based funding programs. Currently, 27 universities and six research institutes across 11 regions are actively engaged in artificial intelligence research, involving a total of 479 researchers. The highest concentration of projects is observed in Almaty and Astana. “Twenty-six projects are being implemented by young scientists under the age of 40, covering seven priority scientific areas. AI research is primarily focused on advanced manufacturing processes, digital technologies, and the aerospace sector. Our key task today is to adapt higher education to the requirements of the AI era. Tangible results have already been achieved: at present, 30 higher education institutions offer 38 educational programs in artificial intelligence. Starting from 2025, AI competencies will be integrated into all educational programs,” he emphasized during parliamentary hearings on the development and regulation of artificial intelligence in Kazakhstan held on September 26, 2025, in the Mazhilis [2]. As of today, Kazakhstan is implementing 62 artificial intelligence projects with a total value of 9.7 billion tenge (approximately USD 17 million), and these figures are expected to grow further amid rapidly

evolving global geopolitical dynamics [3]. These indicators closely align with Priority 4 of the Strategy “Kazakhstan–2050,” which aims to build a prosperous society based on a strong state, a developed economy, and universal labor opportunities, and to position Kazakhstan among the world’s thirty most developed countries. This priority outlines seven long-term development vectors, one of which knowledge and professional skills serves as a key benchmark for the modernization of education and workforce training systems [4].

According to World Economic Forum data for 2025, artificial intelligence may displace approximately 85 million jobs globally by 2027, while simultaneously creating 97 million new ones. Consequently, Kazakhstan’s regulatory approach must be attuned to local socio-economic realities in order to harness the potential of AI without exacerbating social inequality. This study not only sheds light on Kazakhstan’s AI governance trajectory, but also contributes to the broader academic discourse on culturally adaptive artificial intelligence governance in the Global South.

The aim of this article is to analyze how social, cultural, economic, and demographic factors shape the formation and implementation of artificial intelligence (AI) regulation in Kazakhstan, using the 2025 Law “On Artificial Intelligence” as a case study. The article seeks to demonstrate that Kazakhstan’s AI governance model cannot be adequately understood as a purely technical or legal framework, but rather as a socially embedded regulatory system reflecting the country’s post-Soviet institutional legacy, multi-ethnic cultural structure, economic transformation, and demographic characteristics. Through a comparative perspective with the European Union and China, the study aims to identify the distinctive features, advantages, and potential risks of Kazakhstan’s hybrid approach to AI regulation within the broader context of global AI governance.

Research Question: How do social, cultural, economic, and demographic factors influence the design and normative orientation of artificial intelligence regulation in Kazakhstan, and to what extent does Kazakhstan’s AI governance model represent a hybrid regulatory approach when compared with the European Union and China?

This article is significant in that it advances a socio-legal understanding of artificial intelligence regulation by demonstrating how national AI governance frameworks are shaped by embedded social, cultural, economic, and demographic contexts. By focusing on Kazakhstan as a post-Soviet and Central Asian case, the study contributes to the underexplored literature on AI governance in the Global South, offering an alternative to predominantly Western-centric regulatory models. The findings provide analytical insights relevant for policymakers, scholars of digital governance, and comparative sociology of law, particularly in societies undergoing rapid digital and institutional transformation.

Methodology

This study employs a qualitative review-based research design grounded in sociological and comparative legal analysis. The methodology combines a systematic analysis of нормативно-правовых документов, including the 2025 Law of the Republic of Kazakhstan “On Artificial Intelligence,” стратегические государственные программы, and official policy statements, with secondary data from international analytical reports World Economic Forum, World Bank, UNDP, Edelman Trust Barometer and national statistical sources. The analytical framework is informed by the sociology of law and theories of socially embedded regulation, drawing on concepts of institutional trust, rational-legal authority, cultural pluralism, and digital inequality. A comparative approach is applied to contrast Kazakhstan’s AI governance model with the European Union’s risk-based, rights-oriented regulatory framework (EU AI Act) and China’s state-centered, harmony-oriented model of AI regulation. This comparison allows for the identification of hybrid regulatory features and contextual adaptations specific to Kazakhstan. The review integrates interdisciplinary perspectives by examining how social trust, cultural diversity, economic structure, and demographic composition influence normative choices in AI regulation. Rather than producing new empirical data, the study synthesizes existing legal, sociological, and policy-oriented sources

to construct an interpretive model of Kazakhstan's AI governance. This approach enables a holistic assessment of the opportunities and risks associated with AI regulation in transition economies and supports the formulation of context-sensitive policy recommendations.

Results and Discussion

Social factors influencing AI regulation. Social factors including institutional trust, ethical perceptions, and issues of equality form the foundation of Kazakhstan's artificial intelligence policy. Like many post-Soviet states, Kazakhstan continues to grapple with the legacy of bureaucratic opacity and low public trust, with only 42% of citizens expressing confidence in judicial institutions [5]. According to a number of analysts, the adoption of the Law of the Republic of Kazakhstan "On Artificial Intelligence" is intended to address these deficiencies by enhancing transparency, particularly in high-risk sectors such as employment and social protection. This approach directly responds to societal concerns regarding algorithmic bias, whereby AI systems may reproduce or intensify ethnic and gender disparities in a multi-ethnic society (71.3% Kazakhs, 14.6% Russians, and 3.3% Uzbeks according to 2025 data) [6]. From a sociological perspective, AI regulation in Kazakhstan reflects an ongoing search for legitimacy within a hybrid governance framework. Drawing on Max Weber's concept of rational-legal authority, the law seeks to combine bureaucratic efficiency with social safeguards, including prohibitions on manipulative AI systems that could exacerbate inequality. The judicial sector provides a salient example. Pilot projects implemented in the courts of Almaty and Astana, where AI systems analyze approximately 665,000 cases annually, have reduced case-processing times by 15–20%, thereby contributing to improved public perceptions of procedural fairness. As noted by the Chair of the Supreme Court of the Republic of Kazakhstan, Aslambek Mergaliyev, in his official report to the President, "the system is trained to understand the substance of judicial decisions, compare them, identify anomalies, and predict the outcomes of civil cases. As a result, when a claim is filed, judges can immediately access judicial practice in similar cases, including cassation-level rulings" [7].

Despite these seemingly progressive developments in the justice system, social resistance persists in other domains. Survey data indicate that approximately 40% of respondents fear job losses as a result of automation driven by AI-based technologies [8]. These concerns highlight the broader social anxieties associated with technological change and labor market transformation. As noted earlier, public trust in state institutions and courts in Kazakhstan remains uneven. According to surveys conducted in 2025, only around 40–50% of citizens express confidence in the fairness of certain institutions. The AI Law attempts to address this deficit by requiring that AI-driven decisions be explainable and comprehensible to humans, while explicitly prohibiting systems that manipulate individuals or reinforce inequality. Although AI applications contribute to anti-corruption efforts—such as reducing case-processing times in Almaty courts by 15–20%—significant risks remain. In particular, errors or biased outcomes favoring specific groups based on ethnicity, gender, or region could further undermine public trust. Equally important is the principle of equality, which functions as a key social driver of AI governance. Kazakhstan's AI strategy, embedded within the Concept for the Development of the Labor Market for 2024–2029 adopted by Government Resolution No. 1050 of November 29, 2023 [9], prioritizes inclusive governance as a means of mitigating the digital divide, given that rural areas lag behind urban centers by approximately 30% in internet access [10]. This approach aligns with sociological imperatives of "socially embedded" regulation, in which AI is conceived as a tool for empowerment rather than exclusion [11]. Consequently, the effective implementation of these initiatives requires broad public engagement through open consultations on legislation, transparent demonstrations of how AI systems operate, and systematic efforts to enhance digital literacy across the population [12].

Cultural factors: traditions and multiculturalism. Cultural characteristics play a crucial role in shaping Kazakhstan's approach to artificial intelligence regulation. Rather than representing a purely technical set of rules, AI governance in Kazakhstan reflects an effort to embed emerging

technologies within a complex national identity shaped by diverse mentalities, the historical heritage of the Kazakh people, the multi-ethnic composition of society encompassing representatives of more than 130 ethnic groups, and the realities of the post-Soviet transition. By design, the Law “On Artificial Intelligence” emphasizes the principle of human-centeredness and resonates with traditional Kazakh values such as social harmony, respect for elders, and collective well-being. Unlike the predominantly individualistic regulatory approaches characteristic of Western countries (including the European Union and the United States), Kazakhstan’s framework conceptualizes technology as serving the community, while preserving family ties and cultural traditions. Many citizens of Kazakhstan, particularly younger generations, perceive modern technologies as instruments for preserving and transmitting cultural heritage. For instance, projects focused on the digitalization of epics and folklore already employ AI tools for the translation and analysis of ancient texts. In 2022, UNESCO recognized Kazakh oral traditions as part of humanity’s intangible cultural heritage [13]. The AI Law takes these cultural sensitivities into account by prohibiting systems that manipulate emotions or exploit human vulnerabilities, thereby safeguarding traditional values of family cohesion and mutual support from potential technological erosion [14]. The multinational composition of the Republic of Kazakhstan adds both cultural richness and regulatory complexity. With ethnic Kazakhs comprising approximately 71% of the population and the remaining 29% representing other ethnic groups, each community brings distinct linguistic practices, traditions, and attitudes toward technology. For example, Russian-speaking populations tend to be more oriented toward Western standards of transparency, whereas Kazakh-speaking communities often prioritize culturally embedded communicative values. In response, the law mandates cultural audits of AI systems to prevent discrimination based on language or ethnic origin. This requirement includes ensuring that language models operate equitably in both Kazakh and Russian, as reflected in the Concept for the Development of Artificial Intelligence for 2024–2029 [15]. For comparison, the European Union’s Artificial Intelligence Act, adopted by the European Parliament on March 13, 2024, places strong emphasis on cultural neutrality, requiring AI systems to respect the diversity of 27 member states through mandatory bias testing in multilingual environments [16]. However, despite its humanistic and rights-based orientation, the EU framework often prioritizes individual rights in ways that may not fully align with collectivist cultural contexts. In China, by contrast, AI ethics are framed around “socialist values” and social harmony, with technologies explicitly serving national unity and stability under strong state control over content that contradicts official narratives [17]. Kazakhstan selectively incorporates elements from both models: adopting transparency and diversity protection from the European approach, while drawing on the Chinese emphasis on harmony yet without resorting to rigid censorship. This synthesis renders Kazakhstan’s approach distinctive, globalizing regulatory norms while adapting them to a Eurasian cultural mindset in which tolerance, balance, and social cohesion are central values [18]. Cultural factors transform AI regulation in Kazakhstan from a narrowly legal instrument into a symbolic bridge between past and future, ensuring that technological development reinforces rather than erodes national identity and cultural continuity.

Comparative perspective: the European union and China. A comparison of the European Union’s and China’s approaches to artificial intelligence (AI) regulation provides valuable insight into why Kazakhstan’s Law “On Artificial Intelligence,” despite its relatively rapid adoption, appears balanced and well adapted to national realities. Kazakhstan’s regulatory framework draws on two distinct models the European and the Asian while incorporating a distinctive Central Asian dimension characterized by respect for multiculturalism, collectivist values, and pragmatic governance. Whereas the European Union prioritizes individual rights and strict legal protections, China emphasizes social stability and accelerated technological development under strong state oversight. Kazakhstan selectively adopts best practices from both systems, combining regulatory

safeguards with developmental flexibility. In the European Union, the EU Artificial Intelligence Act, adopted in 2024 and operationalized through implementing measures in 2025, represents one of the most stringent AI regulatory regimes globally. The framework is based on a risk-tiered classification system, under which certain AI applications are prohibited (such as systems enabling social manipulation or behavioral coercion), while high-risk domains including the judiciary, employment, and healthcare are subject to mandatory bias audits, transparency requirements, and incident reporting obligations. Financial penalties for non-compliance may reach up to EUR 35 million. The core objective of the EU AI Act is the protection of fundamental human rights, privacy, and non-discrimination, particularly within Europe's multilingual and multicultural environment [19]. These safeguards have contributed to relatively high public trust in AI systems governed by national and supranational institutions. However, the regulatory burden associated with compliance may constrain innovation, especially for small and medium-sized enterprises that lack the resources to conduct costly audits and absorb potential. In contrast, China's AI governance framework, updated through ethical guidelines and regulatory measures in 2025, is structured around the principles of "social harmony" and "socialist values." The state exercises extensive control over AI-related technologies, requiring that they serve objectives of social stability, national security, and political unity. Content deemed capable of generating social unrest or contradicting official narratives is subject to restriction or removal. At the same time, the Chinese government has made massive investments in AI development, allocating trillions of dollars toward the sector by 2030, which helps explain China's global leadership in AI innovation. As a result, AI technologies are rapidly integrated across multiple sectors, from smart cities to healthcare systems [20]. Nevertheless, this model entails significant trade-offs: limitations on freedom of expression and pervasive surveillance practices contribute to public perceptions of AI as a controlled rather than emancipatory tool, thereby reducing trust in technology as a mechanism of autonomous social development [21]. To consolidate these findings, Table 2 provides a structured overview of the key social, cultural, economic, and demographic factors influencing AI regulation in Kazakhstan, highlighting their regulatory implications, associated risks, and policy-relevant responses.

Table 1. - Key factors shaping AI regulation in Kazakhstan: summary of findings

Dimension	Key Characteristics	Impact on AI Regulation	Risks Identified	Policy Implications
Social factors	Low institutional trust; post-Soviet legacy; concerns over fairness and transparency	Emphasis on explainability, transparency, and prohibition of manipulative AI; use of AI to improve judicial efficiency	Algorithmic bias; erosion of trust in case of AI errors; fear of job displacement	Mandatory explainability, public oversight, inclusive consultations, trust-building measures
Cultural factors	Nomadic heritage; collectivist values; respect for elders; over 130 ethnic groups	Human-centered and community-oriented AI governance; cultural audits; multilingual AI systems	Cultural bias; marginalization of linguistic or ethnic groups	Cultural audits of AI, multilingual models, protection of collective values
Economic factors	Transition from resource-based economy; focus on innovation and SMEs	Flexible regulation avoiding excessive sanctions; support for innovation-driven growth	Unequal access to AI benefits; dominance of large actors	Balanced regulation combining innovation incentives with social safeguards
Demographic factors	Young population; urban–rural digital divide; regional inequality	Integration of AI skills into education; focus on inclusive digital development	Digital exclusion of rural areas and older generations	Digital literacy programs; infrastructure development in rural regions
Comparative context	Hybrid model drawing from EU and China	Combination of rights-based safeguards (EU) and harmony-oriented governance (China)	Regulatory incoherence if balance is lost	Context-sensitive hybrid governance model

The findings of this review demonstrate that artificial intelligence regulation in Kazakhstan is shaped by a complex interaction of social, cultural, economic, and demographic factors rather than by technological considerations alone. The Kazakhstani AI governance framework reflects the country's transitional post-Soviet context, where institutional trust remains fragile and regulatory legitimacy must be actively constructed through transparency, accountability, and social safeguards. From a social perspective, the results indicate that low levels of public trust in state institutions significantly influence the normative orientation of AI regulation. The emphasis on explainability, prohibitions on manipulative AI systems, and the use of AI to enhance judicial efficiency can be interpreted as mechanisms aimed at restoring confidence in public institutions. At the same time, persistent concerns about algorithmic bias and job displacement reveal that

technological efficiency alone is insufficient to secure social acceptance, underscoring the importance of inclusive governance and public engagement. Cultural factors emerge as a central dimension of Kazakhstan's AI regulation. The findings show that the principle of human-centeredness embedded in the law is closely aligned with collectivist values, nomadic heritage, and the country's multicultural composition. Rather than adopting a culturally neutral or purely individualistic model, Kazakhstan integrates ethical constraints that seek to protect social harmony, family ties, and linguistic diversity. This approach highlights the role of culture not as a barrier to technological development, but as a normative framework that shapes acceptable and legitimate forms of AI deployment. Economically, the results suggest that Kazakhstan's AI regulation is strategically designed to support innovation-driven growth while avoiding excessive regulatory burdens. By refraining from imposing highly punitive sanctions, the legal framework aims to foster entrepreneurship and the development of small and medium-sized enterprises. However, the findings also point to structural risks, including unequal access to AI resources and the potential concentration of benefits among larger actors or administrative elites, which may undermine inclusive economic development if left unaddressed. Demographic factors further condition the regulatory landscape. Kazakhstan's relatively young population provides a favorable foundation for the diffusion of AI skills and technologies, yet pronounced urban–rural disparities in digital infrastructure and literacy present a significant challenge. The findings underscore that without targeted investments in education, connectivity, and lifelong learning, AI-driven transformation may deepen existing social inequalities rather than mitigate them. Finally, the comparative analysis confirms that Kazakhstan's AI governance model represents a hybrid regulatory approach. By selectively integrating elements of the European Union's rights-based, risk-oriented framework and China's harmony-focused, state-led model, Kazakhstan has developed a context-sensitive regulatory architecture adapted to Central Asian realities. This hybridity constitutes both a strength and a vulnerability: while it enables flexibility and cultural resonance, it also requires continuous institutional coordination to prevent regulatory fragmentation.

Conclusion

As Kazakhstan has embarked on the path of global technological transformation through the adoption of AI-related legislation, it continues to examine the trajectories of leading countries, drawing lessons from their regulatory experiences. Given the country's historical, cultural, mental, and social specificities, its multi-ethnic composition necessitates cultural audits to ensure that artificial intelligence does not marginalize particular ethnic groups. In this context, technology is expected to reinforce social harmony rather than deepen societal fragmentation. Kazakhstan's AI legislation prohibits manipulative practices while avoiding excessively restrictive sanctions that could stifle innovation, thereby creating favorable conditions for the development of small and medium-sized enterprises and for broader economic growth. The advantages of this approach are evident. Kazakhstan has the opportunity to pursue rapid technological development similar to China while simultaneously maintaining public trust in institutions, as emphasized in the European Union. This balance is particularly significant in the Central Asian context, where collective memory of the Soviet past coexists with a strong desire for stability and an aspiration toward modern technological advancement. At the same time, the risks associated with AI deployment should not be underestimated, especially the danger of a widening digital divide, in which access to AI technologies becomes concentrated among elites or administrative actors responsible for addressing social challenges. The Law "On Artificial Intelligence," adopted in Kazakhstan in November 2025, represents a critical milestone for a country seeking to enter the digital era without sacrificing its national identity. As demonstrated in this study, the law is not merely a set of technical regulations, but a reflection of Kazakhstan's deeper social, cultural, economic, and demographic characteristics. From a social perspective, the legislation responds to challenges of

institutional trust by promoting greater transparency and fairness in the justice system and public services. Culturally, it acknowledges the country's nomadic heritage and multicultural composition by requiring that AI systems respect traditions and avoid creating divisions between ethnic groups. Economically, it supports the transition from resource dependency toward innovation-driven growth, promising job creation and diversification. Demographically, it builds upon the country's youthful population while emphasizing the need to ensure that rural areas and older generations are not left behind. The benefits of this flexible regulatory framework are substantial: it enables innovation without deterring business activity, while simultaneously safeguarding human interests. This creates a genuine opportunity for Kazakhstan to position itself as a regional leader in Central Asia and to serve as a reference model for other countries with comparable historical and institutional legacies. Nevertheless, significant challenges remain. Without sustained efforts to address digital inequality and algorithmic bias, AI technologies may reinforce existing social disparities and erode public trust. To mitigate these risks, a set of policy measures is required, including inclusive public consultations, comprehensive digital literacy programs targeting all age groups, transparent demonstrations of AI applications in everyday contexts, and the establishment of independent mechanisms for technological oversight. Under these conditions, artificial intelligence can evolve from a perceived threat into a practical instrument for fostering a more just, inclusive, and modern society in Kazakhstan. Only through such an approach does Kazakhstan possess a unique historical opportunity to emerge as a leader in AI governance in Central Asia. Given the country's strategic plans for AI development, the first tangible outcomes are likely to become visible within the next five to seven years. The ultimate effectiveness of these reforms will be determined over time; however, the decisive first step has already been taken, and it has been taken by Kazakhstan.

Reference

1. President of the Republic of Kazakhstan. (2025). Address of the Head of State Kassym-Jomart Tokayev to the People of Kazakhstan "Kazakhstan in the Era of Artificial Intelligence: Current Challenges and Solutions through Digital Transformation." [Online]. Available at: <https://www.akorda.kz/ru/poslanie-glavy-gosudarstva-kasym-zhomarta-tokaeva-narodu-kazahstana-kazahstan-v-epohu-iskusstvennogo-intellekta-aktualnye-zadachi-i-ih-resheniya-cherez-cifrovuyu-transformatsiyu-885145> (accessed: 20.11. 2025).
2. The Astana Times. (2025). Kazakhstan enacts AI law: Parliament weighs opportunities and risks. [Online]. Available at: <https://astanatimes.com/2025/09/kazakhstan-enacts-ai-law-parliament-weighs-opportunities-and-risks/> (accessed: 02.10.2025).
3. Inform.kz. (2025). Kazakhstan's government allocates approximately 10 billion tenge for AI projects. [Online]. Available at: <https://www.inform.kz/ru/pravitelstvo-kazahstana-videlilo-okolo-10-mlrd-tenge-na-proekti-v-sfere-ii-bf7fcc> (accessed: 03.10. 2025).
4. President of the Republic of Kazakhstan. Strategies and state programs of the Republic of Kazakhstan. [Online]. Available at: https://www.akorda.kz/ru/official_documents/strategies_and_programs (accessed: 20 December 2025).
5. Edelman. (2025). Edelman Trust Barometer 2025: Special Report on Artificial Intelligence. [Online]. Available at: <https://www.edelman.com/trust/2025/trust-barometer> (accessed: 21.11. 2025).
6. Bureau of National Statistics of the Republic of Kazakhstan. (2025). Demographic statistics of Kazakhstan. [Online]. Available at: <https://stat.gov.kz/ru/industries/social-statistics/demography/publications/281562/> (accessed: 11 December 2025).

7. Kursiv.media. (2025). How artificial intelligence is transforming Kazakhstan's judicial system. [Online]. Available at: <https://kz.kursiv.media/2025-01-21/smrd-aisud/> (accessed: 02 December 2025).
8. Pew Research Center. (2025). How the U.S. public and AI experts view artificial intelligence. [Online]. Available at: <https://www.pewresearch.org/science/2025/04/03/how-the-us-public-and-ai-experts-view-artificial-intelligence/> (accessed: 10 December 2025).
9. Government of the Republic of Kazakhstan. (2023). Concept for the Development of the Labor Market for 2024–2029 (Resolution No. 1050, November 29, 2023). [Online]. Available at: <https://adilet.zan.kz/rus/docs/P2300001050> (accessed: 21.11. 2025).
10. World Bank Group. (2025). Digital Economy Report 2025: Central Asia Focus. [Online]. Available at: <https://www.worldbank.org/en/region/eca/publication/digital-economy-report-2025> (accessed: 10 December 2025).
11. United Nations Development Programme (UNDP). (2025). Human Development Report 2025. [Online]. Available at: <https://hdr.undp.org/content/human-development-report-2025> (accessed: 08 December 2025).
12. Government of the Republic of Kazakhstan. Measures to improve digital literacy among the population. [Online]. Available at: <https://www.gov.kz/memleket/entities/enbek/press/news/details/1070058?lang=ru> (accessed: 12 December 2025).
13. Ministry of Foreign Affairs of the Republic of Kazakhstan. Projects aimed at preserving Kazakhstan's cultural heritage. [Online]. Available at: <https://www.gov.kz/memleket/entities/mfa/press/news/details/469340?lang=ru> (accessed: 09 December 2025).
14. Euractiv. (2025). Kazakhstan's new AI law charts an ambitious course inspired by the EU. [Online]. Available at: <https://www.euractiv.com/news/kazakhstans-new-ai-law-charts-ambitious-course-inspired-by-eu/> (accessed: 12 December 2025).
15. Government of the Republic of Kazakhstan. (2024). Concept for the Development of Artificial Intelligence for 2024–2029 (Resolution No. 592, July 24, 2024). [Online]. Available at: <https://adilet.zan.kz/rus/docs/P2400000592> (accessed: 19 December 2025).
16. European Commission. (2025). Regulatory framework on artificial intelligence and reporting serious AI incidents under the EU AI Act. [Online]. Available at: <https://digital-strategy.ec.europa.eu/en/policies/regulatory-framework-ai> (accessed: 13 December 2025).
17. Analytics Vidhya. (2024). China releases strong guidelines for the use of AI in research. [Online]. Available at: <https://www.analyticsvidhya.com/blog/2024/01/china-releases-strong-guidelines-for-use-of-ai-in-research/> (accessed: 09 December 2025).
18. Mayer Brown. (2025). Artificial intelligence: A brave new world—China formulates a global AI governance action plan and ethics rules. [Online]. Available at: <https://www.mayerbrown.com/en/insights/publications/2025/10/artificial-intelligence-a-brave-new-world-china-formulates-new-ai-global-governance-action-plan-and-issues-draft-ethics-rules-and-ai-labelling-rules> (accessed: 11 December 2025).
19. European Commission. EU regulatory framework on artificial intelligence. [Online]. Available at: <https://digital-strategy.ec.europa.eu/en/policies/regulatory-framework-ai> (accessed: 19 December 2025).
20. The Construct. China's AI plan for 2030. [Online]. Available at: <https://www.theconstruct.ai/98-chinas-ai-plan-for-2030/> (accessed: 12 December 2025).

21. Precedence Research. Artificial intelligence market size and forecast. [Online]. Available at: <https://www.precedenceresearch.com/artificial-intelligence-market> (accessed: 10 December 2025).

NEGOTIATING SOCIAL IDENTITY IN URBAN SOCIAL SPACES

Sagidulla G. S.

PhD student, Department of Sociology and Social Work, Al-Farabi, Kazakh National University, Almaty, Kazakhstan

Abstract

This article examines the process of negotiating social identity in urban social spaces, using the city of Almaty as a post-Soviet metropolitan context. The study addresses the growing need to understand how social identities are constructed, contested, and reconfigured under conditions of rapid urbanization, socio-cultural diversification, and spatial transformation. The aim of the article is to systematically analyze and synthesize contemporary scholarly literature on social identity negotiation in urban environments, with particular attention to theoretical, conceptual, and empirical approaches relevant to Almaty. The study is based on a structured literature review of peer-reviewed international and regional publications indexed in major academic databases. Through thematic coding and comparative analysis, the research identifies key dimensions of identity negotiation, including urban social space, public realms, symbolic boundaries, institutional participation, and generational dynamics. The findings demonstrate that social identity in urban environments is a dynamic and relational process shaped by everyday interactions, spatial configurations, and governance frameworks. The analysis shows that, in the case of Almaty, ethnic Kazakh identity is not eroded by urban life but is actively reconstructed through the intersection of ethnic, civic, and urban forms of belonging. By integrating global theoretical perspectives with context-sensitive insights, the article contributes to urban sociology and identity studies and provides a conceptual foundation for future empirical research on social identity, social cohesion, and urban transformation in post-Soviet cities.

Keywords: social identity; identity negotiation; urban social spaces; urban identity; ethnic Kazakhs; Almaty; post-Soviet cities

Introduction

Relevance of the study. Almaty, as the largest metropolitan city and a key socio-economic, cultural, and symbolic center of Kazakhstan, represents a particularly fertile urban environment for examining the processes of social identity negotiation. Rapid urbanization, internal migration, socio-economic stratification, and cultural pluralization have transformed the city into a complex social space where multiple identities, values, and modes of belonging intersect and are continuously renegotiated. In this context, urban social spaces function not merely as physical locations but as arenas of everyday interaction in which individuals actively construct, contest, and reconfigure their social identities. The relevance of this study is further reinforced by the specific characteristics of Almaty's urban dynamics. As a city that combines Soviet-era institutional legacies with post-independence nation-building processes and contemporary global urban influences, Almaty embodies layered social structures and symbolic boundaries. These overlapping historical and cultural trajectories create conditions in which residents navigate between traditional norms, modern urban lifestyles, and emerging forms of civic and digital participation. Consequently, social identity in Almaty is not a fixed attribute but a situational and relational process shaped by spatial context, social interaction, and institutional frameworks. Moreover, Almaty's urban social spaces such as neighborhoods, educational institutions, workplaces, public spaces, and digital urban platforms serve as key sites where identity negotiation becomes especially visible. In these spaces,

individuals are required to adapt to diverse social expectations, negotiate inclusion and exclusion, and balance multiple forms of belonging related to class, generation, cultural background, and urban experience. Understanding how social identities are negotiated within these environments is essential for capturing the micro-level mechanisms through which urban cohesion, social integration, and symbolic boundaries are produced and maintained. From a broader analytical perspective, the study addresses an important gap in urban sociology and identity studies by providing empirically grounded insights from a post-Soviet and Central Asian metropolitan context, which remains underrepresented in international scholarship. By focusing on Almaty, the research contributes to the comparative understanding of how social identity negotiation unfolds in rapidly transforming cities outside the traditional Western urban canon. The findings have practical relevance for urban policy, social planning, and community development, as they offer evidence-based insights into the social processes shaping inclusion, belonging, and everyday interaction in contemporary urban environments.

The aim of this study is to systematically analyze and synthesize scholarly literature addressing the processes of social identity negotiation in urban social spaces, with particular attention to conceptual, theoretical, and empirical approaches relevant to the urban context of Almaty. The article seeks to identify dominant analytical frameworks, key thematic patterns, and methodological trends in existing research, as well as to assess how urban social spaces are conceptualized as sites of identity negotiation in rapidly transforming metropolitan environments.

Research question. This review is guided by the following research question: How is the process of negotiating social identity in urban social spaces conceptualized, theorized, and analyzed in contemporary scholarly literature, and to what extent do existing studies account for the specific social, cultural, and spatial dynamics of Almaty as a post-Soviet metropolitan context?

The significance of this study lies in its contribution to the systematization of fragmented research on social identity negotiation in urban contexts, particularly within post-Soviet and Central Asian cities. While international urban sociology and identity studies have extensively examined metropolitan settings in Western Europe and North America, cities such as Almaty remain insufficiently represented in global academic discourse. This literature review addresses this gap by critically examining how existing theoretical models and empirical findings can be applied, adapted, or reconsidered in relation to Almaty's unique urban trajectory. By consolidating interdisciplinary perspectives from sociology, urban studies, social psychology, and cultural studies, the article enhances conceptual clarity regarding the role of urban social spaces in shaping identity negotiation processes. The findings offer a structured analytical foundation for future empirical research and provide a reference framework for scholars, urban planners, and policy-oriented researchers interested in issues of social cohesion, urban diversity, and identity dynamics in transitional urban environments.

Methodology of the study. This article adopts a structured literature review methodology aimed at ensuring analytical rigor and transparency. The review is based on peer-reviewed academic publications indexed in major international databases, including Scopus and Web of Science, as well as selected regional scholarly sources relevant to the urban context of Kazakhstan and Central Asia. The selection of literature was guided by predefined inclusion criteria, focusing on studies that address social identity, identity negotiation, urban social spaces, and related concepts within metropolitan or rapidly urbanizing settings. The analytical procedure involved thematic coding and comparative analysis of the selected literature. Key concepts, theoretical frameworks, and methodological approaches were identified and grouped into thematic clusters, such as urban space and identity, social interaction and belonging, symbolic boundaries, and post-Soviet urban transformation. Particular attention was paid to how authors conceptualize "urban social space" and operationalize the notion of "identity negotiation" across different disciplinary traditions. The synthesis of findings was conducted through an integrative approach, allowing for

the identification of convergences, divergences, and unresolved debates within the literature. This methodological design enables a critical assessment of existing knowledge and supports the development of a coherent analytical framework tailored to the study of social identity negotiation in the urban context of Almaty.

Analytical synthesis of global research on the reconstruction of social identity of ethnic groups in urban environments. Contemporary international scholarship conceptualizes the reconstruction of social identity among ethnic groups in urban environments as a dynamic, relational, and context-dependent process rather than a fixed or essentialized attribute (Jenkins, 2014; Wimmer, 2013). Across urban sociology, social psychology, and cultural studies, identity reconstruction is understood as an ongoing negotiation shaped by spatial arrangements, institutional frameworks, and everyday social interactions. Cities are thus viewed not merely as physical settings but as socially produced environments in which identities are continuously redefined. A central insight of global research is that urbanization intensifies identity work by placing diverse ethnic groups in conditions of proximity, symbolic comparison, and competition for social recognition (Vertovec, 2007; Amin, 2012). In urban contexts, ethnic identity becomes particularly salient because individuals must navigate heterogeneous social expectations, norms, and power relations. As a result, urban life generates both opportunities for identity reconfiguration and pressures toward adaptation, boundary maintenance, or hybridization.

A substantial body of literature emphasizes urban social spaces such as neighborhoods, workplaces, educational institutions, markets, and community organizations as primary arenas where ethnic identities are negotiated (Lefebvre, 1991; Low, 2017). These spaces structure patterns of interaction and define the terms under which belonging and difference are enacted. Studies consistently show that identity reconstruction is embedded in everyday practices, including routines of co-presence, informal encounters, and spatial mobility, through which individuals learn to interpret social cues and position themselves vis-à-vis others (Goffman, 1963; Valentine, 2008). Importantly, urban social spaces are not neutral containers of social life. Rather, they are shaped by power relations, planning decisions, and cultural hierarchies that influence who feels entitled to occupy space and under what conditions (Harvey, 2008; Low & Smith, 2006). Consequently, ethnic identity in urban settings is often situational and adaptive, shifting depending on the spatial context and the perceived risks or benefits associated with visibility.

Public space occupies a central position in global research on ethnic identity reconstruction. Scholars argue that public spaces function as key sites where ethnic difference becomes visible and socially evaluated (Mitchell, 2003; Amin, 2008). Visibility in public space enables ethnic groups to assert presence, cultural expression, and claims to urban belonging. At the same time, it exposes them to mechanisms of surveillance, regulation, and symbolic exclusion. Research highlights the role of symbolic boundaries constructed along ethnic, religious, linguistic, or class lines in shaping interactions in public settings (Lamont & Molnár, 2002). These boundaries are produced and reproduced through everyday encounters, media representations, and institutional responses, and they directly affect how ethnic identities are recognized or marginalized. Identity reconstruction, therefore, involves continuous boundary work, where individuals selectively emphasize, negotiate, or downplay aspects of their ethnic identity in response to situational demands (Wimmer, 2008).

Another prominent strand of literature focuses on institutions and participatory mechanisms as key determinants of identity reconstruction in cities. Urban citizenship is increasingly conceptualized as a practice-based phenomenon rather than a purely legal status, encompassing access to participation, recognition, and symbolic inclusion in urban life (Isin, 2002; Holston, 2008). Engagement in local organizations, civic initiatives, educational systems, and labor markets provides ethnic groups with structured opportunities to negotiate belonging and social legitimacy. Empirical studies suggest that inclusive institutional frameworks facilitate more stable

and reflexive forms of identity reconstruction by legitimizing diversity and enabling dialogue across social boundaries. Conversely, exclusionary or assimilation-oriented policies may constrain identity negotiation, reinforcing marginalization or encouraging the retreat into closed ethnic networks. This highlights the importance of governance regimes in shaping the conditions under which identity reconstruction occurs. Research on ethnic place-making further demonstrates the spatial embeddedness of identity reconstruction processes. Ethnic neighborhoods, commercial districts, and cultural hubs serve as material and symbolic anchors that support continuity, collective memory, and economic integration (Anderson, 2015). These spaces allow ethnic groups to reproduce social ties while adapting to urban contexts. The literature also reveals that ethnic places are frequently contested within urban planning and policy discourses. City authorities may frame such spaces as assets of multiculturalism or, alternatively, as challenges to social cohesion and urban order (Qadeer, 2016). As a result, identity reconstruction becomes intertwined with struggles over spatial legitimacy, representation, and the right to shape urban space. Across disciplinary traditions, contemporary research converges on a rejection of essentialist notions of ethnic identity. Instead, identity reconstruction in urban environments is increasingly described as hybrid, layered, and relational (Hall, 1996; Anthias, 2001). Urban residents often combine ethnic affiliations with civic, professional, generational, and lifestyle-based identities, reflecting the complexity of urban social life. This perspective underscores that identity reconstruction is not a linear process of assimilation or preservation but a flexible strategy through which individuals navigate structural constraints and social opportunities. Global scholarship thus frames cities as sites where ethnic identities are continuously reshaped through interaction, institutional mediation, and spatial practice. International research demonstrates that the reconstruction of social identity among ethnic groups in urban environments is shaped by the interplay of spatial context, public visibility, institutional inclusion, and power relations. While these dynamics appear across diverse urban settings, scholars consistently emphasize the need for context-sensitive analysis that accounts for historical trajectories and governance models of specific cities. This body of literature provides a robust analytical foundation for examining how these global processes manifest in particular urban contexts, including post-Soviet metropolitan cities such as Almaty, which will be addressed in the subsequent section of the study.

Reconstruction of social identity in the urban environment: the case of Almaty

Research focusing on Almaty demonstrates that the reconstruction of social identity among ethnic Kazakhs unfolds within a complex urban environment shaped by historical legacies, post-Soviet transformations, and contemporary processes of urbanization and globalization. As the largest metropolitan city in Kazakhstan, Almaty concentrates diverse social groups, institutional opportunities, and symbolic resources, making it a key site where ethnic Kazakh identity is not simply preserved but actively reconfigured through everyday urban practices. One of the central mechanisms of identity reconstruction in Almaty is the negotiation between ethnic, civic, and urban forms of belonging. Empirical studies indicate that for ethnic Kazakhs residing in the city, social identity increasingly incorporates urban and territorial components alongside ethnic affiliation (Nugayeva & Beimisheva, 2025). Urban identity emerges as a stable and meaningful layer of self-identification, often ranking among the most significant forms of social belonging. This suggests that ethnic Kazakh identity in Almaty is embedded within the experience of the city as a lived space, rather than existing solely as a cultural or genealogical marker.

The urban environment of Almaty plays a decisive role in reshaping how ethnic Kazakhs perceive themselves and others. The spatial organization of the city marked by contrasts between Soviet-era neighborhoods and post-Soviet residential developments creates differentiated social contexts that influence interaction patterns and identity negotiation (Kozhakhmetov & Abilov, 2023). Fragmented urban morphology, gated communities, and limited permeability of public spaces reduce everyday intergroup encounters, thereby affecting the formation of shared urban

experiences. For ethnic Kazakhs, this spatial fragmentation reinforces the situational nature of identity reconstruction. In open and accessible public realms, identity negotiation tends to emphasize civic and urban belonging, whereas in more segregated or closed environments, ethnic markers may become more salient. This dynamic indicates that social identity reconstruction is closely tied to the availability of inclusive urban social spaces that enable interaction, visibility, and mutual recognition.

Another significant dimension of identity reconstruction among ethnic Kazakhs in Almaty relates to social distance and symbolic boundaries. Studies of interethnic relations in Kazakhstan highlight that social proximity or remoteness is shaped by language use, historical narratives, and everyday interaction patterns (Kaliyev et al., 2024). In the urban context of Almaty, where Russian has historically functioned as a dominant language of interethnic communication, ethnic Kazakhs navigate a dual linguistic and cultural landscape. This duality influences the reconstruction of social identity by positioning ethnic Kazakhs between different symbolic communities. On the one hand, urban life facilitates broader social integration and pragmatic interaction across ethnic lines; on the other hand, it generates heightened sensitivity to issues of cultural recognition, language status, and symbolic hierarchy. As a result, identity reconstruction often involves balancing openness to urban diversity with the preservation of ethnic distinctiveness, rather than a linear process of assimilation.

Generational differences further shape the reconstruction of ethnic Kazakh identity in Almaty. Research on youth and identity suggests that younger urban Kazakhs increasingly combine ethnic, civic, and urban identities, demonstrating flexible and hybrid forms of belonging (Nurmatov et al., 2022). For this group, attachment to the city and participation in urban social life become key sources of identity, sometimes outweighing traditional ethnic or national markers. This trend reflects a broader shift toward urban-based identity frameworks, where the city itself functions as a reference point for self-definition. At the same time, such hybridization does not imply the erosion of ethnic identity; rather, it points to its rearticulation within new social and spatial conditions. Ethnic Kazakh identity in Almaty thus becomes relational and context-dependent, shaped by education, mobility, professional networks, and engagement with urban culture.

Public spaces and so-called “third places” play a crucial role in the reconstruction of social identity among ethnic Kazakhs in Almaty. Parks, streets, cafes, and shared urban facilities serve as arenas where everyday interactions contribute to the formation of urban solidarity and shared meanings (Nugayeva & Beimisheva, 2025). These spaces allow ethnic Kazakhs to experience the city not only as a functional environment but as a symbolic and emotional landscape that reinforces a sense of belonging. However, the effectiveness of public spaces in fostering inclusive identity reconstruction depends on their openness and accessibility. Where public realms are privatized or heavily regulated, opportunities for spontaneous interaction and identity negotiation are limited, potentially reinforcing social segmentation (Kozhakhmetov & Abilov, 2023). This highlights the importance of urban design and governance in shaping the social conditions under which ethnic identity is reconstructed.

To systematize the results of the literature analysis and to highlight the key mechanisms through which social identity is reconstructed in urban environments, including the specific context of Almaty, the main analytical findings are summarized in Table 1. The table integrates global theoretical insights with context-sensitive observations relevant to the urban experience of ethnic Kazakhs.

Table 1. Key dimensions and mechanisms of social identity reconstruction of ethnic groups in urban environments

Analytical Dimension	Key Findings in Global Literature	Specific Manifestations in Almaty	Implications for the Reconstruction of Social Identity of Ethnic Kazakhs
Urban social space	Cities are viewed as socially produced spaces where identity is negotiated through everyday interaction and spatial practices	Urban space in Almaty is shaped by Soviet and post-Soviet urban forms, creating differentiated interaction contexts	Ethnic Kazakh identity is reconstructed through adaptation to diverse urban settings rather than through fixed cultural scripts
Public space and everyday encounters	Public spaces function as arenas of visibility, recognition, and symbolic boundary-making	Fragmentation and limited permeability of public spaces reduce everyday intergroup encounters	Identity negotiation depends on access to inclusive public realms that allow interaction and recognition
Social distance and symbolic boundaries	Ethnic identity is shaped by processes of boundary-making related to language, culture, and perceived social proximity	Linguistic duality and historical hierarchies influence perceptions of proximity and distance	Reconstruction of identity involves balancing openness to diversity with the preservation of ethnic distinctiveness
Institutional and civic participation	Urban citizenship is enacted through participation in institutions and collective practices	Educational, professional, and civic institutions serve as key sites of social integration	Ethnic Kazakh identity increasingly incorporates civic and urban dimensions alongside ethnic belonging
Generational dynamics	Younger urban residents tend to develop hybrid and flexible identity configurations	Urban Kazakh youth combine ethnic, civic, and urban identities	Identity reconstruction is more pronounced among younger cohorts, reflecting adaptive urban socialization
Ethnic place-making	Ethnic spaces provide symbolic continuity but may become contested	Urban neighborhoods and cultural spaces are subject to planning and regulation	Identity is reconstructed through negotiation between ethnic continuity and urban transformation
Urban identity	Urban belonging emerges as a distinct layer of social identity	Urban identity ranks among dominant forms of self-identification in Almaty	Ethnic Kazakh identity is embedded within a broader sense of urban belonging
Governance and urban design	Urban policies shape conditions for inclusion or exclusion	Gated developments and mono-functional areas hinder social cohesion	Institutional context directly affects opportunities for identity negotiation

The analysis demonstrates that the reconstruction of social identity in urban environments is a multidimensional and context-sensitive process shaped by the interaction of spatial configurations, public realms, institutional frameworks, and everyday social practices. In the case of ethnic Kazakhs in Almaty, identity reconstruction does not entail the erosion of ethnic belonging but rather its rearticulation within a complex urban setting where ethnic, civic, and urban identities intersect. The city emerges as an active social environment that structures opportunities for interaction, recognition, and participation, thereby influencing how ethnic Kazakh identity is negotiated, hybridized, and embedded in urban life. These findings underscore the importance of viewing social identity not as a static attribute but as a relational process continuously shaped by urban space, governance, and social dynamics, providing a robust analytical foundation for further context-specific investigation.

Conclusion

The aim of this study to systematically analyze and synthesize scholarly literature on the processes of negotiating social identity in urban social spaces with specific reference to the metropolitan context of Almaty has been fully achieved. Through a structured review and integrative analysis of international and regional research, the article has identified key conceptual frameworks, dominant thematic patterns, and analytical approaches that explain how social identity is negotiated in complex urban environments. The findings confirm that contemporary scholarship conceptualizes social identity not as a fixed attribute but as a dynamic, relational, and situational process shaped by spatial context, everyday interaction, institutional arrangements, and power relations. In addressing the research question, the study demonstrates that while global literature provides robust theoretical models for understanding identity negotiation in cities, existing research has only partially accounted for the specific social, cultural, and spatial dynamics of post-Soviet metropolitan contexts such as Almaty. By integrating global theoretical insights with context-sensitive evidence from studies focused on Almaty, this article shows that social identity negotiation in the city is characterized by the intersection of ethnic, civic, and urban forms of belonging. In the case of ethnic Kazakhs, urban life does not diminish ethnic identity but actively reshapes it through engagement with urban social spaces, public realms, institutional participation, and generational change. The study contributes to urban sociology and identity studies by bridging global theoretical debates with the empirical realities of a Central Asian metropolis. It provides a coherent analytical framework for understanding how social identities are negotiated in rapidly transforming cities beyond the Western urban canon and establishes a solid foundation for future empirical research on identity, social cohesion, and urban transformation in Almaty and comparable post-Soviet urban contexts.

Reference

1. Amin, A. (2008). Collective culture and urban public space. *City*, 12(1), 5–24. <https://doi.org/10.1080/13604810801933495>
2. Amin, A. (2012). *Land of strangers*. Polity Press.
3. Anderson, K. (2015). *Race and the crisis of humanism*. Routledge.
4. Anthias, F. (2001). New hybridities, old concepts: The limits of “culture”. *Ethnic and Racial Studies*, 24(4), 619–641. <https://doi.org/10.1080/01419870120049815>
5. Belanche, D., Casaló, L. V., & Rubio, M. Á. (2021). Local place identity: A comparison between residents of rural and urban communities. *Journal of Rural Studies*, 82, 242–252.
6. Gheitarani, N., Mehdi Norouzian, M., & Safaei-Mehr, M. (2024). Space configuration and identity of urban neighborhoods. *European Online Journal of Natural and Social Sciences: Proceedings*, 13(4 (s)), pp-62.
7. Goffman, E. (1963). *Stigma: Notes on the management of spoiled identity*. Prentice-Hall.

8. Hall, S. (1996). Introduction: Who needs "identity"? In S. Hall & P. du Gay (Eds.), *Questions of cultural identity* (pp. 1–17). SAGE.
9. Harvey, D. (2008). The right to the city. *New Left Review*, 53, 23–40.
10. Holston, J. (2008). *Insurgent citizenship: Disjunctions of democracy and modernity in Brazil*. Princeton University Press.
11. Isin, E. F. (2002). *Being political: Genealogies of citizenship*. University of Minnesota Press.
12. Jenkins, R. (2014). *Social identity* (4th ed.). Routledge.
13. Kaliyev, T., Ashimkhanova, D., & Mussatayeva, F. (2024). Social Distance of Ethnic Groups: from Proximity to Remoteness (in the Example of Kazakhstan). *Journal of Central Asian Studies*, 93(1), 57-68.
14. Kozhakhmetov, A., & Abilov, A. (2023). Impact and Role of the Public Realm in Creating More Socially Cohesive Communities: A Case Study of Urban Pattern in Almaty, Kazakhstan. *Pertanika Journal of Social Sciences & Humanities*, 31(4).
15. Lamont, M., & Molnár, V. (2002). The study of boundaries in the social sciences. *Annual Review of Sociology*, 28, 167–195. <https://doi.org/10.1146/annurev.soc.28.110601.141107>
16. Lefebvre, H. (1991). *The production of space* (D. Nicholson-Smith, Trans.). Blackwell. (Original work published 1974)
17. Low, S. M. (2017). *Spatializing culture: The ethnography of space and place*. Routledge.
18. Low, S. M., & Smith, N. (Eds.). (2006). *The politics of public space*. Routledge.
19. Mitchell, D. (2003). *The right to the city: Social justice and the fight for public space*. Guilford Press.
20. Nugayeva, A., & Beymisheva, A. (2025). Structural elements and content of the phenomenon of urban identity: Social and territorial components (the case of the city of Almaty). *Journal of Psychology and Sociology of Al-Farabi Kazakh National University*, 93(2), 90–103.
21. Nurmatov, Z., Abdrasilov, T., Kaldybay, Q., & Sikhimbayeva, D. (2022). The importance of national identity among young people in Kazakhstan. *Adam Alemi*, 91(1), 105–113.
22. Putra, A. R. A., Sudrajat, R., Saputra, M. I., Gunawan, S., & Permana, D. Y. (2024). An analysis of the role of law in the formation of social identity in urban communities. *Asian Journal of Social and Humanities*, 2(11), 2304-2309.
23. Qadeer, M. A. (2016). *Multicultural cities: Toronto, New York, and Los Angeles*. University of Toronto Press.
24. Sadvokassova, A., Burkhanov, A., & Sharipova, D. (2025). In Search for Kazakhstani Identity: Societal Perceptions of Kazakhstan's Nation-Building. *Nationalism and Ethnic Politics*, 31(1), 114-137.
25. Valentine, G. (2008). Living with difference: Reflections on geographies of encounter. *Progress in Human Geography*, 32(3), 323–337. <https://doi.org/10.1177/0309133308089372>
26. Vertovec, S. (2007). Super-diversity and its implications. *Ethnic and Racial Studies*, 30(6), 1024–1054. <https://doi.org/10.1080/01419870701599465>
27. Wimmer, A. (2008). The making and unmaking of ethnic boundaries. *American Journal of Sociology*, 113(4), 970–1022. <https://doi.org/10.1086/522803>
28. Wimmer, A. (2013). *Ethnic boundary making: Institutions, power, networks*. Oxford University Press.

THE RELIGIOUS, SCIENTIFIC, CULTURAL, AND SOCIAL SIGNIFICANCE OF STUDYING BIOETHICS

Yerimbet Ramzan Yedilbekuly. E.

Al-Farabi Kazakh National University, Almaty, Kazakhstan

Amankul Temur Oralbaiuly

Al-Farabi Kazakh National University, Almaty, Kazakhstan

Erimbet Rizuan Edilbekovich

Al-Farabi Kazakh National University, Almaty, Kazakhstan

ABSTRACT

This article examines the religious, scientific, cultural, and social significance of the study of bioethics. Bioethics, as an interdisciplinary field, addresses moral and ethical issues related to the beginning and end of human life, human dignity, and responsibility in medicine and biotechnology. The study analyzes the relationship between bioethics and religion, its influence on scientific development, its place within cultural value systems, and its impact on social stability. Particular attention is paid to contemporary bioethical challenges and the importance of a comprehensive approach to their resolution that integrates religious, scientific, cultural, and social perspectives.

Keywords: bioethics, religion, science, culture, society, morality, responsibility.

INTRODUCTION

In the context of globalization and the rapid development of biomedical technologies, bioethics has become a key interdisciplinary field that comprehensively addresses issues related to the beginning and end of human life, the limits of medical intervention, and the balance between scientific progress and moral responsibility [1]. Bioethics is no longer confined to medicine or philosophy alone; it has developed in close interaction with religious studies, cultural studies, and the social sciences [2].

Religious bioethical principles play a particularly important role in providing moral guidance on complex contemporary issues such as abortion, euthanasia, genetic engineering, organ transplantation, and reproductive technologies [3]. In this regard, studying bioethics from religious, scientific, cultural, and social perspectives constitutes a highly relevant scholarly task.

Scientific Foundations and the Interdisciplinary Nature of Bioethics

The term *bioethics* entered scientific discourse in the mid-twentieth century and initially focused on moral responsibility in medical research [4]. Over time, it evolved into a broad field that evaluates all biomedical decisions affecting human life [5].

Scientific bioethics is grounded in the principles of autonomy, non-maleficence, beneficence, and justice, systematized in the works of Beauchamp and Childress [6]. However, these principles do not always align uniformly with all cultural and religious contexts, which necessitates a critical reassessment of universal bioethical models [7].

Scientific Progress and Moral Boundaries

While scientific advances have significantly improved the quality of human life, they have also generated new moral dilemmas. According to the World Health Organization, approximately 73 million abortions are performed worldwide each year, highlighting the urgency of bioethical debates in the field of reproductive health [6].

In addition, more than 172,000 organ transplantations were performed globally in 2023, yet the shortage of donor organs remains a pressing ethical challenge [7].

The Religious Significance of Studying Bioethics

Religious traditions introduce fundamental concepts of the sanctity and dignity of human life into bioethical discourse [8]. In Islam, life is regarded as a trust from God, and its preservation is considered one of the primary objectives of Sharia (maqasid al-sharia) [9]. In Christianity, human beings are perceived as created in the image of God, and any encroachment upon life is regarded as a grave moral sin [10].

These religious principles establish moral boundaries and responsibility in biomedical decision-making. For example, in issues such as euthanasia and cloning, religious bioethics requires evaluating moral consequences before considering technical feasibility [11].

The Cultural Dimension of Bioethics

Bioethics cannot be examined outside its cultural context, as societal perceptions of life, illness, death, and the human body are culturally shaped [12]. In Western societies, individual autonomy is often considered a supreme value, whereas in traditional and religious cultures, collective responsibility and moral obligation take precedence [13].

Cultural differences directly influence bioethical decisions. For instance, organ donation may be perceived as an act of altruism in some cultures, while in others it may be regarded as a violation of bodily integrity [14].

The Social Importance of Bioethics

Bioethics addresses issues of social justice, access to healthcare, and the protection of vulnerable populations [15]. As biomedical technologies advance, the risk of deepening social inequality becomes increasingly significant [16].

From this perspective, bioethics plays a crucial role in shaping social policy and public health systems. Social bioethics offers ethical frameworks aimed at ensuring equitable protection of life and health for all members of society [17].

Contemporary Medical Challenges and Religious Bioethics

Genome editing, artificial intelligence-based diagnostics, telemedicine, and neurotechnologies raise new bioethical questions [18]. These technologies require a reconsideration of human identity and responsibility [19].

Religious bioethics provides a critical perspective on these developments, emphasizing that technological progress must be aligned with moral and spiritual values [20].

Artificial Intelligence in Medicine

Although artificial intelligence enhances diagnostic accuracy, it raises questions of responsibility in decision-making. Both Islamic and Christian bioethics affirm that ultimate responsibility rests with human beings, not algorithms [13].

Palliative Care

Palliative medicine is supported in both religious traditions as an ethical alternative to euthanasia. It aims to alleviate suffering while preserving human dignity at the end of life [14].

Bioethics and Social Stability

Public trust in medicine, science, and state institutions is directly linked to adherence to bioethical norms. When bioethical principles are violated, phenomena such as social unrest, religious radicalization, and fear of medicine may emerge. Therefore, bioethics is considered a key factor in maintaining social stability.

Bioethics is a complex field comprising religious, scientific, cultural, and social components. Religion protects the sanctity of life and introduces a spiritual dimension; science identifies risks and opportunities and proposes regulatory principles; culture facilitates open ethical discourse within society; and the social sphere establishes principles of justice and equal opportunity.

CONCLUSION

Studying bioethics from religious, scientific, cultural, and social perspectives forms a comprehensive approach aimed at safeguarding human dignity [21]. Religious traditions provide moral and spiritual guidance, while science offers empirical foundations for decision-making [22].

The interaction between these dimensions enables effective responses to contemporary biomedical challenges [23]. In the era of scientific progress, the role of bioethics is not merely to impose restrictions but to ensure that technological development remains human-centered. Consequently, bioethical research from a religious studies perspective contributes significantly to sustainable social development.

Recommendations for Kazakhstan

Kazakhstan is a multi-confessional, multicultural, and secular state; therefore, the development of bioethics requires an integrated approach that respects national specificities.

Strengthening Bioethical Education

- Introduce advanced compulsory bioethics courses in medical universities;
- Develop interdisciplinary programs for students of religious studies, medicine, and law.

Enhancing the National Bioethics Council

- Include not only physicians but also religious scholars, theologians, and sociologists;
- Develop national bioethical guidelines on abortion, euthanasia, transplantation, IVF, and genetics;
- Establish sustained cooperation with international bioethics organizations.

Institutionalizing Dialogue with Religious Organizations

- Create joint bioethical platforms involving the Muslim Spiritual Administration of Kazakhstan, Orthodox representatives, and other confessions;
- Conduct coordinated public outreach on controversial medical issues.

Strengthening Public Awareness

- Disseminate accessible scientific and religious bioethical information through media and social networks;
- Use bioethics education as a preventive tool against radicalization among youth by emphasizing the value of life.

Harmonizing Law and Bioethics

- Require mandatory ethical review in healthcare legislation;
- Implement ethical monitoring systems for medical experimentation and emerging technologies.

REFERENCES

1. Potter V.R. Bioethics: Bridge to the Future. Englewood Cliffs: Prentice-Hall, 1971. -205 p.
2. Callahan D. The Roots of Bioethics: Health, Progress, Technology, Death. Oxford: Oxford University Press, 2012. — 312 p.
3. Ghaly M. Islamic Bioethics in the Twenty-First Century. London: Routledge, 2019. - 298 p.
4. Jonsen A. The Birth of Bioethics. — Oxford: Oxford University Press, 2003. — 432 p.
5. ten Have H. Global Bioethics: An Introduction. — London: Routledge, 2016. — 246 p.
6. Beauchamp T.L., Childress J.F. Principles of Biomedical Ethics. — 8th ed. — Oxford: Oxford University Press, 2019. — 512 p.
7. Engelhardt H.T. The Foundations of Bioethics. Oxford: Oxford University Press, 1996. 420 p.
8. Pellegrino E.D. Human Dignity and Bioethics. — Notre Dame: University of Notre Dame Press, 2008. — 311 p.
9. Al-Bar M., Chamsi-Pasha H. Contemporary Bioethics: Islamic Perspective. — Berlin: Springer, 2015. — 367 p.
10. John Paul II. Evangelium Vitae. — Vatican City: Libreria Editrice Vaticana, 1995. — 196 p.

11. Sachedina A. Islamic Biomedical Ethics. — Oxford: Oxford University Press, 2009. — 256 p.
12. Hofstede G. Culture's Consequences. — Thousand Oaks: Sage, 2001. — 596 p.
13. Kleinman A. Writing at the Margin: Discourse Between Anthropology and Medicine. — Berkeley: University of California Press, 1995. — 304 p.
14. Fox R., Swazey J. Spare Parts: Organ Replacement in American Society. — Oxford: Oxford University Press, 2002. — 365 p.
15. Daniels N. Just Health. — Cambridge: Cambridge University Press, 2008. — 412 p.
16. WHO. Ethics and Health. — Geneva: World Health Organization, 2017. — 98 p.
17. Ruger J. Health and Social Justice. — Oxford: Oxford University Press, 2010. — 286 p.
18. UNESCO. Bioethics and Human Rights. — Paris: UNESCO, 2005. — 42 p.
19. Bostrom N. Superintelligence. — Oxford: Oxford University Press, 2014. — 352 p.
20. Campbell A. Medical Ethics. — Oxford: Oxford University Press, 2014. — 384 p.
21. ten Have H. Global Bioethics: Methods and Problems. — London: Routledge, 2018. — 290 p.
22. Callahan D., Jennings B. Ethics and Public Health. — New York: Oxford University Press, 2002. — 378 p.
23. Gillon R. Medical Ethics: Four Principles Plus Attention to Scope. — BMJ, 2003. — Vol. 326. — P. 130–133.

HIGHER EDUCATION AND RURAL YOUTH: A SYSTEMATIC BIBLIOGRAPHIC REVIEW

Shakenov D. S.

PhD student, Department of Sociology and Social Work, al-Farabi Kazakh National University, Almaty, Kazakhstan

Sarybayeva I. S.

Egyptian University of Islamic culture Nur-Mubarak, Almaty, Kazakhstan

Abstract

Over the past two decades, access to higher education for rural youth has emerged as a critical issue in global academic and policy debates, reflecting persistent territorial and social inequalities in educational opportunities. Despite the massification of higher education systems, rural students continue to face structural barriers related to socioeconomic disadvantage, spatial isolation, and institutional arrangements. This study aims to systematically analyze international academic literature on higher education and rural youth in order to identify dominant research themes, theoretical perspectives, methodological approaches, and emerging trends over the last 20 years. The study employs a systematic bibliographic review combined with bibliometric mapping techniques. Publications were retrieved from the Scopus and Web of Science databases using a set of keywords related to higher education access, rural youth, and educational inequality. An initial search yielded 267 publications, of which 110 peer-reviewed articles were retained after a multi-stage screening and exclusion process. Thematic structures and keyword co-occurrence patterns were analyzed using the VOSviewer software. The results demonstrate a sharp increase in scholarly attention to higher education and rural youth since 2019, indicating the rapid consolidation of this research field. The literature is predominantly situated within the social sciences, while also exhibiting growing interdisciplinarity, particularly in relation to environmental studies, energy, and regional development. Thematic analysis reveals that rurality functions as a central analytical category connecting education with socioeconomic vulnerability, spatial inequality, demographic factors, and public health. The findings further highlight a geographically asymmetric research landscape, dominated by a limited number of countries, alongside increasing scholarly contributions from Kazakhstan and other transitional contexts. The study concludes that access to higher education for rural youth is increasingly conceptualized as a structural and systemic issue rather than an individual-level problem. By synthesizing fragmented research, this review provides a coherent analytical framework and identifies key research gaps, offering a foundation for future empirical studies and evidence-based policy interventions aimed at promoting equitable access to higher education for rural youth.

Keywords: higher education; rural youth; access to education; educational inequality; territorial disparities; bibliometric analysis; Kazakhstan

Introduction

Relevance of the study. Over the past two decades, access to higher education for rural youth has become a central concern in global academic and policy debates. Despite the massification of higher education systems worldwide, substantial disparities persist between urban and rural populations in terms of educational opportunities, institutional access, and long-term socio-economic outcomes. International research consistently demonstrates that rural students face structural disadvantages associated with geographic isolation, limited school resources, lower levels of academic preparation, and reduced access to information about higher

education pathways. These factors collectively undermine educational equity and restrict upward social mobility. From a global perspective, higher education is widely recognized as a crucial driver of human capital development, economic growth, and innovation. Extensive empirical evidence confirms that education contributes significantly to productivity, labor-market outcomes, and long-term economic sustainability (Hanushek & Woessmann, 2020). However, unequal access to higher education weakens these macro-level benefits by reinforcing territorial and social inequalities. When rural youth remain underrepresented in higher education, countries risk losing a substantial share of their potential human capital, particularly in regions already experiencing demographic decline and economic marginalization. The challenge of rural disadvantage is especially evident in systems characterized by centralized university admissions, where standardized selection mechanisms often fail to account for inequalities in school quality and learning environments. Comparative research from post-Soviet and transitional contexts shows that rural applicants are systematically less likely to succeed in competitive admissions processes, even when formal equality of access is guaranteed. A multiple case study of Georgia and Kazakhstan conducted by Chankseliani et al. (2020) demonstrates that centralized admission systems may inadvertently reproduce and intensify rural–urban inequalities rather than mitigate them. Their findings underscore the structural nature of rural disadvantage and highlight the need for policy instruments specifically designed to address territorial disparities. At the same time, global higher education systems are undergoing rapid digital transformation, which is often presented as a potential mechanism for expanding access to disadvantaged groups, including rural youth. Digital platforms, online admissions procedures, and remote learning opportunities theoretically reduce spatial barriers to higher education. However, recent studies suggest that digitalization may also deepen existing inequalities when access to digital infrastructure, technological skills, and institutional support remains uneven (Dzhanegizova, 2024). This dual effect of digital transformation makes it essential to critically examine whether technological reforms genuinely enhance educational access for rural populations or primarily benefit students from more advantaged backgrounds.

The relevance of this issue is particularly pronounced in the context of Kazakhstan, where spatial inequality, regional disparities in school quality, and unequal access to higher education continue to pose systemic challenges. Although the state has implemented centralized testing, educational grants, and international scholarship programs aimed at increasing educational mobility, empirical evidence indicates that these measures do not fully compensate for the disadvantages accumulated during earlier stages of schooling. Research on government-funded international scholarships shows that such programs can serve as pathways for social change but often remain accessible primarily to students with stronger academic and social capital (Jonbekova, 2024). Moreover, Kazakhstan’s ongoing higher education reforms particularly those related to digitalization and internationalization create new institutional conditions that require careful scholarly evaluation. While digital reforms offer opportunities to expand access beyond major urban centers, they also risk excluding rural students if infrastructural and institutional inequalities are not adequately addressed (Dzhanegizova, 2024). In this regard, the Kazakhstan case reflects broader global tensions between educational expansion and persistent inequality. Given these global and national dynamics, a systematic bibliographic review of research on higher education and rural youth is both timely and necessary. Such a review enables the identification of dominant theoretical perspectives, methodological trends, and empirical gaps in the existing literature. By synthesizing international and Kazakhstan-focused scholarship, the present study provides a structured overview of how rural educational inequality is conceptualized and analyzed in contemporary research. This bibliographic analysis thus lays an essential foundation for future empirical studies and evidence-based policy interventions aimed at improving access to higher education for rural youth.

The aim of this study is to systematically analyze the international academic literature on higher education and rural youth in order to identify dominant research themes, theoretical frameworks, methodological approaches, and emerging trends over the past two decades. By conducting a bibliographic review of peer-reviewed publications, the study seeks to map the evolution of scholarly attention to issues of access, inequality, and structural barriers faced by rural youth in higher education systems. In addition, the study aims to synthesize existing knowledge and highlight research gaps relevant to both global and Kazakhstan-specific contexts.

Research question: How has the issue of access to higher education for rural youth been conceptualized, studied, and thematically structured in international academic literature over the past 20 years?

The significance of this study lies in its contribution to the systematization and integration of fragmented research on higher education and rural youth. Although the topic has attracted growing scholarly attention, existing studies remain dispersed across disciplines such as sociology, education, economics, and public policy, often lacking a coherent analytical synthesis. By providing a structured bibliographic overview, this study enhances conceptual clarity and facilitates a more comprehensive understanding of rural educational inequality. From a practical perspective, the findings of this review are relevant for policy makers, educational institutions, and researchers, as they offer evidence-based insights into the structural factors shaping access to higher education for rural youth. The identification of dominant research clusters and gaps may inform the design of targeted educational policies, equity-oriented admission mechanisms, and future empirical studies, particularly in countries with pronounced territorial disparities such as Kazakhstan.

Literature Review

A substantial body of international research highlights persistent inequalities in access to higher education between rural and urban populations. Rural youth often face cumulative disadvantages stemming from limited school resources, geographic isolation, lower exposure to academic guidance, and constrained aspirations regarding higher education pathways (Stone, 2016; Kryst et al., 2018). Studies conducted in diverse national contexts consistently demonstrate that rural students encounter structural barriers that shape both their educational choices and their likelihood of successful transition to higher education. One of the most comprehensive comparative analyses of rural disadvantage in post-Soviet contexts is provided by Chankseliani et al. (2020), who examine centralized university admissions systems in Georgia and Kazakhstan. Their multiple case study reveals that standardized admission mechanisms, while formally merit-based, often fail to account for unequal schooling conditions and thus reproduce rural-urban disparities. The authors argue that centralized admissions may inadvertently privilege applicants from urban schools with stronger academic preparation, thereby institutionalizing territorial inequality within higher education systems. Similar patterns have been observed in studies from the United States and Europe, where rural students' educational trajectories are shaped by local school cultures, limited access to preparatory resources, and weaker institutional linkages between secondary schools and universities (Kryst et al., 2018; Ontiveros, 2020). These findings underscore the structural and systemic nature of rural disadvantage, rather than framing it as an outcome of individual choice or motivation.

The issue of access to higher education for rural youth is closely connected to broader debates on human capital formation and economic development. Classical and contemporary economic research emphasizes that education plays a central role in fostering productivity, innovation, and long-term growth (Hanushek & Woessmann, 2020). Unequal educational access, therefore, not only affects individual life chances but also undermines national development trajectories. Empirical studies from both developed and emerging economies demonstrate that investments in higher education yield substantial economic returns when aligned with labor market needs and skills development (Heijke et al., 2003; Li et al., 2017). However, when access

to higher education is unevenly distributed across regions and social groups, the potential benefits of human capital accumulation remain underutilized. Research on small open economies further suggests that disparities in educational participation weaken national competitiveness and exacerbate regional inequalities (Mikiashvili, 2019). In the context of Kazakhstan, Karabayev et al. (2023) establish a direct relationship between higher education development and economic growth, emphasizing that the quality and inclusiveness of higher education systems are critical determinants of sustainable development. From this perspective, improving access to higher education for rural youth is not merely a social equity concern but a strategic economic imperative.

The rapid digital transformation of higher education has introduced new dimensions to the debate on educational access. Information and communication technologies (ICTs) are frequently presented as tools capable of reducing spatial barriers and expanding educational opportunities for rural populations (Lal & Paul, 2016). Online learning platforms, digital admissions processes, and virtual academic communities theoretically enable rural students to overcome geographic isolation. However, empirical evidence suggests that digitalization produces ambivalent outcomes. While technological innovations may increase access in principle, they also risk deepening inequalities when digital infrastructure, digital literacy, and institutional support are unevenly distributed (Dzhanegizova, 2024). In the Kazakhstan context, digital reforms in higher education have been accompanied by challenges related to connectivity, regional disparities, and uneven institutional readiness, particularly in rural areas. Studies on virtual communities of practice further demonstrate that digital environments can support innovation and knowledge exchange in higher education, but only when participants possess sufficient digital competencies and institutional support (Özmen, 2013). These findings indicate that digital transformation alone cannot resolve access inequalities without complementary social and educational policies.

Another important strand of literature focuses on government scholarship programs and international educational mobility as instruments for promoting social change. Jonbekova (2024) examines state-funded international scholarship programs in Kazakhstan and argues that such initiatives can facilitate social mobility, skills transfer, and institutional development. However, access to these programs often remains socially selective, favoring students with stronger academic, linguistic, and social capital. Further research by Jonbekova et al. (2023) demonstrates that graduates of international higher education programs contribute to their home country through professional expertise, institutional reform, and knowledge diffusion. Nevertheless, the authors note that the transformative potential of these programs depends on broader structural conditions, including domestic labor markets and regional inequalities. For rural youth, international scholarships may represent a pathway to upward mobility, yet structural barriers at earlier educational stages continue to limit participation. The reviewed literature reveals a fragmented yet convergent body of research emphasizing the structural nature of rural disadvantage in access to higher education. Studies across disciplines highlight the interplay between territorial inequality, human capital development, digital transformation, and policy interventions. However, despite the growing number of empirical studies, the literature remains dispersed across national contexts and theoretical traditions.

Methods

This study employs a systematic bibliographic review methodology combined with bibliometric mapping techniques. Academic publications were retrieved from the Scopus and Web of Science databases, which were selected due to their comprehensive coverage of high-quality, peer-reviewed international journals. The search was limited to publications published over the last 20 years to capture long-term trends in the academic discourse. The literature search was conducted using a combination of key terms, including *“higher education access”*, *“rural youth”*, *“rural students”*, *“educational inequality”*, *“territorial disparities”*, and related keywords. The initial

search yielded 267 publications. Following a multi-stage screening and exclusion process based on relevance, duplication, language, and thematic alignment 110 articles were retained for in-depth analysis. To identify thematic structures and relationships within the selected literature, a thematic map was generated using the bibliometric visualization software VOSviewer. This approach enabled the identification of core research clusters, co-occurring keywords, and dominant thematic trajectories within the field. The combined use of systematic review procedures and bibliometric mapping ensures methodological rigor and enhances the reliability and interpretability of the findings.

Results and Discussion

The analysis of publication dynamics demonstrates the temporal distribution and growth of scholarly output on higher education and rural youth over the period from 2006 to 2025. In total, 110 publications were identified and included in the bibliometric analysis. During the initial stage of the analyzed period (2006–2016), research activity on this topic was extremely limited. Most years recorded either zero publications or no more than one document. Specifically, no publications were identified for 2009–2010, 2012–2013, and 2015–2016, indicating that the issue of higher education access for rural youth remained largely underrepresented in the academic literature during this time. A gradual increase in publication activity became visible after 2017. Although only one publication was recorded in both 2017 and 2018, the year 2019 marked a turning point, with eight publications, signaling the emergence of sustained academic interest in the topic. The most significant growth occurred from 2020 onward. The number of publications increased to 12 documents in 2020 and 11 in 2021, followed by a sharp rise to 19 publications in 2022. Although a slight decrease was observed in 2023 (14 publications), research output remained consistently high in subsequent years, with 15 publications in 2024. The peak of publication activity was reached in 2025, with 21 documents, representing the highest annual output within the analyzed timeframe. The results indicate that the majority of publications were produced during the last five years of the period under review. This concentration suggests that higher education and rural youth has evolved into a rapidly expanding research field, gaining prominence in response to contemporary challenges related to educational inequality, digital transformation, and regional disparities.

Subject area distribution of publications

The analysis of subject area distribution demonstrates that research on higher education and rural youth is highly interdisciplinary, while remaining strongly concentrated within the social sciences. As shown in Figure 1, the largest share of publications belongs to Social Sciences, which account for 47.3% of all analyzed documents.

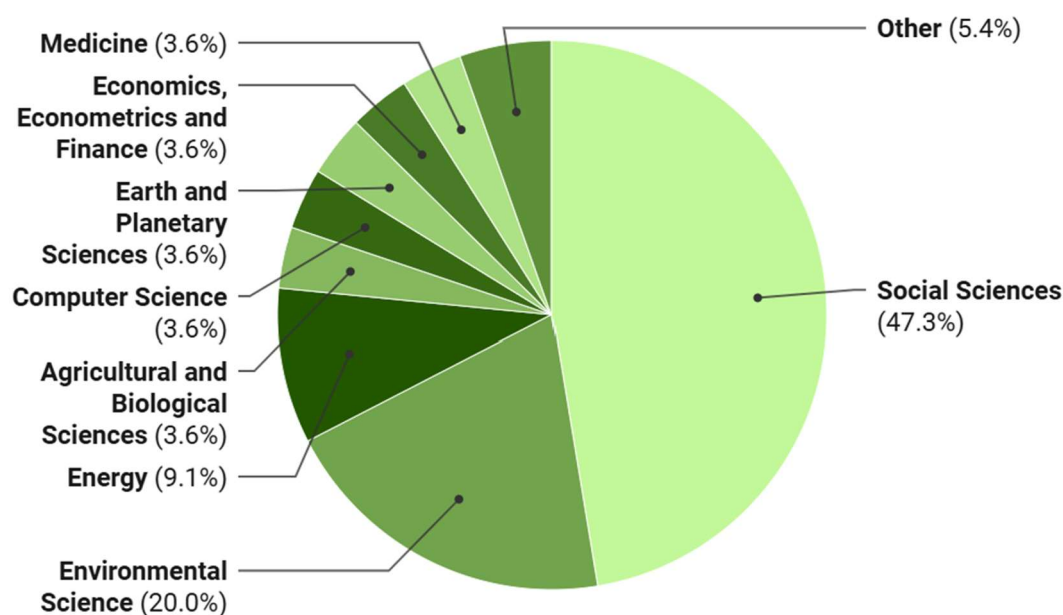


Figure 1. - Subject areas of publications on higher education and rural youth

This dominance reflects the conceptual framing of rural access to higher education primarily as a social inequality, policy, and institutional issue. The second largest subject area is Environmental Science (20.0%). This relatively high proportion suggests a strong linkage between rural education, sustainable development, regional resilience, and environmental challenges. Studies within this category often approach rural youth education through the lenses of sustainable rural development, environmental policy, and regional planning. The Energy field represents 9.1% of publications, indicating growing scholarly interest in the role of education and skills development for rural youth in energy transitions, renewable energy sectors, and resource-based regional economies. This finding highlights the alignment between higher education access and emerging labor market demands in rural and peripheral regions.

Several subject areas contribute more modest but still significant shares, each accounting for 3.6% of publications. These include Agricultural and Biological Sciences, Computer Science, Earth and Planetary Sciences, Economics, Econometrics and Finance, and Medicine. The presence of these disciplines illustrates the multidimensional nature of the research field, where higher education access for rural youth is examined in relation to agricultural modernization, digital competencies, regional economic development, and health-related human capital. Finally, Arts and Humanities, Biochemistry, Genetics and Molecular Biology, and Other fields each account for 1.8% of the analyzed literature. Although these areas are less represented, their inclusion indicates emerging interdisciplinary connections, particularly in studies addressing cultural capital, identity formation, and broader societal implications of rural education.

Country and territorial distribution of publications

The analysis of publications by country and territory reveals a geographically diverse but uneven distribution of research output on higher education and rural youth. The results indicate that scholarly production is concentrated in a limited number of countries, primarily those with well-developed research infrastructures and strong traditions in higher education studies. The United States leads in terms of publication output, accounting for 14 documents, followed closely by the Netherlands with 12 publications and China with 11 publications. These countries represent key global centers of educational research and policy-oriented scholarship. In the case of the

United States, the high volume of studies reflects long-standing academic interest in rural education, educational inequality, and access to higher education within a context of pronounced regional diversity. Similarly, the Netherlands' strong presence is indicative of its active research community in comparative education, social stratification, and international higher education studies. A second group of countries demonstrates moderate research activity. Australia contributes 9 publications, while Kazakhstan accounts for 8 documents, positioning it as one of the most prominent contributors outside the traditional Western research core. This finding highlights the growing scholarly engagement with rural higher education issues in Kazakhstan, likely driven by persistent regional inequalities, centralized admission systems, and ongoing higher education reforms. The Czech Republic (7 publications) and India (6 publications) also show notable levels of academic output, reflecting increasing attention to rural–urban educational disparities in transitional and developing higher education systems. A third group of countries is represented by a small number of publications, often limited to one document per country. This group includes Croatia, Malaysia, Palestine, Poland, Rwanda, Serbia, Somalia, Spain, Sweden, Thailand, and an Undefined category. Although their individual contributions are limited in volume, their inclusion underscores the global relevance of the research topic across diverse socio-economic and geopolitical contexts.

In addition, Central Asian countries beyond Kazakhstan are represented, though to a lesser extent. Kyrgyzstan contributes 3 publications, while Uzbekistan accounts for 2 publications. The presence of these countries indicates emerging academic interest in rural higher education access within the broader post-Soviet and Central Asian context, albeit with still limited research capacity and international visibility. The country-level distribution suggests that research on higher education and rural youth is globally dispersed but structurally asymmetric. Knowledge production is dominated by a small number of countries with strong academic institutions, while many regions remain underrepresented despite facing significant rural educational challenges. This imbalance points to the need for greater inclusion of perspectives from developing and transitional countries, particularly those where rural populations constitute a substantial share of society and where access to higher education remains a pressing policy concern.

Thematic structure of the literature

The thematic mapping based on keyword co-occurrence analysis reveals a multicluster structure of the research field, reflecting the interdisciplinary nature of studies on higher education and rural youth. As shown in Figure 2, the network is organized around several interconnected thematic clusters, with “rural area” emerging as the central and most strongly connected node.

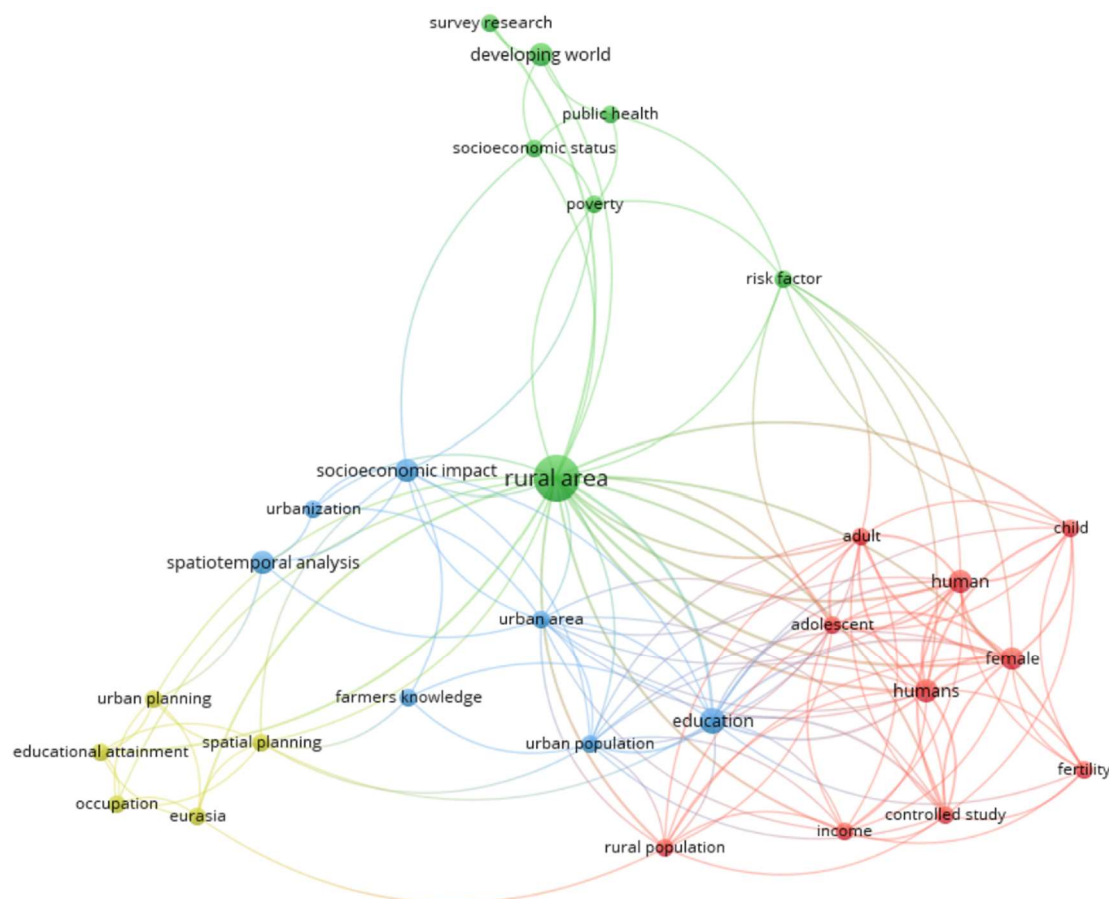


Figure 2. - Thematic map of keyword co-occurrence in studies on higher education and rural youth

This centrality indicates that rurality functions as the core analytical category linking social, educational, economic, and health-related dimensions of the literature. *The green cluster* primarily focuses on socioeconomic conditions and vulnerability in rural contexts. Key terms such as poverty, socioeconomic status, public health, risk factor, and developing world dominate this cluster. This thematic grouping reflects research that conceptualizes access to higher education for rural youth within broader frameworks of social inequality, deprivation, and structural disadvantage. Studies within this cluster often emphasize how poverty, health risks, and low socioeconomic status constrain educational opportunities long before the transition to higher education. *The blue cluster* is centered on spatial and territorial dimensions of education, linking concepts such as urban area, urban population, urbanization, spatiotemporal analysis, and socioeconomic impact. This cluster highlights comparative rural–urban analyses and spatial approaches used to examine educational disparities. The presence of terms related to urban planning and spatial analysis suggests that access to higher education is frequently studied through territorial inequality, regional development, and population distribution lenses. *The red cluster* concentrates on demographic and individual-level characteristics, including education, income, adolescent, adult, female, child, and controlled study. This cluster reflects micro-level and population-based studies that examine how age, gender, income, and demographic status shape

educational participation and outcomes. The strong internal connectivity of this cluster indicates a substantial body of empirical research grounded in quantitative and survey-based methodologies. *The yellow cluster* represents a smaller but conceptually important group of studies related to education outcomes, skills, and employment, incorporating terms such as educational attainment, occupation, farmers' knowledge, spatial planning, and Eurasia. This cluster connects higher education access with labor market integration, sector-specific knowledge, and regional development, particularly in agricultural and post-Soviet contexts. The thematic map demonstrates that research on higher education and rural youth is not confined to educational policy alone, but embedded within broader discussions of social inequality, spatial development, public health, and demographic change. The strong interconnections between clusters suggest that access to higher education for rural youth is conceptualized as a multidimensional and systemic issue, requiring integrated analytical and policy approaches.

The findings of this systematic bibliographic review indicate that research on higher education and rural youth has undergone a significant transformation over the past two decades, evolving from a marginal topic into a rapidly expanding and interdisciplinary field of inquiry. The sharp increase in publication activity after 2019 confirms that rural educational inequality has become a salient issue within global higher education research, particularly in the context of growing concerns about territorial disparities, digital transformation, and inclusive development. One of the central findings is the strong dominance of social science perspectives, as evidenced by the subject area distribution, where nearly half of all publications fall within the Social Sciences. This pattern aligns with prior research emphasizing that access to higher education for rural youth is primarily conceptualized as a structural and institutional problem, rather than an issue of individual motivation or ability (Stone, 2016; Kryst et al., 2018). The prominence of social science research reflects a broader shift toward analyzing higher education through lenses of inequality, governance, and social justice. At the same time, the substantial presence of Environmental Science and Energy-related studies suggests an important expansion of the research agenda beyond traditional educational frameworks. This interdisciplinary orientation supports arguments advanced in the literature on human capital and economic development, which emphasize the role of education in enabling sustainable growth, regional resilience, and labor market adaptation (Hanushek & Woessmann, 2020; Karabayev et al., 2023). In rural contexts, higher education is increasingly examined as a mechanism linking environmental sustainability, energy transitions, and regional economic diversification. The country-level analysis reveals a structurally asymmetric global research landscape, dominated by countries with strong academic infrastructures, such as the United States, the Netherlands, and China. However, the relatively high contribution of Kazakhstan represents a noteworthy finding. With eight publications included in the dataset, Kazakhstan emerges as one of the most visible contributors outside the traditional Western research core. This pattern reflects the country's ongoing struggles with rural–urban inequality, centralized admission systems, and ambitious higher education reforms. The prominence of Kazakhstan in the literature directly corresponds with empirical findings by Chankseliani et al. (2020), who demonstrate how centralized admissions reproduce rural disadvantage, as well as with Jonbekova's (2024) analysis of state-led educational mobility initiatives. The thematic mapping further reinforces the interpretation of rural higher education access as a multidimensional and systemic phenomenon. The central positioning of the keyword "rural area" confirms that rurality is not treated merely as a geographic descriptor, but as a complex social condition intersecting with poverty, health, spatial inequality, and demographic factors. The socioeconomic vulnerability cluster reflects longstanding concerns about cumulative disadvantage, echoing findings that rural students experience structural constraints well before the point of university entry (Chankseliani et al., 2020; Stone, 2016). The spatial cluster highlights the importance of territorial and rural–urban comparisons, supporting research that frames

educational inequality as a product of uneven regional development rather than individual deficits. This perspective resonates with studies emphasizing the role of regional planning, urbanization, and population distribution in shaping educational access (Kryst et al., 2018; Ontiveros, 2020). Meanwhile, the demographic cluster underscores the continued reliance on quantitative, population-based methodologies, reflecting the influence of economic and public health research traditions in the study of education. Importantly, the findings also reveal a growing but ambivalent emphasis on digital transformation. While digitalization is frequently presented as a tool for expanding access to higher education, the literature reviewed supports Dzhanevizova's (2024) argument that digital reforms may reproduce or exacerbate inequalities if infrastructural and institutional disparities persist. This tension is particularly visible in rural contexts, where limited connectivity and digital skills constrain the inclusive potential of technological innovations.

Conclusion

This study set out to systematically analyze international academic literature on higher education and rural youth in order to identify dominant research themes, theoretical perspectives, methodological approaches, and emerging trends over the past two decades. Based on the conducted bibliographic and bibliometric analysis, it can be concluded that the research aim was fully achieved. The findings provide a clear and evidence-based answer to the research question regarding how access to higher education for rural youth has been conceptualized, studied, and thematically structured in international scholarship. The results demonstrate that the literature has evolved from sporadic and fragmented studies into a coherent and rapidly expanding research field, particularly after 2019. Contemporary research increasingly frames rural access to higher education as a structural and systemic issue, shaped by territorial inequality, socioeconomic disadvantage, institutional arrangements, and broader development dynamics. The bibliometric analysis reveals that research on higher education and rural youth is predominantly situated within the social sciences, while simultaneously expanding into environmental, economic, and technological domains. This interdisciplinary configuration reflects a growing recognition that rural educational inequality cannot be understood in isolation from regional development, labor market transformations, and sustainability challenges. The thematic mapping further confirms that rurality functions as a central analytical category connecting education with poverty, health, spatial inequality, and demographic factors. At the country level, the study identifies a structurally asymmetric global research landscape, dominated by a limited number of countries with strong academic infrastructures. At the same time, the relatively high visibility of Kazakhstan highlights the increasing scholarly attention to rural higher education issues in transitional contexts characterized by centralized admissions systems and ongoing reforms. This finding underscores the relevance of Kazakhstan as both an empirical case and a contributor to the global academic discourse. Importantly, the review also demonstrates that digital transformation and scholarship-based mobility programs, while frequently presented as mechanisms for expanding access, produce ambivalent outcomes for rural youth. Without addressing underlying infrastructural, social, and territorial inequalities, such policy instruments risk reproducing existing disparities rather than eliminating them. This conclusion aligns with and extends existing empirical findings in the literature. This study makes a theoretical and methodological contribution by integrating fragmented research into a structured analytical framework and by demonstrating the value of combining systematic bibliographic review procedures with bibliometric mapping techniques. The results highlight significant research gaps, particularly regarding underrepresented regions, longitudinal analyses of rural educational trajectories, and context-sensitive policy evaluations. From a practical perspective, the findings emphasize the need for integrated and territorially sensitive policy approaches to improving access to higher education for rural youth. Future research should move beyond isolated interventions and focus on the interaction between educational systems, regional development strategies, and social support mechanisms. By doing

so, scholars and policymakers can contribute to more equitable and sustainable higher education systems that fully incorporate rural populations into national development trajectories.

Reference

1. Chankseliani, M., Gorgodze, S., Janashia, S., & Kurakbayev, K. (2020). Rural disadvantage in the context of centralised university admissions: a multiple case study of Georgia and Kazakhstan. *Compare: A Journal of Comparative and International Education*, 50(7), 995-1013, doi: <https://doi.org/10.1080/03057925.2020.1761294>
2. Dzhanegezova, A. (2024). Digital transformation of higher education in Kazakhstan: challenges and solutions. *Економічний часопис-XXI*, 209(05+ 06), 42-55.
3. Hanushek, E. A., & Woessmann, L. (2020). Education, knowledge capital, and economic growth. *The economics of education*, 171-182.
4. Heijke, H., Meng, C., & Ris, C. (2003). Fitting to the job: the role of generic and vocational competencies in adjustment and performance. *Labour economics*, 10(2), 215-229.
5. Jonbekova, D. (2024). Government scholarships for international higher education: pathways for social change in Kazakhstan. *Higher education*, 87(3), 761-777, doi: <https://doi.org/10.1007/s10734-023-01034-8>
6. Jonbekova, D., Serkova, Y., Mazbulova, Z., Jumakulov, Z., & Ruby, A. (2023). How international higher education graduates contribute to their home country: An example from government scholarship recipients in Kazakhstan. *Higher Education Research & Development*, 42(1), 126-140, doi: <https://doi.org/10.1080/07294360.2021.2019200>
7. Karabayev, S., Nurgaliyeva, K., Kredina, A., Bekturganova, M., & Aimagambetov, Y. (2023). Relationship between determinants of higher education and economic development: The case of Kazakhstan. *Problems and Perspectives in Management*, 21(1), 336, doi: [10.21511/ppm.21\(1\).2023.29](https://doi.org/10.21511/ppm.21(1).2023.29)
8. Kryst, E. L., Kotok, S., & Hagedorn, A. (2018). Pursuing Higher Education in Rural Pennsylvania Schools: Shaping the College Path. *Rural Educator*, 39(1), 1-15.
9. Lal, K., & Paul, S. (2016). ICTs as Enabler in Higher Education. In *Technology: Corporate and Social Dimensions* (pp. 169-180). Singapore: Springer Singapore.
10. Li, H., Loyalka, P., Rozelle, S., & Wu, B. (2017). Human capital and China's future growth. *Journal of Economic Perspectives*, 31(1), 25-48.
11. Mikiashvili, N. (2019). Education, Human Capital and Competitiveness of Small Open Economies (Case of Georgia. *European Scientific Journal ESJ*.
12. Ontiveros, J. (2020). Connecting rural students to higher education. *The Vermont Connection*, 41(1), 8.
13. Organisation for Economic Co-operation and Development (OECD). *Developing a national assessment that supports Kazakhstan's education goals* (No. 27, December 2020). Retrieved from: https://www.oecd.org/content/dam/oecd/en/publications/reports/2020/12/developing-a-national-assessment-that-supports-kazakhstan-s-education-goals_0928b94a/1c4ed074-en.pdf
14. Özmen, F. (2013). Virtual Communities of Practices (VCoPs) for Ensuring Innovation at Universities--Firat University Sample. *Eurasian Journal of Educational Research*, 53, 131-150.
15. Stone, A. N. (2016). Rural students and higher education: An overview of challenges and opportunities. *Texas Education Review*, 5(1), 1-9.

Medical Sciences

UDC: 618.19-002-006.6-073.43

CLINICAL FEATURES OF EARLY DIAGNOSIS OF BREAST PATHOLOGY: THE ROLE OF ULTRASOUND IN THE DETECTION OF INFLAMMATORY, PRECANCEROUS DISEASES AND BREAST CANCER

Arman Khozhayev

Oncologist, Doctor of Ultrasound Diagnostics, Professor of the S.N. Nugmanov Department of Oncology, Asfendiyarov Kazakh National Medical University, Almaty, Kazakhstan

Marat Mauletbayev

Oncologist, Associate Professor of the Department of Oncology, Astana Medical University, Astana, Kazakhstan

Aigerim Aubakirova

Radiologist, Doctor of Ultrasound Diagnostics, Clinical and Diagnostic Rehabilitation Center "SANAD", Karaganda, Kazakhstan

Assem Garipova

Doctor of Ultrasound Diagnostics, Semey Medical University, University Hospital, Semey, Kazakhstan

Damira Baichapanova

Doctor of Ultrasound Diagnostics, Kurmangazy District Hospital, Atyrau region, Kurmangazy district, Kurmangazy village, Kazakhstan

Aida Mangutova

Doctor of Ultrasound Diagnostics, Medical Center "Damed Clinic", Almaty, Kazakhstan

Alexandr Khalmetov

Resident oncologist, Astana Medical University, Astana, Kazakhstan

Annotation: this scientific and analytical work presents the clinical aspects of ultrasound diagnostics of inflammatory, precancerous, and breast cancer, including rare pathologies. It provides a detailed and comprehensive overview of modern ultrasound diagnostic methods using various modes: B-mode alone, its combination with color Doppler and elastography, as well as their features and informative value in the differential and early diagnosis of pathological conditions of the mammary gland. Current proposals of ultrasound clinicians are provided in the following BI-RADS standard (6th edition). The possibilities of ultrasound correlation for nonspecific symptoms such as pain and discomfort in the mammary glands, known as mastalgia and mastodynia, are described. Clinical protocols for the diagnosis and treatment of various mammary gland pathologies are presented, and current international practices and trends regarding oncovigilance and early diagnosis of breast cancer, including screening, using ultrasound are

described in detail.

Key words: breast, mammary gland, mammalogy, oncology, radiology, ultrasound, ultrasound diagnostics, B-mode, color Doppler, elastography, mammography, breast cancer, screening.

Today, ultrasound (US) diagnostics of various breast pathologies, including inflammatory, dyshormonal, precancerous conditions, and breast cancer, is a leading method, both for initial diagnosis and for comprehensive examinations.

According to current protocols for the diagnosis and treatment of breast pathologies in the Republic of Kazakhstan, US diagnostics is the leading method for both initial diagnosis and monitoring [1, 2, 3].

As noted by Forrai G. et al. [4] breast US can be used on its own in patients aged under 30. Over the age of 30-35 years, it can be a complementary procedure to mammography, when needed. It is not suitable for breast cancer screening, at any age. As for US scans of other regions, breast US scanning should be documented with images in accordance with professional rules, even in negative cases. Colour Doppler is optional, but can be used in addition. Some studies suggest that a significant number of malignancies can be detected by US scanning as a complement for mammography, but this has not yet been routinely introduced due to extra human resource requirements and a high false positive rate. Automated breast US (ABUS) scan hasn't become widespread yet as a complementary investigation modality for dense breast structures. Using a probe covering the breast, volumetric data are collected about the entire breast, from which slices can be reconstructed to review the glandular tissue in the main anatomical planes. This modality provides a good anatomical overview, as it is reproducible, and it can be complemented by an automatic image recognition system. Its disadvantage is that the false positivity rate is high for the biopsies it indicates, most of which will be benign. It should be emphasized that the resolution and information content of US images provided by ABUS is the same as for manual US scanning. Shear-wave elastography (SWE) is a non-invasive imaging procedure based on tissue elasticity, measured in kPa. An abnormal process will modify the elastic properties of the affected tissue. According to studies, US elastography may help differentiate Breast Imaging Reporting and Data System (BI-RADS) 3 and 4a lesions, and may increase the specificity of US scanning, thereby reducing the number of unnecessary breast biopsies. The role of elastography in the monitoring of neoadjuvant treatments, in the differential diagnosis of suspected axillary lymph nodes, and in the evaluation of microcalcifications affecting the glandular tissue has been investigated. This method has also been integrated into the current BI-RADS lexicon of 2013 [5].

Tsunoda H., Moon W.K. in their study [6] note that abnormalities on breast US images which do not meet the criteria for masses are referred to as nonmass lesions. These features and outcomes have been investigated in several studies conducted by Asian researchers. However, the term "nonmass" is not included in the American College of Radiology BI-RADS 5th edition for US. According to the Japan Association of Breast and Thyroid Sonology (JABTS) guidelines, breast lesions are divided into mass and nonmass. US findings of nonmass abnormalities are classified into five subtypes: abnormalities of the ducts, hypoechoic areas in the mammary glands, architectural distortion, multiple small cysts, and echogenic foci without a hypoechoic area. These findings can be benign or malignant; however, focal or segmental distributions and presence of calcifications suggest malignancy. Intraductal, invasive ductal, and lobular carcinomas can present as nonmass abnormalities. For the nonmass concept to be included in the next BI-RADS and be widely accepted in clinical practice, standardized terminologies, an interpretation algorithm, and outcome-based evidence are required for both screening and diagnostic US.

Although the term, "nonmass", is not used in the current BI-RADS for the US lexicon, the

components of nonmass abnormalities are included. Ductal changes and architectural distortions are listed among the associated features. Moreover, calcifications are a separate major category after masses; the descriptors for calcifications are as follows: 1) in a mass, 2) outside of a mass, or 3) intraductal. Cysts and clustered microcysts are included in special case categories. Notably, the definition of a mass in the BI-RADS US lexicon omitted the convexity criterion to allow for the inclusion of lesions with diffuse growth patterns, such as invasive lobular carcinoma or ductal carcinoma in situ (DCIS). The 6th edition of BI-RADS is currently under review and may include the term, “nonmass lesions”, as a new category in the revised lexicon. Nonmass lesions are defined as discrete areas that can be differentiated from normal tissues, lack the margins of a mass, and cannot be assigned a specific shape. In the JABTS guidelines, a mass is defined as a space-occupying lesion or lump formed by components that differ from the surrounding tissue, whereas nonmass abnormalities refer to lesions that are difficult to discern as a mass on US images. The term, “abnormality,” was chosen to emphasize a finding with pathological significance, particularly with a texture that differed from the normal surrounding tissue. The US findings of nonmass abnormalities are classified into five subtypes: 1) abnormalities of the ducts, 2) hypoechoic areas in the mammary glands, 3) architectural distortion, 4) multiple small cysts, and 5) echogenic foci without a hypoechoic area. While some cases presented findings of only one subtype, many exhibited a mixture of five subtypes. Although nonmass abnormalities may co-exist with masses, the abovementioned findings were often depicted as isolated findings without mass formation. Therefore, it remains clinically essential to understand these nonmass abnormalities. Various benign and malignant diseases can present as nonmass abnormalities. These findings are most useful in detecting DCIS; they are reflected in the anatomic structures of the ducts and lobules [6,7].

In lactating breasts, multiple dilated mammary ducts with milk are visible on US. However, bilateral or unilateral ductal dilatations with smooth walls and absent internal echogenicity can be observed below the nipple or areola in normal non-lactating breasts. Fluid secretions in the ducts sometimes appear as internal echoes; however, checking for floating can help differentiate whether they are fluid or solid. Therefore, dilated ducts observed only in certain areas beyond the nipple, ducts with irregular widening and narrowing, ducts with solid echoes, and ducts with thickened walls should be recognized as ductal abnormalities and distinguished from ducts without any pathological significance. Suspicious findings for cancer include the presence of a unilateral segmental distribution, irregularity of ductal caliber, continuous or multiple lesions, a gradual angle between intraductal proliferative lesions and the duct wall, and calcifications in the solid component. In benign diseases such as intraductal papillomas, the solid component in the dilated duct forms a steep angle with the duct wall and has high homogeneous echoes [6,8].

A hypoechoic area has different properties as compared with the surrounding or contralateral mammary gland but does not meet the criteria for a mass. In the case of a mass, the internal echoes are defined relative to the fatty tissue, whereas the term, “hypoechoic,” here refers to the echogenicity relative to the surrounding mammary or fibro-glandular tissue. The terms, “patchy” or “mottled,” are used to describe areas consisting of relatively small, speckled, low echoes, whereas the term, “geographic” is used when such areas have fused together; the term, “indistinct,” is used to describe areas that have indistinguishable boundaries. Because this type of abnormality is determined by a deviation from the normal mammary structure, the JABTS terminology and diagnostic criteria committee has concluded that it is clinically more appropriate to compare echogenicity with the easily comparable internal echoes of mammary tissue rather than with distant fatty tissue, where comparison of echo levels is often ambiguous. The presence of hypoechoic areas in the mammary glands is the most important finding for understanding breast-related diseases. However, distinguishing pathological findings that deviate from normal physiologic patterns or fibrocystic changes is difficult. The key point of differentiation is the

distribution of the hypoechoic areas. Multiple similar findings in the bilateral breasts suggest normal or benign lesions, whereas focal or segmental distribution suggests suspicious or malignant lesions. Therefore, if a hypoechoic area is found, it should be compared with the normal ipsilateral or contralateral side for evaluation [6]. Diseases that can be depicted as hypoechoic areas in the mammary glands include benign pathologies such as epithelial hyperplasia, fibrosis, radial scar, sclerosing adenosis, and mastitis. Malignant diseases include DCIS, invasive ductal carcinoma with predominant intraductal component, invasive ductal carcinoma, invasive lobular carcinoma, and inflammatory carcinoma. The presence of calcifications raises concerns regarding the possibility of malignancy. It is difficult to distinguish whether a lesion is localized within the ducts (in situ) or has an invasive component. In some cases, a preoperative diagnosis of DCIS may change to invasive ductal carcinoma after surgery. Invasion should be considered particularly when lesions are extensive [6,9].

Architectural distortion pertains to a lesion that distorts breast tissue without mass formation. This reflects convergent changes in the tissue, which can be attributed to both benign and malignant findings. Breast cysts are circumscribed anechoic masses with accentuated posterior echoes and imperceptible walls. However, multiple small cysts, which are several millimeters in size, may easily be understood when considering them as a single entity rather than when recognizing each cyst as a mass. If no cysts are found in other parts of the breast while a cluster of small cysts is observed in a localized area, the term, “clustered microcysts,” can be used. Multiple small cysts are classified into two groups based on their distribution: 1) the presence of multiple scattered cysts in the bilateral breasts, which are typically benign, due to fibrocystic changes, 2) the presence of multiple small cysts with focal or segmental distributions and clustered microcysts. Microcalcifications on mammography can sometimes be recognized on US as echogenic foci without definite ductal abnormalities or hypoechoic areas. However, advancements in US equipment have made these findings more common for both benign and malignant diseases. The evaluation of nonmass abnormalities is based on Brightness Mode (B-mode) images; however, color Doppler and elastography may also aid in evaluation. Information on vascularity is important because early-stage breast cancers, including DCIS, are often hypervascular. In the hypoechoic areas of mammary glands, increased blood flow is more likely to indicate malignancy. It has also been reported that micro-invasive carcinoma is more hypervascular than DCIS, thus rendering it useful for differentiating the presence of micro-invasion. Furthermore, it has been reported that high vascularity is useful for improving specificity during screening. Information on elasticity by either strain or SWE can be used to characterize benign and malignant lesions in nonmass hypoechoic or distorted areas. In strain elastography (SE), elasticity is scored from 1 (soft) to 5 (hard) by light compression, where scores of 4 and 5 indicate malignancy. However, some DCIS cases are soft and similar to the surrounding tissue. Thus, as compared to masses, the criteria for use with nonmass abnormalities are not established [6,10].

Tsunoda H., Moon W.K. [6] emphasize that for the nonmass concept of breast US to be included in the next BI-RADS (6th edition) and be widely accepted in clinical practice, the following issues need to be addressed. First, terminology needs to be standardized. Clear definitions for nonmass lesions should be established such that the same lesions are less likely to be classified as either mass or nonmass. In addition, the terms, “nonmass abnormalities” and “nonmass lesions”, must also be distinguished; “nonmass abnormalities” should be used when referring to all five subtypes included in the JABTS guidelines, whereas “nonmass lesions” should be used when referring to nonmass hypoechoic areas in the mammary glands. Therefore, the definitions and usage of these terms require further discussion. Second, there is a need for standardizing the feature descriptors and assessments of nonmass lesions.

Now, it is necessary to dwell in more detail on the use of color Doppler US and elastography

in addition to B-mode in the diagnosis of solid breast tumors.

Okuno T. et al. conducted a multicenter study (JABTS BC-07) to establish the diagnostic criteria for breast US, including color Doppler and elastography, for non-mass abnormalities of the breast and verify their diagnostic usefulness. As the authors note color Doppler US reveals the vascularity of a tumor through visualization of the blood flow. However, it is not considered a standalone examination and is accompanied by B-mode US. Tissue elastography is another technique that can be used in breast US; two modes of tissue elastography, SE and SWE, are currently available [11].

The JABTS-BC 07 study was a multicenter observational study conducted along with CD-CONFIRM, a study verifying the utility of color Doppler US and elastography in the diagnosis of solid breast tumors, from April 2018 to March 2021 [12]. Authors enrolled women with pathologically confirmed non-mass abnormalities of the breast who underwent B-mode and color Doppler examinations and women with non-mass abnormalities of the breast with no significant change for more than 1 year. Non-mass abnormalities that remained unchanged for more than 1 year were considered benign. Clinical data and US images of non-mass abnormalities of the breast were collected, with the exclusion of lesions for which vacuum-assisted biopsies had previously been performed. In cases in which Real-time Tissue Elastography (FUJIFILM Medical Corporation) had been performed, images of elastography were also collected. They grouped bidirectional B-mode images, size measurement images, B-mode images of the same site on the contralateral side, B-mode videos, color Doppler videos, characteristic color Doppler images, and elastography images from cases in which Real-time Tissue Elastography had been performed. The primary endpoints were the sensitivity, specificity, and accuracy of color Doppler US adjunct to B-mode US for non-mass abnormalities of the breast. The secondary endpoints were the validity of B-mode and color Doppler classifications and findings in the differential diagnosis between benign and malignant non-mass abnormalities of the breast and the sensitivity, specificity, and accuracy of color Doppler US and SE adjunct to B-mode US for non-mass abnormalities of the breast.

A high-resolution US system with high-frequency (10 MHz and over) transducers was used in the study. The velocity range of the color Doppler was initially set to 3-4 cm/s. The velocity range, color scan area, and color gain were adjusted for vascularity. The subcutaneous fat and pectoral muscle layers were included in the region of interest of SE. The JABTS and the Japan Society of Ultrasonics in Medicine (JSUM) classify B-mode findings of non-mass abnormalities into the following four categories: hypoechoic areas in the mammary gland, abnormalities of the ducts, architectural distortion, multiple small cysts, and echogenic foci without a hypoechoic area. B-mode US images in this study were evaluated according to the criteria of non-mass abnormalities in the JABTS guidelines, location and distribution of the lesions, and echogenic foci as additional findings. Bilateral location or diffuse distribution indicate benign nature, while unilateral location and regional or quadrant distribution indicate malignant nature. The presence of echogenic foci in the hypoechoic area in the mammary gland suggests advancement of malignancy. The Terminology and Diagnostic Criteria Committee of the JABTS has developed definitions and diagnostic criteria for color Doppler US. Vascularity was evaluated subjectively according to the criteria of breast masses in the CD-CONFIRM study, i.e., according to a 4-point scale: 0, avascular; (1+), hypo-vascular; (2+), moderately vascular; and (3+), hyper-vascular. Penetrating or plunging blood flow in hypoechoic areas of the mammary gland and lesions with architectural distortions were suspected to be malignant. In ducts with internal solid components, a single afferent blood flow into the solid component implied a benign lesion, and multiple blood flows were suspected to be indicative of malignancy. The researchers formulated the diagnostic criteria for non-mass abnormalities of the breast based on Real-time Tissue Elastography as follows: score 1, the entire area of the lesion displays green, indicating soft tissue; score 2, the area of the lesion displays both green and blue, but predominantly green; score 3, the area of the lesion displays both green and

blue, but predominantly blue; score 4, the entire area of the lesion displays blue, indicating hard tissue; and score 5, extensive area of the lesion displays blue. In Japan, the following diagnostic categories are used: Category 1, normal; Category 2, benign; Category 3a, probably benign (surveillance is recommended); Category 3b, probably benign (biopsy is recommended); Category 4, suspected malignancy; and Category 5, malignant. Japanese Category 3b, 4, and 5 correspond to the BI-RADS Category 4A, 4B and 4C, and 5 respectively [11].

The centralized image interpretation committee comprised 16 breast US specialists, including one general physician, 10 breast surgeons, and five US technologists. They all had over 15 years of experience in breast US examinations, and the five US technologists were certified sonographers of JSUM. The images were interpreted without access to medical or background information other than the patient's age. A remote US image interpretation system, developed for JABTS BC-07 and CD-CONFIRM by Zenbe Corporation, was used. By employing this system, image readers could evaluate the data on their computers at their convenience. First, the B-mode images were evaluated, and the B-mode category was subsequently determined. Color Doppler images were evaluated, and categorization combining B-mode and color Doppler imaging was performed. Cases with available elastographic images were also evaluated, and a category combining B-mode, color Doppler, and elastographic findings was assessed. For vascularity (–), authors added -1 to the B-mode category, and for vascularity (2+) and (3+), our colleagues added +1 to the B-mode category. Furthermore, elasticity scores of 4 and 5 were given a category with +1 added to the B-mode category. Data collection and statistical analyses were performed at the Clinical Research Data Center of Tohoku University Hospital. Clinical data and US findings were registered using an electrical data capture system built by Viedoc Japan, and US images were collected using network-attached storage via the Internet. Statistical analyses were performed using SAS software version 9.4. (SAS Institute Inc., Cary, NC, USA). For statistical analysis of sensitivity and specificity, Japanese categories 2 and 3a were considered negative, i.e., benign, whereas categories 3b, 4, and 5 (biopsy is recommended) were considered positive, i.e., malignant. The McNemar test was used to compare B-mode imaging alone; the combination of B-mode imaging and color Doppler imaging; and the combination of B-mode imaging, color Doppler imaging, and elastography. Univariate and multivariate logistic regression analyses were used to estimate odds ratios for the association between B-mode, color Doppler, and elastography findings of malignant non-mass abnormalities. P values less than 0.05 were considered statistically significant [11].

The researchers ultimately analyzed 385 non-mass abnormalities, comprising 202 malignant and 183 benign lesions. Of the 385 non-mass abnormalities, 237 were examined simultaneously using Real-time Tissue Elastography. The 385 non-mass abnormalities included 272 hypoechoic areas in the mammary gland (155 malignant and 117 benign) and 62 abnormalities of the ducts (40 malignant and 22 benign), including 54 lesions with internal solid components, 22 lesions with architectural distortion (8 malignant and 14 benign), 22 lesions with multiple small cysts (12 malignant and 10 benign), and seven malignant lesions of echogenic foci without a hypoechoic area. The 202 malignant lesions included 94 noninvasive ductal carcinomas, 82 invasive ductal carcinomas, 10 invasive lobular carcinomas, and others. The 183 benign lesions included 51 fibrocystic changes, eight cases of fibrous disease, eight cases of intraductal papilloma, and others. Seventy-three cases with benign lesions had unknown histological results and have been observed. The sensitivity, specificity, and accuracy of B-mode alone were 83.7%, 32.8%, and 59.5%, respectively. The sensitivity, specificity, and accuracy of B-mode plus color Doppler US were 93.1%, 29.0%, and 62.6%, respectively. The sensitivity of B-mode alone was significantly improved by the addition of color Doppler imaging ($p=0.0004$). The specificity of B-mode alone was decreased by the addition of color Doppler US; however, the difference was not statistically significant. The accuracy of B-mode alone was improved by adding color Doppler US; however, the

difference was not statistically significant. The sensitivity, specificity, and accuracy of B-mode US alone were 84.6%, 34.2%, and 60.3% respectively. The sensitivity, specificity and accuracy of B-mode US+color Doppler US+elastography were 89.4%, 32.5%, and 62.0% respectively. The sensitivity of B-mode US alone was improved by adding color Doppler US and elastography, but the difference was not significant ($p=0.1088$). The specificity and accuracy of B-mode US alone was not altered by the addition of color Doppler US and elastography. The vascularity of blood flow into an internal solid component of the ducts was not a statistically significant finding for distinguishing between 35 benign and 19 malignant lesions [(2+)/(3+) vs. (-)/(1+), odds ratio (OR) 1.62, 95% confidence interval (CI) 0.57-4.63, $p=0.36$]. A single vascular stalk into an internal solid component of the ducts (present vs. absent, OR 0.44, 95% CI 0.14-1.38, $p=0.154$) and multiple blood flows (present vs. absent, OR 2.57, 95% CI 0.81-8.13, $p=0.10$) ($n=54$) were not significantly different between benign and malignant tumors. Elasticity scores were significant findings for distinguishing between 70 benign and 92 malignant non-mass abnormalities (elasticity score 3/4/5 vs. elasticity score 1/2, OR 4.49, 95% CI 2.20-9.16, $p<0.0001$) [11].

In conclusion, the authors state that the addition of color Doppler US and SE to B-mode imaging in this study improved sensitivity without compromising specificity because in the case of invasive breast cancers, tumor cells infiltrating the stroma are accompanied by vascular hyperplasia, and in the case of noninvasive ductal carcinomas, the higher the degree of malignancy, the higher the vascular hyperplasia in the stroma, and the greater the vascularity. Thus, color Doppler US is incomparable for the diagnosis of breast cancer with improved sensitivity. In contrast, benign lesions in the mammary gland are relatively soft and exhibit low scores on elastography, making it superior for diagnosing benign lesions, thus improving the specificity. Color Doppler and elastography work in a complementary manner, resulting in improved sensitivity while maintaining specificity. For breast masses, the addition of color Doppler US and elastography to B-mode US has considerably improved specificity while maintaining sensitivity. In this study, the specificity did not improve as much for non-mass abnormalities as for masses. This is because fibrocystic changes, which are benign lesions, often show a decrease in the elasticity, whereas noninvasive ductal carcinoma, which is a malignant lesion, often maintains its elasticity [11].

In the work of Cho S.M. et al. [13], the authors set the goal to determine how often non-mass lesions are seen in screening breast USs, and analyze their US features according to the US lexicon to find features suggestive of malignant non-mass lesions. This study is a single center retrospective study for nonmass lesions on screening breast US. Among 21,604 patients who underwent screening breast US, there were 279 patients with nonmass lesions. Of these lesions, 242 lesions were included for analysis. To distinguish between benign and malignant nonmass lesions, univariate analysis was performed on size, echogenicity, distribution, orientation, and associated US features. Additionally, Fisher's exact test was performed for mammographic density and abnormalities. 279 patients with nonmass lesions were included (mean age 53.7 ± 9.7 years, all women). The incidence of nonmass lesions on screening breast US was 1.29% with positive predictive value of 5.78%. The most common malignant nonmass lesion was ductal carcinoma in situ. Nonparallel orientation ($p = 0.002$), echogenic rim ($p = 0.005$), architectural distortion ($p = 0.0004$), posterior shadowing ($p = 0.007$), vascularity ($p < 0.001$), and calcifications ($p < 0.001$) were indicators of malignant lesions. Additionally, mammographic abnormalities were significantly associated with malignant lesions ($p < 0.001$). In conclusion, our colleagues conclude that the incidence of nonmass lesions on screening breast US was 1.29%, with a positive predictive value of 5.78%. Mammographic abnormalities, nonparallel orientation, architectural distortion, posterior shadowing, vascularity, and calcifications were associated with malignant nonmass lesions.

In the work of Naeem M. et al. [14], the researchers point out that breast malignancy is

the second most common cause of cancer death in women. However, less common breast masses can mimic carcinoma and can pose diagnostic challenges. In their case-based study, the authors described a spectrum of rare breast neoplastic and non-neoplastic masses ranging from malignant to benign entities. Malignant masses in this review include adenoid cystic carcinoma, spindle cell lipoma, granular cell tumor, angiosarcoma, glomus tumor, adenosquamous carcinoma, and myofibroblastoma. Benign masses include sarcoidosis, diabetic mastopathy, and cat scratch disease.

The radiological and, in particular, US features of these types of mammary gland pathology are described:

- adenoid cystic carcinoma: this tumor accounts for 0.5-0.8% of all breast cancers and affects women more often than men; on US, it is often characterized as a hypoechoic, irregular mass with minimal vascularity on color Doppler;
- spindle cell lipoma: this is a rare variant of lipoma with a predominantly adipocytic component, also known as 'benign stromal spindle cell tumor'; on US, the mass has a homogenous hypo to hyperechoic appearance with minimal posterior shadowing;
- granular cell tumor: previously called breast granular cell myoblastoma, granular cell tumor is an uncommon neoplasm of the peripheral nervous system originating from the Schwann cells; the sonographic appearance also varies; a granular cell tumor often presents as a hypoechoic mass with circumscribed or irregular margins, with or without posterior acoustic shadowing, a peripheral echogenic halo may be seen;
- angiosarcoma: a malignancy of endovascular origin, angiosarcoma accounts for approximately 1% of all soft tissue breast tumors; on US, angiosarcoma is usually very hypervascular with a heterogeneous appearance secondary to intratumoral hemorrhage;
- glomus tumor: these are uncommon mesenchymal tumors arising from glomus bodies, which are specialized neurovascular organs; sonographically, glomus tumors are generally hypoechoic and extremely vascular in appearance with turbulent flow; an associated efferent vessel is often described;
- adenosquamous carcinoma of the breast: a rare form of invasive mammary cancer, adenosquamous carcinoma accounts for approximately 0.3% of all breast cancers; the majority are low grade and do not typically present with metastasis, which is most frequent to axillary lymph nodes; on sonogram, it typically appears as a hypoechoic, irregular mass with posterior acoustic shadowing;
- myofibroblastoma: a benign mesenchymal tumor, myofibroblastoma of the breast is seen in postmenopausal women and older men between 60 to 80 years of age and constitutes less than 1% of all breast tumors; a well-defined hypoechoic mass is typically seen on US with or without variable degree of posterior acoustic shadowing;
- sarcoidosis: sarcoidosis is a multisystem granulomatous disease that commonly affects the lungs, lymph nodes, skin, spleen, and liver; less than 1% cases involve the breast; US usually demonstrates a hypoechoic, irregular mass with posterior acoustic shadowing;
- diabetic mastopathy: this is a benign fibrotic disease of the breast seen in patients with long standing insulin dependent type I and rarely type II diabetes mellitus; it is thought that hyperglycemia causes accumulation of glycosylated end products, which trigger an autoimmune response causing lymphocytic infiltration and fibrosis which can be mass-like; on US, it is difficult to distinguish diabetic mastopathy from malignancy; an irregular mass with or without posterior acoustic shadowing is commonly seen; core biopsy is performed for definitive diagnosis with histopathology demonstrating lymphocytic infiltration in a predominant periductal and perivascular distribution; keloid fibrosis is also seen in severe cases;
- cat scratch disease: cat scratch disease is a bacterial infection that is caused by *Bartonella henselae* and histologically characterized by granulomatous inflammatory lymphadenopathy

nearby the site of inoculation from a cat scratch; in the breast, cat scratch disease can present as unilateral mastitis or a mass; on color Doppler, these masses typically demonstrate hila with vascular flow consistent with enlarged intramammary lymph nodes; biopsy may be necessary in elusive cases.

Summarizing the study, the authors state that benign and malignant atypical breast masses can mimic invasive ductal or lobular carcinoma along with benign breast pathology. The imaging features of these rare masses are often non-specific and biopsy with histopathologic diagnosis is required to diagnose these rare masses.

A very interesting scientific study devoted to the study of breast cancer risk characteristics in women undergoing US examination of the entire breast, compared with mammography, was conducted by Sprague B.L. et al. [15].

As the authors emphasize there are no consensus guidelines for supplemental breast cancer screening with whole breast US. However, criteria for women at high risk of mammography screening failures – interval invasive cancer or advanced cancer – have been identified. Our colleagues evaluated mammography screening failure risk among women undergoing supplemental US screening in clinical practice compared to women undergoing mammography alone.

The study included 38,166 US screening exams among 29,112 women and 825,360 mammography screening exams among 377,140 women, yielding a ratio of one US screening exam for every 22 mammography alone screening episodes. Most US screening exams (75%) were the woman's first US screen and 63% of screening USs occurred within 9 months following a mammogram. Two percent of US screens occurred among women who had a prior magnetic resonance imaging screening exam recorded in the Breast Cancer Surveillance Consortium (BCSC) database, compared to 0.4% among the mammography alone group. Approximately 69% of US screening exams occurred among women aged 40-59 years and 25.7% were among women who identified as Asian, Black, or Hispanic. 95.3% of US screening exams were among women with dense breasts, while 21.7% occurred among women with a first-degree family history of breast cancer, 24.3% had a prior benign breast disease diagnosis, and 43.7% were among women who were overweight or obese. There were statistically significant differences in the distribution of demographic and risk characteristics between US screening exams and mammography screening alone exams ($p < 0.0001$). In comparison to mammography, US screening exams were much more likely to occur in women who were younger than age 50 years, premenopausal, had dense breasts, and normal body mass index. Small differences were observed in race/ethnicity, family history of breast cancer, and personal history of benign breast disease. In analyses restricted to exams among women with dense breasts, there were 35,616 US screening exams and 342,343 mammography alone screening episodes, corresponding to a ratio of 1:10. In this subset of exams, US screening was more likely to occur in White women, and slightly more likely to occur among women who were younger than 50 years, premenopausal, had extremely dense breasts, a family history of breast cancer, and a history of benign breast disease. The distribution of body mass index was very similar across groups [15].

Among screening US exams in women ages 35-74, 27.2% occurred in women with intermediate BCSC 5-year invasive breast cancer risk (1.67-2.49%) and 18.1% occurred among women with high or very high BCSC 5-year invasive breast cancer risk ($\geq 2.50\%$). In the comparator group of mammography alone exams, 19.6% occurred in women with intermediate BCSC 5-year invasive breast cancer risk and 9.5% occurred among women with high or very high BCSC 5-year invasive breast cancer risk. In analyses restricted to exams among women aged 35-74 years with dense breasts, 46.4% of screening US exams occurred in women with intermediate or higher BCSC 5-year invasive breast cancer risk, whereas 40.7% of mammography alone screening exams occurred in women with intermediate or higher BCSC 5-year invasive breast cancer risk. A total of

22.6% of screening USs were performed in women at high risk of interval invasive cancer after mammography due to having either heterogeneously dense breasts and BCSC 5-year invasive breast cancer risk of $\geq 2.5\%$, or extremely dense breasts and BCSC 5-year invasive risk $\geq 1.67\%$. Among the mammography alone comparator group, 8.0% of exams were in women at high interval invasive cancer risk (adjusted OR [aOR]=3.28; 95% CI: 3.17-3.39 for high interval invasive cancer risk, US vs. mammography). Among women with dense breasts, 23.7% of screening USs were performed in women at high risk of interval invasive cancer, whereas 18.5% of mammography alone exams were in women at high risk of interval invasive cancer (aOR=1.35; 95% CI:1.30-1.39). 30.7% of US screens among women ages 40-74 years occurred in women with intermediate or high BCSC 6-year advanced breast cancer risk ($\geq 0.38\%$). Among the mammography alone comparator group, 18.6% of exams occurred in women with intermediate or higher advanced breast cancer risk (aOR=1.60; 95% CI:1.55-1.64 for intermediate or higher advanced cancer risk, US vs. mammography). In analyses restricted to exams among women aged 40-74 years with dense breasts, 32.0% of screening US exams occurred in women with intermediate or high BCSC 6-year advanced breast cancer risk, whereas 30.5% of mammography screening alone exams occurred in women with intermediate or high BCSC 6-year advanced breast cancer risk (aOR=0.91; 95% CI:0.89-0.94) [15].

The authors note that the results from a geographically diverse sample of breast imaging facilities in the United States demonstrate that US screening was predominantly utilized by women with dense breasts. Other breast cancer risk factors were also more common, and risk of mammography failures – interval invasive breast cancer and advanced cancer – was higher among US screening exams compared to mammography screening alone. Analyses restricted to exams among women with dense breasts indicated only modest differences in risk of interval or advanced cancer between the US and mammography alone groups. Overall, findings indicate strong selection of women for US screening based on breast density alone and moderate selection based on other breast cancer risk factors, corresponding to a wide distribution in risk of mammography screening failure among women undergoing breast US screening. The moderate differences in the risk distributions for invasive breast cancer, interval cancer, and advanced breast cancer observed in the full study population between US screening exams versus mammography alone exams narrowed substantially when restricted to exams among women with dense breasts. Most notably, the prevalence of intermediate or high 6-year advanced breast cancer risk among women with dense breasts was higher among mammography alone screening exams compared to supplemental US screening exams after adjusting for BCSC registry. Our colleagues emphasize that their results also demonstrate that a clinically significant proportion of women at high risk of advanced cancer underwent mammography screening alone with no supplemental screening. These findings suggest a potential role for risk assessment at the time of mammography screening or during primary care visits when screening strategies are discussed. In summary, the authors note that they found that US screening in this geographically-diverse multi-site study was strongly targeted to women with dense breasts. The distributions of breast cancer risk, interval invasive breast cancer risk, and advanced cancer risk varied widely among women undergoing US screening. Many women at high risk of screening mammography failure did not undergo supplemental screening following mammography. Consideration and further public awareness of other breast cancer risk factors beyond breast density could facilitate identification of women at high risk of mammography screening failures who may be appropriate for supplemental US screening [15].

As is well known, pain and discomfort in the mammary glands, known as mastalgia and mastodynia, are among the most common complaints women present with for breast US examinations. This often occurs even before consulting a mammologist. An interesting study on this issue was conducted by Bui A.H. et al. [16]. Based on an analysis of a number of studies, the

authors found that most imaging examinations performed for isolated breast pain have negative results, with no correlate to explain the patient's symptoms. Prior studies have reported negative imaging results (BI-RADS 1) in 77.3% to 95% of isolated breast pain cases. Occasionally, a benign correlate will be identified at the site of focal pain. Prior studies have reported benign imaging findings (BI-RADS 2), most commonly cysts, in 2.5% to 20% of cases. Specific benign findings may be reassuring to the patient and offer an opportunity for intervention, such as cyst or abscess aspiration, for symptomatic relief. Rarely, malignant findings will be associated with the site of focal pain. The reported malignancy rates range from 0% to 2.3%. Several studies observed malignancy rates (0.2% to 0.4%) similar to the cancer detection rate in asymptomatic screening mammography population (5/1000 screens; 0.5%). In other words, the main and overwhelming percentage of these symptoms relate to extramammary causes.

It should be noted that this clinical and diagnostic picture is also observed in our practice, in connection with which, as an additional examination, we refer the patient to a neurologist, who, as a rule, prescribes magnetic resonance imaging of the cervical-thoracic spine, as well as a consultation with a cardiologist and, if necessary, a pulmonologist.

Now, regarding lactostasis and/or lactational mastitis. In the work of Ye H. et al. [17], the authors note the importance of the US method, both in the initial diagnosis of this disease and after treatment. B-US (mode) data of 41 patients were statistically analyzed. It was found that before treatment, 14 patients showed lamellar hypoechoic or anechoic areas of the breast with a maximum of 4.2cm x 2.2cm on B-US. Therefore, mastitis or breast abscess can be considered for these patients. Among them, 13 patients had normal B-US images after treatment. Besides, 1 patient had no obvious change and was hospitalized with intravenous administration of antibiotics and fine needle puncture under the guidance of B-US. The imaging recovery rate was 92.86%.

Chen C. et al. in their study note that lactational breast abscess is a serious complication of mastitis and commonly diagnosed in breast-feeding women [18]. In their study, for the first time, authors investigated the feasibility, efficacy, and cosmetic results of surgical drainage of lactational breast abscess with US-guided Encor VABB system. From January 2017 to May 2018, a total of 36 female patients in the first people's hospital of Zunyi were included. All cases were confirmed with aspiration of pus. Lactational patients with the following conditions were considered to meet the eligibility criteria for surgical drainage of breast abscess with US-guided Encor system: (a) single breast abscess identified on US with a minimum diameter of five or more centimeters; (b) multiple breast abscesses identified on US with a minimum diameter of three or more centimeters; (c) treatment failure with needle aspiration (a maximum of three times without complete resolution).

All the surgeries were performed by two skilled surgeons with experience of breast US by using the 7-gauge Encor VABB system. A Chison Q6 US system (KeeboMed Corporation) with high-resolution linear array transducers (7.5 MHz) was used to provide real-time US guidance. Patients were maintained in a supine position with the target area sterilized and draped. Local anaesthesia is performed with the mixture of 0.5% lidocaine, 1:200 000 epinephrine and normal saline solution in a total volume of 80-100 ml. The ultrasonic transducers and tubing of Encor device were protected with sterile covers. A 5 mm inframammary incision was made with a #11 triangular blade to served as the access for the probe. The probe was then positioned beneath the lesion under real-time US guidance using freehand technique. The pus were drained by vacuum aspiration, and some were sent for bacteriological culture. The septa among abscesses, if exist, were broken with the ultra-sharp cutting tip and the rotating cutter to ensure thorough drainage. A sample of the lesion tissue was excised using the rotating blade with vacuum aspiration, and were sent for pathologic evaluation. When all abscesses were no longer visible under US, the procedure was considered done. A longitudinally and transversely sonographic rescan was performed to confirm the complete drainage. 100-250 ml normal saline solution was irrigate in the previous abscess cavity using 50 ml syringe under real-time US guidance, and then was

aspirated to remove cellular debris and surface pathogens. Next, a catheter connected with a plastic suction bottle was placed for continuing drainage through the same inframammary incision. The catheter was fixed securely to the skin with silk suture. The catheter could be removed when the volume of drainage became less than 20 ml/d and with the confirmation of no residual abscesses. The previous abscess cavity was irrigated once a day with normal saline to remove surface microorganisms or tissue debris and to prevent occlusion of catheter. Continuation of breastfeeding was always encouraged for all patients. The blood test and breast ultrasonography were repeated 3 days for postoperative evaluation until complete resolution. Surgical drainage of lactational breast abscesses with US-guided Encor VABB system was successfully performed in all 36 patients. In conclusion, our colleagues summarize that surgical drainage of breast abscess with US-guided Encor VABB system is a feasible and safe procedure with excellent cosmetic outcomes. It could serve as a promising alternative for women with lactational breast abscess who require surgical intervention [18].

To summarize the above, it can be concluded that the method of US diagnostics of various breast pathologies, ranging from lactostasis in lactating women and inflammatory changes to cancer of this organ, is one of the leading methods in the comprehensive diagnosis of such changes in the mammary gland. Also, this radiographic method is essential both for the initial diagnosis of pathological conditions and for their monitoring during follow-up examination and treatment. Furthermore, thanks to technological advances in medical technology, a variety of complementary imaging modalities for breast pathological changes now exist. This includes, of course, complementing the basic B-mode US, which visualizes breast tissue and adjacent tissue structures in real time as a black-and-white image, with color Doppler and elastography. Doppler US focuses on blood flow, while elastography focuses on the structural properties of tissues, in other words, their elasticity. US diagnostic techniques for various breast pathologies in general, and early-stage breast cancer in particular (including as a second-stage screening examination following digital mammography), are an important component of the specialty of «Radiology». Their high information content, sensitivity, and specificity often allow for an accurate diagnosis without resorting to more complex examination methods, which often carry a significant risk of complications and/or radiation exposure. These methods also enable targeted, specialized treatment for these patients.

LITERATURE

1 Klinicheskij protokol diagnostiki i lechenija «Rak Molochnoj Zhelezy» - Ob#edinennoj komissiej po kachestvu medicinskih uslug Ministerstva zdravooohranenija Respubliki Kazahstan ot 21 nojabrja 2022 goda, Protokol №174. – 66 s (In Russ.).

2 Klinicheskij protokol diagnostiki i lechenija «Dobrokachestvennye novoobrazovanija molochnoj zhelezy» - Ob#edinennoj komissiej po kachestvu medicinskih uslug Ministerstva zdravooohranenija Respubliki Kazahstan ot 08 sentjabrja 2023 goda, Protokol №189. – 22 s (In Russ.).

3 Klinicheskij protokol diagnostiki i lechenija «Laktacionnyj mastit i laktostaz» - Ob#edinennoj komissiej po kachestvu medicinskih uslug Ministerstva zdravooohranenija Respubliki Kazahstan ot 01 marta 2019 goda, Protokol № 56. – 15 s (In Russ.).

4 Forrai G, Kovács E, Ambrózay É, Barta M, Borbély K, Lengyel Z, Ormándi K, Péntek Z, Tünde T, Sebő É. Use of Diagnostic Imaging Modalities in Modern Screening, Diagnostics and Management of Breast Tumours 1st Central-Eastern European Professional Consensus Statement on Breast Cancer. *Pathol Oncol Res.* 2022 Jun 8;28:1610382. doi: 10.3389/pore.2022.1610382.

5 Carl J. D'Orsi, Edward A. Sickles, Ellen B. Mendelson, Elizabeth A. Morris 2013 ACR BI-RADS Atlas: Breast Imaging Reporting and Data System. American College of Radiology, 2014. –

689 p.

6 Tsunoda H, Moon WK. Beyond BI-RADS: Nonmass Abnormalities on Breast Ultrasound. *Korean J Radiol*. 2024 Feb;25(2):134-145. doi: 10.3348/kjr.2023.0769.

7 Ito T, Ueno E, Endo T, Omoto K, Kuwajima A, Taniguchi N, Tsunoda H, Tohno E, Hashimoto H, Fujimoto Y, Watanabe T. The Japan Society of Ultrasonics in Medicine guidelines on non-mass abnormalities of the breast. *J Med Ultrason* (2001). 2023 Jul;50(3):331-339. doi: 10.1007/s10396-023-01308-9.

8 Ban K, Tsunoda H, Watanabe T, Kaoku S, Yamaguchi T, Ueno E, Hirokaga K, Tanaka K. Characteristics of ultrasonographic images of ductal carcinoma in situ with abnormalities of the ducts. *J Med Ultrason* (2001). 2020 Jan;47(1):107-115. doi: 10.1007/s10396-019-00981-z.

9 Guo W, Wang T, Li F, Jia C, Zheng S, Zhang X, Bai M. Non-mass Breast Lesions: Could Multimodal Ultrasound Imaging Be Helpful for Their Diagnosis? *Diagnostics* (Basel). 2022 Nov 23;12(12):2923. doi: 10.3390/diagnostics12122923.

10 Hong S, Li W, Gao W, Liu M, Song D, Dong Y, Xu J, Dong F. Diagnostic performance of elastography for breast non-mass lesions: A systematic review and meta-analysis. *Eur J Radiol*. 2021 Nov;144:109991. doi: 10.1016/j.ejrad.2021.109991.

11 Okuno T, Watanabe T, Yamaguchi T, Konno S, Takaki R, Watanabe R, Ban K, Hirokaga K, Tsuruoka M, Morita T. Usefulness of color Doppler and strain elastography adjunctive to B-mode ultrasonography in the diagnosis of non-mass abnormalities of the breast: results of the BC-07 multicenter study of 385 cases. *J Med Ultrason* (2001). 2025 Jan;52(1):157-168. doi: 10.1007/s10396-024-01485-1.

12 Watanabe T, Yamaguchi T, Okuno T, Konno S, Takaki R, Sato M, Tsuruoka M, Shirai H, Ogawa Y, Ban K, Fujimoto Y, Hirokaga K, Watanabe R, Morita T. Utility of B-Mode, Color Doppler and Elastography in the Diagnosis of Breast Cancer: Results of the CD-CONFIRM Multicenter Study of 1351 Breast Solid Masses. *Ultrasound Med Biol*. 2021 Nov;47(11):3111-3121. doi: 10.1016/j.ultrasmedbio.2021.07.009.

13 Cho SM, Cha JH, Kim HH, Shin HJ, Chae EY, Choi WJ, Eom HJ, Kim HJ. Prevalence and outcomes of nonmass lesions detected on screening breast ultrasound based on ultrasound features. *J Ultrasound*. 2025 Jun;28(2):369-378. doi: 10.1007/s40477-024-00981-x.

14 Naeem M, Zulfiqar M, Ballard DH, Billadello L, Cao G, Winter A, Lowdermilk M. "The unusual suspects"-Mammographic, sonographic, and histopathologic appearance of atypical breast masses. *Clin Imaging*. 2020 Oct;66:111-120. doi: 10.1016/j.clinimag.2020.04.039.

15 Sprague BL, Ichikawa L, Eavey J, Lowry KP, Rauscher G, O'Meara ES, Miglioretti DL, Chen S, Lee JM, Stout NK, Mandelblatt JS, Alsheik N, Herschorn SD, Perry H, Weaver DL, Kerlikowske K. Breast cancer risk characteristics of women undergoing whole-breast ultrasound screening versus mammography alone. *Cancer*. 2023 Aug 15;129(16):2456-2468. doi: 10.1002/cncr.34768.

16 Bui AH, Smith GJ, Dyrstad SW, Robinson KA, Herman CR, Owusu-Brackett N, Fowler AM. An Image-Rich Educational Review of Breast Pain. *J Breast Imaging*. 2024 May 27;6(3):311-326. doi: 10.1093/jbi/wbae001.

17 Ye H, Hu D, Zheng H, Yang Y, Lin Y, Liu J, Luo X, Li R, Hu F, Jin L. Clinical efficacy of Gualou Xiaoyong Decoction and painless lactation manipulation in treating lactation acute mastitis and breast abscess: An observational study. *Medicine* (Baltimore). 2023 Aug 25;102(34):e34617. doi: 10.1097/MD.00000000000034617.

18 Chen C, Luo LB, Gao D, Qu R, Guo YM, Huo JL, Su YY. Surgical drainage of lactational breast abscess with ultrasound-guided Encor vacuum-assisted breast biopsy system. *Breast J*. 2019 Sep;25(5):889-897. doi: 10.1111/tbj.13350.

Historical Sciences

Тарих сабағында Семей полигонын тарихын оқытуда ЖИ қолдану

Н.Ж. Токтаганов

Марғұлан атындағы Павлодар педагогикалық университеті, Павлодар қ., Қазақстан

А.М. Садыкова

Марғұлан атындағы Павлодар педагогикалық университеті, Павлодар қ., Қазақстан

Аңдатпа

Бұл мақалада тарих сабағында Семей ядролық сынақ полигонының тарихын оқыту үдерісінде жасанды интеллект (ЖИ) технологияларын қолданудың педагогикалық мүмкіндіктері қарастырылады. Семей полигоны – XX ғасырдағы ең күрделі әлеуметтік-экологиялық мәселелердің бірі болғандықтан, оны оқытуда деректердің көпқырлылығы, тарихи құжаттардың молдығы және оқушылардың сыни ойлау дағдыларын дамыту маңызды. Мақалада ЖИ негізіндегі құралдар (интеллектуалды чат-боттар, деректерді визуализациялау, интерактивті карталар, цифрлық мұрағаттармен жұмыс) арқылы тарихи ақпаратты жүйелеу, оқушылардың қызығушылығын арттыру және жеке оқу траекториясын қалыптастыру жолдары талданады. Сонымен қатар, ЖИ-дің тарихи деректерді талдаудағы рөлі, себеп-салдарлық байланыстарды анықтауға ықпалы және тарихи сананы қалыптастырудағы маңызы көрсетіледі.

Зерттеу нәтижелері ЖИ қолдану оқушылардың оқу мотивациясын күшейтіп, күрделі тарихи мәселелерді терең түсінуге мүмкіндік беретінін дәлелдейді. Мақала тарих пәні мұғалімдеріне, әдіскерлерге және білім беруді цифрландыру саласындағы зерттеушілерге арналған.

Сонымен қатар, мақалада жасанды интеллектті қолданудағы этикалық мәселелер мен тарихи шындықты бұрмаламау қағидаттарын сақтау қажеттілігіне ерекше назар аударылады.

Кілт сөздер: Семей полигоны, тарихты оқыту, жасанды интеллект, цифрлық білім, тарихи сана, интерактивті әдістер, білім беру технологиялары

Н.Ж. Токтаганов, А.М. Садыкова*

Павлодарского педагогического университета имени Маргулана, г. Павлодар, Казахстан

Аннотация

В данной статье рассматриваются педагогические возможности использования технологий искусственного интеллекта (ИИ) в процессе преподавания истории Семипалатинского ядерного испытательного полигона на уроках истории. Поскольку Семипалатинский полигон является одной из самых сложных социально-экологических проблем XX века, при его изучении особое значение имеют многогранность данных, обилие исторических документов и развитие у учащихся навыков критического мышления. В статье анализируются пути систематизации исторической информации, повышения познавательного интереса учащихся и формирования индивидуальной образовательной

траектории с помощью ИИ-инструментов (интеллектуальных чат-ботов, визуализации данных, интерактивных карт, работы с цифровыми архивами). Кроме того, раскрывается роль ИИ в анализе исторических источников, его влияние на выявление причинно-следственных связей и значение в формировании исторического сознания.

Результаты исследования показывают, что применение ИИ способствует повышению учебной мотивации учащихся и позволяет глубже осмыслить сложные исторические проблемы. Статья адресована учителям истории, методистам и исследователям в области цифровизации образования.

Также в статье уделяется особое внимание этическим вопросам использования искусственного интеллекта и необходимости соблюдения принципов недопущения искажения исторической правды.

Ключевые слова: Семипалатинский полигон, преподавание истории, искусственный интеллект, цифровое образование, историческое сознание, интерактивные методы, образовательные технологии

N. Toktaganov, A. Sadykova*

Pavlodar Pedagogical University named after Margulan, Pavlodar, Kazakhstan

Annotation

This article examines the pedagogical possibilities of using artificial intelligence (AI) technologies in teaching the history of the Semipalatinsk nuclear test site in history classes. Since the Semipalatinsk test site represents one of the most complex socio-environmental issues of the twentieth century, its study requires attention to the multidimensional nature of data, the abundance of historical documents, and the development of students' critical thinking skills. The article analyzes ways to systematize historical information, increase students' learning motivation, and form individualized learning trajectories through AI-based tools such as intelligent chatbots, data visualization, interactive maps, and work with digital archives. In addition, the role of AI in analyzing historical sources, its contribution to identifying cause-and-effect relationships, and its significance in shaping historical consciousness are highlighted.

The research findings demonstrate that the use of AI enhances students' academic motivation and enables a deeper understanding of complex historical issues. The article is intended for history teachers, methodologists, and researchers in the field of digitalization of education.

Furthermore, special attention is given to ethical issues related to the use of artificial intelligence and the necessity of adhering to principles that prevent the distortion of historical truth.

Keywords: Semipalatinsk test site, history education, artificial intelligence, digital education, historical consciousness, interactive methods, educational technologies

Қысқашы. Қазіргі жаһандану және цифрландыру жағдайында білім беру жүйесі түбегейлі өзгерістерге ұшырап, оқыту үдерісінде жаңа технологияларды тиімді қолдану өзекті мәселеге айналып отыр. Әсіресе тарих пәнін оқытуда дәстүрлі баяндау әдістерімен қатар, оқушылардың танымдық белсенділігін арттыратын, сыни ойлауын дамытатын және тарихи сананы қалыптастыратын инновациялық тәсілдерді енгізу қажеттілігі артып келеді. Осы тұрғыдан алғанда, жасанды интеллект технологиялары білім беру саласында кең мүмкіндіктерге жол ашып, тарихи білімді игерудің жаңа деңгейін қалыптастыруға ықпал етуде.

Қазақстан тарихындағы аса маңызды әрі қайғылы кезеңдердің бірі – Семей ядролық сынақ полигонының тарихы болып табылады. XX ғасырдың ортасында жүзеге асырылған ядролық сынақтар аймақтың экологиялық жағдайына, халықтың денсаулығына және әлеуметтік өміріне ауыр зардаптар тигізді. Бұл тарихи құбылысты оқыту тек деректерді жеткізумен шектелмей, оның себеп-салдарын, адамзатқа тигізген әсерін және тарихи жауапкершілік мәселесін терең түсіндіруді талап етеді. Сондықтан Семей полигоны тақырыбы оқушылардың азаматтық көзқарасын, гуманистік құндылықтарын және тарихи санасын қалыптастыруда ерекше маңызға ие.

Алайда Семей полигоны тарихын оқыту барысында бірқатар қиындықтар туындайды, соның ішінде тарихи деректердің күрделілігі, статистикалық мәліметтердің көптігі, картографиялық және мұрағаттық материалдардың ауқымдылығы ерекше орын алады. Дәстүрлі оқыту әдістері бұл ақпаратты толық әрі жүйелі түрде меңгеруге әрдайым мүмкіндік бере бермейді. Осыған байланысты оқыту үдерісіне жасанды интеллектке негізделген құралдарды енгізу тарихи материалды тиімді игерудің баламалы жолы ретінде қарастырылады.

Жасанды интеллект технологиялары тарихи деректерді талдау, салыстыру және визуализациялау арқылы оқушылардың ақпаратты қабылдауын жеңілдетіп, олардың оқу мотивациясын арттыруға мүмкіндік береді. Интерактивті карталар, цифрлық мұрағаттар, интеллектуалды сұхбаттасу жүйелері оқушыларды дербес ізденіске жетелеп, тарихи оқиғаларды кеңістік пен уақыт тұрғысынан кешенді түсінуге жағдай жасайды. Сонымен қатар, ЖИ қолдану оқушылардың жеке оқу ерекшеліктерін ескеріп, білімді саралап оқытуға мүмкіндік береді.

Осыған орай, тарих сабағында Семей ядролық сынақ полигонының тарихын оқытуда жасанды интеллект технологияларын қолдану мәселесін ғылыми тұрғыдан зерделеу өзекті болып табылады. Бұл мақалада ЖИ-дің білім беру үдерісіндегі әлеуетін айқындау, оның тарихты оқытудағы тиімділігін талдау және тарихи шындықты сақтай отырып қолданудың маңызын көрсету көзделеді. Аталған мәселені зерттеу тарих пәнін оқытудың сапасын арттыруға және оқушылардың тарихи білімін тереңдетуге бағытталған ғылыми-әдістемелік негіз қалыптастыруға мүмкіндік береді [1].

Негізгі бөлім. Тарих сабағында Семей ядролық сынақ полигонының тарихын оқыту – оқушыларға XX ғасырдағы күрделі геосаяси, әлеуметтік және экологиялық үдерістерді түсіндірудің маңызды құралы болып табылады. Бұл тақырып тек аймақтық немесе ұлттық деңгейдегі мәселе емес, сонымен қатар бүкіл адамзатқа ортақ жаһандық проблема ретінде қарастырылады. Осыған байланысты оны оқытуда мазмұнның тереңдігімен қатар, оқыту әдістерінің тиімділігі ерекше рөл атқарады. Қазіргі білім беру кеңістігінде жасанды интеллект технологияларын қолдану тарихты оқытудың мазмұны мен формасын жаңғыртуға мүмкіндік беретін маңызды құрал ретінде алға шығуда.

Семей полигоны тарихын оқытуда ең алдымен дереккөздермен жұмыс мәселесі туындайды. Ядролық сынақтарға қатысты архивтік құжаттар, статистикалық мәліметтер, ғылыми зерттеулер, куәгерлердің естеліктері сияқты деректер көлемі өте ауқымды әрі күрделі. Жасанды интеллектке негізделген жүйелер бұл деректерді сұрыптауға, жүйелеуге және салыстыруға мүмкіндік береді. Мысалы, цифрлық мұрағаттармен жұмыс істейтін ЖИ құралдары оқушыларға белгілі бір уақыт аралығындағы құжаттарды тез табуға, тақырып бойынша негізгі үрдістерді анықтауға жағдай жасайды. Бұл өз кезегінде оқушылардың дерекпен жұмыс жасау дағдысын қалыптастырып, тарихи зерттеу элементтерін меңгеруіне ықпал етеді.

ЖИ технологияларының тағы бір маңызды қыры – тарихи ақпаратты визуализациялау мүмкіндігі. Семей полигоны аумағында жүргізілген ядролық сынақтардың географиялық орналасуын, уақыттық динамикасын және олардың салдарын интерактивті карталар мен

графиктер арқылы көрсету оқушылардың кеңістік пен уақытты қабылдауын жеңілдетеді. Мұндай визуалды құралдар күрделі статистикалық мәліметтерді түсінікті формада ұсынуға көмектесіп, оқушылардың тарихи оқиғалар арасындағы себеп-салдарлық байланыстарды анықтауына мүмкіндік береді. Сонымен қатар, визуализация оқыту үдерісін қызықты әрі тартымды етіп, оқушылардың сабаққа деген ынтасын арттырады.

Интеллектуалды чат-боттар мен диалогтық ЖИ жүйелері тарих сабағында жеке оқыту элементтерін енгізуге жол ашады. Оқушылар өздерін қызықтырған сұрақтарды қойып, қосымша түсіндірмелер ала алады, ал бұл олардың дербес оқу дағдыларын дамытуға ықпал етеді. Семей полигоны тақырыбы аясында чат-боттар тарихи кезеңдер, негізгі оқиғалар, маңызды тұлғалар және қабылданған саяси шешімдер туралы мәліметтерді ұсыну арқылы оқушылардың білімін тереңдетуге көмектеседі. Мұндай тәсіл оқушыны пассивті тыңдаушы емес, белсенді ізденуші ретінде қалыптастыруға бағытталған [2].

Сонымен қатар, жасанды интеллект оқушылардың сыни ойлау қабілетін дамытуда маңызды рөл атқарады. Семей полигоны тарихы түрлі көзқарастар мен бағалауларды қамтитын күрделі тақырып болғандықтан, ЖИ құралдары әртүрлі дереккөздерді салыстыруға, ұқсастықтар мен айырмашылықтарды анықтауға мүмкіндік береді. Оқушылар ресми құжаттар мен жеке естеліктерді, ғылыми зерттеулер мен қоғамдық пікірді салыстыра отырып, тарихи оқиғаларға жан-жақты баға беруді үйренеді. Бұл тарихи сананың қалыптасуына және оқушылардың өз көзқарасын дәлелді түрде қорғау қабілетінің дамуына ықпал етеді.

ЖИ технологияларын қолдану оқу үдерісін дараландыруға да мүмкіндік береді. Әр оқушының білім деңгейі, қызығушылығы мен оқу қарқыны әртүрлі болғандықтан, жасанды интеллект негізіндегі жүйелер оқу материалын саралап ұсынуға жағдай жасайды. Мысалы, кейбір оқушылар экологиялық зардаптарға көбірек қызығушылық танытса, енді біреулері саяси шешімдер мен халықаралық контексті зерттеуге ұмтылады. ЖИ осы бағыттарды ескеріп, оқушыларға сәйкес тапсырмалар мен қосымша материалдар ұсына алады. Бұл оқыту үдерісінің тиімділігін арттырып, білім алудағы тең мүмкіндіктерді қамтамасыз етеді.

Алайда жасанды интеллект технологияларын қолдануда белгілі бір шектеулер мен жауапкершілік мәселелері де бар. Семей полигоны тарихы халықтың тағдырымен, адам өмірімен және экологиялық апаттармен тікелей байланысты болғандықтан, тарихи шындықты бұрмалауға жол бермеу аса маңызды. Осы тұрғыдан алғанда, ЖИ қолдану барысында дереккөздердің сенімділігіне, ақпараттың ғылыми негізділігіне және этикалық қағидаттардың сақталуына ерекше назар аудару қажет. Мұғалімнің жетекші рөлі бұл жерде сақталып, жасанды интеллект көмекші құрал ретінде пайдаланылуы тиіс.

Сонымен бірге, ЖИ технологияларын тарих сабағына енгізу мұғалімнің кәсіби құзыреттілігін арттыруды талап етеді. Мұғалім тек пәндік біліммен ғана шектелмей, цифрлық сауаттылықты меңгеріп, ЖИ құралдарын тиімді қолдану жолдарын білуі қажет. Бұл өз кезегінде педагогикалық тәжірибені жаңғыртып, заманауи білім беру талаптарына сай оқыту ортасын қалыптастыруға мүмкіндік береді [3].

Семей ядролық сынақ полигонының тарихын оқытуда жасанды интеллект технологияларын қолдану тарихи білімді тереңдетудің, оқушылардың танымдық белсенділігін арттырудың және тарихи сананы қалыптастырудың тиімді жолы болып табылады. ЖИ құралдары күрделі тарихи материалды меңгеруді жеңілдетіп қана қоймай, оқушыларды жауапты азаматтық позицияға тәрбиелеуге ықпал етеді. Осы бағыттағы ғылыми-әдістемелік ізденістер тарих пәнін оқытудың мазмұны мен сапасын арттыруға елеулі үлес қоса алады.

Зерттеу бөлімі. Бұл зерттеу тарих сабағында Семей ядролық сынақ полигонының тарихын оқытуда жасанды интеллект (ЖИ) платформаларын қолданудың тиімділігін анықтауға бағытталды. Зерттеу барысында ЖИ технологияларының оқу үдерісіндегі орны,

олардың түрлері мен мүмкіндіктері, сондай-ақ Семей полигонына қатысты тарихи деректерді меңгертудегі рөлі талданды. Қазіргі білім беру жүйесінде жасанды интеллект оқытуды жаңғыртудың маңызды тетігіне айналып, тарихи білімді игерудің жаңа әдістемелік бағыттарын қалыптастыруға ықпал етуде.

Зерттеу барысында ең алдымен тарих сабағында қолдануға болатын жасанды интеллект платформалары іріктелді. Олардың қатарына мәтінмен жұмыс жасайтын интеллектуалды жүйелер, деректерді визуализациялайтын платформалар, интерактивті карталар құрастыратын құралдар, цифрлық мұрағаттармен жұмыс істеуге мүмкіндік беретін ЖИ негізіндегі сервистер енгізілді. Бұл платформалар оқушылардың тарихи ақпаратты қабылдауын жеңілдетіп қана қоймай, олардың дербес ізденіс жасау дағдыларын дамытуға бағытталды [4].

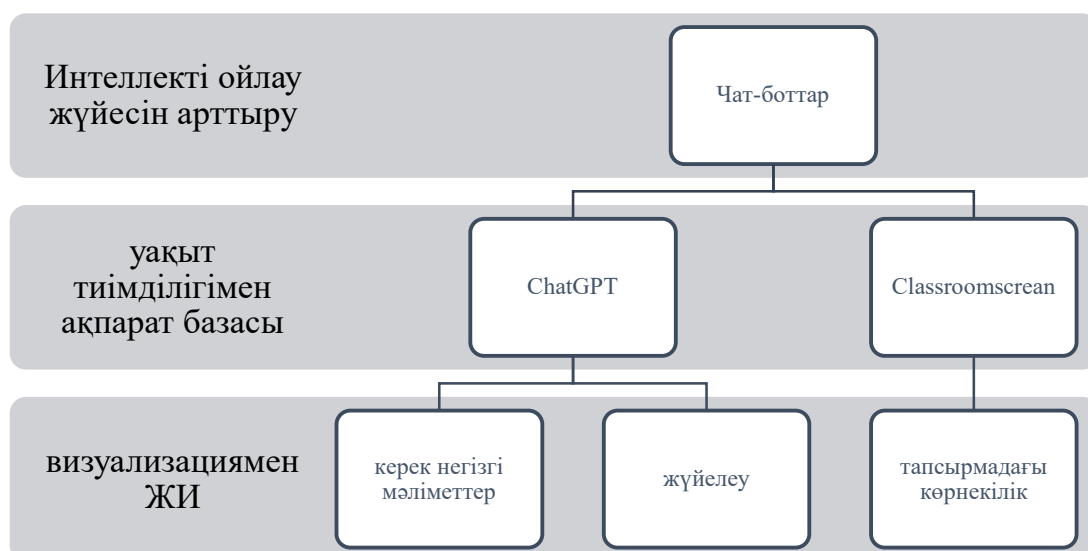
Мәтіндік ақпаратпен жұмыс жасауға арналған ЖИ платформалары зерттеу барысында кеңінен қолданылды. Мұндай жүйелер тарихи деректерді қысқарту, салыстыру, негізгі ойды анықтау және сұрақ-жауап форматында түсіндіру мүмкіндіктерімен ерекшеленеді. Семей полигоны тақырыбында бұл платформалар ядролық сынақтардың кезеңдерін, негізгі даталарды, қабылданған саяси шешімдерді және олардың салдарын жүйелі түрде түсіндіруге мүмкіндік берді. Оқушылар тарихи мәтіндермен жұмыс істеу барысында ақпаратты жай ғана жаттап қоймай, оны талдауға, қорытынды жасауға үйренді.

Зерттеу барысында деректерді визуализациялауға арналған жасанды интеллект платформалары да қолданылды. Семей ядролық сынақ полигоны аумағында жүргізілген сынақтардың саны, мерзімі және географиялық орналасуы статистикалық тұрғыдан күрделі болғандықтан, визуалды құралдар ерекше маңызға ие болды. ЖИ көмегімен құрылған диаграммалар, кестелер мен уақыт сызықтары оқушыларға тарихи үдерістердің динамикасын айқын көруге мүмкіндік берді. Бұл әдіс ядролық сынақтардың қарқынын, олардың кезең-кезеңмен жүргізілуін және уақыт өте келе өзгерген саяси көзқарастарды түсіндіруде тиімді нәтиже көрсетті [5].

Интерактивті карталар жасауға арналған ЖИ платформалары зерттеудің маңызды құрамдас бөлігі болды. Семей полигонының географиялық орналасуын, оған жақын орналасқан елді мекендерді, сынақ жүргізілген аймақтарды карта арқылы көрсету оқушылардың кеңістіктік ойлау қабілетін дамытуға ықпал етті. Интерактивті карталар арқылы оқушылар белгілі бір сынақтың қай жерде, қай жылы жүргізілгенін, оның қоршаған ортаға тигізген ықпалын нақтылай алды. Бұл тәсіл тарих пен география пәндерінің пәнаралық байланысын нығайтуға мүмкіндік берді.

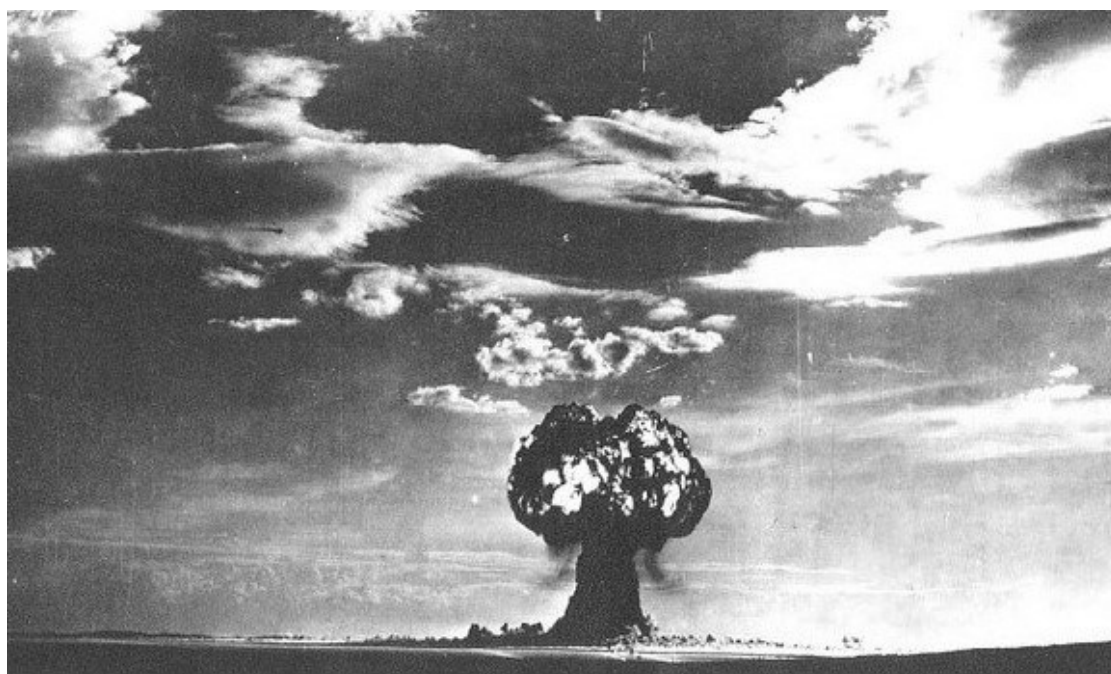
Зерттеу барысында цифрлық мұрағаттармен жұмыс істеуге мүмкіндік беретін ЖИ жүйелері де пайдаланылды. Семей полигонына қатысты тарихи құжаттар, ресми баяндамалар, халықаралық келісімдер, ғылыми зерттеулер мен естеліктер сияқты дереккөздер цифрлық форматта ұсынылды. Жасанды интеллект бұл деректерді кілт сөздер арқылы іздеуге, белгілі бір кезең бойынша сұрыптауға және салыстыруға көмектесті. Оқушылар архивтік материалдармен жұмыс істей отырып, тарих ғылымының зерттеу әдістерімен танысты және дереккөздің маңызын түсінді [6].

Зерттеу аясында қолданылған ЖИ платформаларының тағы бір түрі – интеллектуалды диалогтық жүйелер болды. Бұл жүйелер оқушылардың сұрақтарына жедел жауап беріп, қосымша түсіндірмелер ұсыну арқылы жеке оқыту элементтерін жүзеге асырды. Семей полигоны тақырыбында мұндай жүйелер ядролық қарудың жасалу тарихы, сынақтардың мақсаттары, олардың халықаралық деңгейдегі салдары туралы мәліметтер берді. Диалогтық формат оқушылардың сабаққа белсенді қатысуына және өздігінен білім алуға деген ынтасын арттырды (сурет – 1).



Сурет – 1. ЖИ мүмкіншіліктері мен тиімділігі

Зерттеу барысында Семей ядролық сынақ полигонының тарихи мәліметтеріне ерекше назар аударылды. Семей полигоны 1949 жылы Кеңес Одағының ядролық қару сынақтарын жүргізу мақсатында құрылғаны белгілі. Алғашқы ядролық сынақ 1949 жылдың 29 тамызында өткізілді және бұл оқиға Қазақстан тарихында ғана емес, әлемдік тарихта да маңызды орын алды. Кейінгі қырық жылға жуық уақыт ішінде полигонда жүздеген ядролық сынақ жүргізілді, олардың басым бөлігі жер үстінде және әуеде жүзеге асырылды (сурет – 2)



Сурет – 2. Ядролық сынақ кезінде жасалған фотосуреті

Бұл сынақтар Семей өңірінің экологиялық жағдайына ауыр зардаптар әкелді. Радиациялық ластану топыраққа, су көздеріне және ауаға таралып, аймақ тұрғындарының денсаулығына кері әсерін тигізді. Зерттеу барысында ЖИ платформалары арқылы экологиялық салдарлар жөніндегі статистикалық мәліметтер талданып, аурулардың өсу динамикасы, халық санының өзгеруі сияқты көрсеткіштер қарастырылды. Мұндай деректер

оқушыларға тарихи оқиғалардың нақты адам тағдырымен тікелей байланысты екенін түсінуге көмектесті.

Семей полигоны тарихын оқытуда қоғамдық қозғалыстар мен саяси шешімдерге де назар аударылды. XX ғасырдың соңында қалыптасқан ядролық қаруға қарсы қозғалыстар, соның ішінде «Невада – Семей» қозғалысы, полигонды жабу жолындағы күрестің маңызды кезеңі болды. Жасанды интеллект көмегімен бұл қозғалыстың тарихи құжаттары, үндеулері мен халықаралық қолдауы талданып, оқушыларға азаматтық белсенділіктің маңызы түсіндірілді [7].

Зерттеу нәтижелері көрсеткендей, жасанды интеллект платформаларын қолдану Семей полигоны тақырыбын оқытуда оқушылардың оқу мотивациясын айтарлықтай арттырды. Оқушылар күрделі тарихи ақпаратты жеңіл қабылдап, өз бетімен зерттеу жүргізуге қызығушылық танытты. Сонымен қатар, ЖИ қолдану оқушылардың сыни ойлау, талдау және қорытынды жасау дағдыларының дамуына оң әсер етті (сурет – 3).



Сурет – 3. Семей полигонының сынақ нәтижесі

Сонымен бірге, зерттеу барысында ЖИ қолданудың белгілі бір шектеулері де анықталды. Тарихи деректердің дәлдігі, ақпараттың сенімділігі және этикалық мәселелер басты назарда болуы тиіс екені белгілі болды. Сондықтан жасанды интеллект тарих сабағында мұғалімнің орнын алмастыратын құрал емес, керісінше, оның кәсіби қызметін толықтыратын көмекші құрал ретінде қолданылуы қажет [8].

Зерттеу нәтижелері тарих сабағында Семей ядролық сынақ полигонының тарихын оқытуда жасанды интеллект платформаларын қолдану білім беру үдерісінің сапасын арттыратынын көрсетті. ЖИ технологиялары тарихи мәліметтерді терең меңгеруге, оқушылардың тарихи санасын қалыптастыруға және олардың азаматтық жауапкершілігін дамытуға тиімді ықпал етеді. Бұл бағыттағы зерттеулерді одан әрі жалғастыру тарихты оқыту әдістемесін жетілдіруге және заманауи білім беру талаптарына сай оқыту моделін қалыптастыруға мүмкіндік береді [9].

Талқылау мен нәтиже. Зерттеу жұмысы тарих сабағында Семей ядролық сынақ полигонының тарихын оқытуда жасанды интеллект технологияларын қолданудың тиімділігін анықтау мақсатында жүргізілді. Зерттеу барысында оқушылар екі топқа бөлінді: эксперименттік және бақылау тобы. Эксперименттік топта сабақтар жасанды интеллектке негізделген цифрлық құралдарды қолдану арқылы өткізілсе, бақылау тобында дәстүрлі оқыту әдістері пайдаланылды. Бұл тәсіл ЖИ технологияларының оқушылардың білім деңгейіне, оқу мотивациясына және тарихи санасының қалыптасуына ықпалын салыстырмалы түрде талдауға мүмкіндік берді [10].

Эксперименттік топта Семей полигоны тақырыбын меңгерту барысында интерактивті материалдар, деректерді визуализациялау, цифрлық мұрағаттармен жұмыс және интеллектуалды диалогтық жүйелер қолданылды. Оқушылар тарихи деректерді өздігінен талдап, сұрақтар қою арқылы білімдерін тереңдетті. Ал бақылау тобында мұғалімнің түсіндіруі, оқулық мәтіндері және жазбаша тапсырмалар негізгі оқыту құралы ретінде қолданылды. Екі топта да оқу мазмұны бірдей болғанымен, қолданылған әдістер мен құралдарда айқын айырмашылық байқалды.

Зерттеу нәтижелерін талдау эксперименттік топтағы оқушылардың сабаққа деген қызығушылығы мен белсенділігі жоғарылағанын көрсетті. Олар тарихи оқиғалардың себеп-салдарлық байланыстарын жақсырақ түсіндіріп, Семей полигонының әлеуметтік, экологиялық және саяси салдарына қатысты өз көзқарастарын дәлелді түрде жеткізе алды. Сонымен қатар, эксперименттік топтағы оқушылар дереккөздермен жұмыс барысында салыстыру, талдау және қорытынды жасау дағдыларын жиірек қолданғаны байқалды.

Бақылау тобындағы оқушылар да негізгі тарихи мәліметтерді меңгергенімен, олардың жауаптары көбіне репродуктивті сипатта болды. Яғни, оқушылар дайын ақпаратты қайталауға бейім болып, тарихи құбылыстарды терең талдауға сирек барды. Бұл жағдай дәстүрлі оқыту әдістерінің ақпарат жеткізуде тиімді болғанымен, оқушылардың жоғары деңгейдегі ойлау дағдыларын дамытуда шектеулі екенін көрсетті.

Талқылау барысында жасанды интеллект технологияларын қолдану оқушылардың оқу мотивациясын арттырып қана қоймай, олардың тарихи санасының қалыптасуына оң әсер еткені анықталды. Эксперименттік топтағы оқушылар Семей полигоны мәселесін тек өткеннің бір кезеңі ретінде емес, қазіргі қоғам үшін де маңызы бар тарихи сабақ ретінде қабылдай бастады. Бұл олардың азаматтық ұстанымы мен гуманистік құндылықтарының дамуына ықпал етті.

Аралық және қорытынды кезең нәтижелері төмендегідей қорытындыларды берді:

1. Эксперименттік топта оқушылардың 86%-ы ЖИ мүмкіншіліктерін дұрыс қолданып, оқиғаларды логикалық-терминдік тізбекте көрсете алды (бақылау тобында – 63%) (сүрет – 4);



Сурет 4 – Зерттеу кезеңнің нәтижесі

1. Оқушылардың сабаққа қызығушылығы сауалнама арқылы өлшенгенде, эксперименттік топта жоғары деңгейі байқалды – 92% оқушы ЖИ сабаққа қызығушылығын арттырғанын көрсетті (сурет – 5);



Сурет 5 – Негізгі кезеңде ЖИ қолдану барысындағы оқушылардың қызығушылығының көрсеткіші

Сонымен қатар, зерттеу нәтижелері ЖИ технологияларын қолданудың мұғалімнің жетекші рөлін әлсіретпейтінін, керісінше, оны жаңа деңгейге көтеретінін көрсетті. Мұғалім оқыту үдерісін ұйымдастырушы және бағыттаушы ретінде маңызды рөл атқарып, ал жасанды интеллект көмекші құрал қызметін атқарды. Осылайша, зерттеу нәтижелері тарих сабағында

Семей ядролық сынақ полигонының тарихын оқытуда жасанды интеллектті қолдану тиімді әрі болашағы зор бағыт екенін дәлелдейді.

Қорытынды. Жүргізілген зерттеу тарих сабағында Семей ядролық сынақ полигонының тарихын оқытуда жасанды интеллект технологияларын қолдану білім беру үдерісінің тиімділігін арттыратынын көрсетті. Эксперименттік және бақылау топтарының нәтижелерін салыстыру ЖИ негізіндегі әдістерді пайдаланған жағдайда оқушылардың оқу мотивациясы жоғарылап, тарихи деректерді талдау, себеп-салдарлық байланыстарды анықтау және өз көзқарасын дәлелдеу дағдыларының айқын дамығанын дәлелдеді. Бұл жасанды интеллекттің тарих пәнін оқытуда заманауи педагогикалық құрал ретінде маңызын айқындайды.

Зерттеу барысында жасанды интеллект платформалары тарихи ақпаратты жүйелеуге, күрделі деректерді визуализациялауға және оқушылардың жеке оқу ерекшеліктерін ескеруге мүмкіндік бергені анықталды. Семей полигоны сияқты әлеуметтік-экологиялық тұрғыдан күрделі тақырыпты оқытуда ЖИ құралдары оқушылардың тарихи санасын қалыптастыруға, азаматтық жауапкершілігін арттыруға және гуманистік құндылықтарды түсінуге ықпал етті. Сонымен қатар, ЖИ қолдану тарих сабағын интерактивті әрі мазмұнды етіп, оқушыларды белсенді оқу үдерісіне тартуға жағдай жасады.

Сонымен бірге, зерттеу нәтижелері жасанды интеллектті қолдану барысында тарихи шындықты сақтау, дереккөздердің сенімділігін қамтамасыз ету және этикалық қағидаттарды ұстану қажеттігін көрсетті. Бұл тұрғыда мұғалімнің кәсіби рөлі шешуші мәнге ие болып, жасанды интеллект көмекші құрал ретінде тиімді пайдаланылуы тиіс. Жалпы алғанда, тарих сабағында Семей ядролық сынақ полигонының тарихын оқытуда жасанды интеллект технологияларын қолдану оқытудың сапасын арттыратын, оқушылардың тарихи білімін тереңдететін және заманауи білім беру талаптарына жауап беретін тиімді бағыт болып табылады.

ПАЙДАЛАНЫЛҒАН ӘДЕБИЕТТЕР ТІЗІМІ

1. Назарбаев Н. Ә. Ғасырлар тоғысында. – Алматы : Өнер, 1996. – 272 б.
2. Қозыбаев М. Қ. Тарих және тағдыр. – Алматы : Жалын, 1997. – 344 б.
3. Әбіл Е. А. Қазақстанның ядролық қарусыздану саясаты. – Астана : Елорда, 2011. – 256 б.
4. Нұрпейісов К. Н. Қазақстан тарихы (XX ғасыр). – Алматы : Атамұра, 2010. – 312 б.
5. Laumulin M. The Semipalatinsk Nuclear Test Site: Legacy and Challenges. – Almaty : Kazakhstan Institute for Strategic Studies, 2015. – 198 p.
6. Holloway D. Stalin and the Bomb: The Soviet Union and Atomic Energy, 1939–1956. – New Haven : Yale University Press, 1994. – 475 p.
7. UNESCO. Education in the Digital Age: Artificial Intelligence and Learning. – Paris : UNESCO Publishing, 2020. – 186 p.
8. Holmes W., Bialik M., Fadel C. Artificial Intelligence in Education: Promises and Implications for Teaching and Learning. – Boston : Center for Curriculum Redesign, 2019. – 210 p.
9. Тәжібаева Ш. С. Тарихты оқытудың заманауи технологиялары. – Алматы : Қазақ университеті, 2018. – 220 б.
10. Сейітов З. С. Семей ядролық полигоны: тарихы мен тағдыры. – Семей : Таным, 2009. – 184 б.

Political Studies

The role of small and medium-sized states in the new world order: the example of Azerbaijan

Gülgün Mübariz Quliyeva

SEFD, Department of "Diplomacy and Processesmodern integration "Baku State University. Azerbaijan. ORCID 0009-0003-9754-3588

Abstract

Against the backdrop of the transformation of the global system, the role of small and medium-sized states is increasingly increasing. Despite their limited resources, these states can become important actors in international relations through smart diplomacy, regional cooperation and soft power. The Republic of Azerbaijan, with its geographical location, energy potential and multifaceted foreign policy, demonstrates exemplary experience in this area. This article examines the geopolitical and diplomatic role of small and medium-sized states based on the example of Azerbaijan against the background of the main trends of the new world order. In the contemporary international relations system, the formation of a new world order is accompanied by the growing role of small and medium-sized states. In geopolitical spaces where the interests of global powers collide, such states act as balancers, mediators, and guarantors of regional stability. The Republic of Azerbaijan serves as a remarkable example in this context. Owing to its strategic geographical position, energy resources, and multi-vector diplomacy, Azerbaijan plays the role of a bridge between regional and global powers. Its foreign policy is based on balanced approaches, multilateral cooperation, and active participation in international organizations. These features have transformed Azerbaijan into a key actor not only in the South Caucasus but also across the broader Eurasian space. This article analyzes the increasing significance of small and medium-sized states in the new world order, examines Azerbaijan's role and strategic functions, and explores future challenges and perspectives.

Keywords: new world order, small states, Azerbaijan, diplomacy, geopolitics, multipolarity

The new world order is characterized by the shift in global balances of power, the emergence of regional cooperation and multilateral diplomacy. Small and medium-sized states use flexible and balanced policy strategies to protect their national interests and increase their influence in global politics. In this regard, the Republic of Azerbaijan successfully implements the CSD function, expanding its regional and global influence through energy, transit, diplomacy and soft power tools [3]. In recent years, changes in the international system have led to a shift to a multipolar and more uncertain level of world politics, including the relative decline in US dominance, the rise of new power centers such as China and India, and the activation of Russia and other regional actors. In such circumstances, the role of small and medium-sized states (CSD) is becoming more dynamic and flexible. These states are able to occupy an important position in international relations by being located in geoeconomic transition zones, using resources efficiently and pursuing a flexible foreign policy. The activities of the Republic of Azerbaijan are an interesting example in this regard.

Since the beginning of the 21st century, the system of international relations has entered a stage of deep transformation. The unipolar order formed with the end of the Cold War has lost its effectiveness over time, and multipolar tendencies in global politics have begun to strengthen. Against the backdrop of competition between the United States, Russia, China, the European Union and other great powers, regional organizations and states with the status of a middle power have become important players in shaping the international agenda. In this new environment, the role of small and medium-sized states is not limited to being passive observers, but on the contrary, they are demonstrating balancing and proactive positions in global geopolitical processes.

The growing importance of small and medium-sized states in the modern world order can be explained by a number of factors. First of all, geopolitical position, access to energy and natural resources, transit and communication networks increase the weight of these states in international politics. Secondly, in an environment of competition between global powers, small and medium-sized states, in addition to protecting their interests through multi-vector diplomacy, also play the role of guarantors of regional stability.

The Republic of Azerbaijan deserves special attention in this regard. Located in the geostrategic center of the South Caucasus, Azerbaijan serves as a bridge between East and West, as well as North and South. Thanks to its energy resources, participation in international transport corridors, and multilateral diplomacy, Azerbaijan represents an exemplary model of small and medium-sized states in the new world order. Its foreign policy course is based on a balanced approach, adherence to international law, and the development of regional cooperation.

The purpose of this article is to examine the role of small and medium-sized states in the new world order in theoretical and practical aspects, and to analyze the geopolitical, economic, and diplomatic capabilities of these states based on the example of Azerbaijan. The study will also consider the challenges and prospects faced by Azerbaijan

Relevance of the topic. The process of forming a new world order in global politics makes the growing role of small and medium-sized states in international relations particularly relevant. If in the second half of the 20th century, the influence of great powers dominated world politics, in the 21st century the activity of small and medium-sized states in issues of international security, energy supply, development of transport and logistics networks and regional cooperation has increased significantly.

In the modern era, the change in the balance between global powers, the strengthening of the multipolar order and the increasing role of regional organizations make small and medium-sized states an important actor in the system of international relations. Such states act as both mediators and dialogue platforms, as well as providers of energy and transport corridors.

The example of Azerbaijan is of particular importance in this context. As a place where geopolitical interests clash in the region, Azerbaijan's balanced and pragmatic policy in the South Caucasus serves both to maintain internal stability and to strengthen its international image. On the one hand, Azerbaijan contributes to Europe's energy security by ensuring the safe export of energy resources to world markets, and on the other hand, it stands at the center of East-West and North-South transit routes through its participation in strategic projects such as the "One Belt, One Road" initiative and the Zangezur corridor.

At the same time, thanks to its independent foreign policy course, Azerbaijan is trying to maintain a balanced approach in its relations with global powers, the United States, Russia, China, Turkey and the European Union. This proves that small and medium-sized states can be not only geopolitical objects, but also geopolitical subjects in the new world order.

The relevance of the topic also lies in the fact that in modern conditions, the future development of international relations is closely related to the initiatives of small and medium-

sized states and their role in regional stability. In this regard, the example of Azerbaijan provides rich material for theoretical generalizations and practical conclusions.

Research goals and objectives. The main goal of this research is to analyze the growing role of small and medium-sized states in the new world order on a theoretical and practical level, to determine their functions and strategic capabilities in the system of international relations based on the example of Azerbaijan. To achieve the goal, the following tasks are envisaged:

1. Study of theoretical foundations, interpretation of the position of small and medium-sized states in theories of international relations, analysis of their historical and modern functions in the international system.
2. Determination of the characteristics of the new world order, explanation of the characteristics of the new political order in the context of changing the balance between global powers, strengthening multipolarity and increasing the role of regional actors.
3. Analysis of the strategic capabilities of small and medium-sized states, investigation of their role in the field of energy security, transport-logistics corridors, regional stability and diplomatic mediation.
4. Studying Azerbaijan as an example, determination of the role of Azerbaijan in international relations based on its geopolitical position, energy resources, transit functions and multilateral diplomacy.
5. Assessment of challenges and prospects Analysis of the risks, threats and development opportunities faced by Azerbaijan and small and medium-sized states in general.

Thus, the study aims to contribute to the scientific debate on the role of small and medium-sized states in international relations both from a theoretical perspective and from a practical perspective, demonstrating the growing importance of Azerbaijan in the new world order

Research methodology. In this study, the role of small and medium-sized states in the new world order is analyzed with a comprehensive approach based on the example of Azerbaijan. The methodological basis of the study is international relations theories, in particular realism, liberalism and constructivism. Realism allows us to explain the search for balance in the security policy of small and medium-sized states; liberalism creates conditions for examining their activity through multilateral cooperation and international organizations; constructivism allows us to pay attention to the international image and identity policy of states such as Azerbaijan.

The following methods were used in the study:

1. Analytical-methodological approach - theoretical analysis of the processes taking place in the system of international relations and their application to the example of Azerbaijan.
2. Historical-comparative method - comparison of the position of small and medium-sized states in the international system in different periods and tracking of changes in the modern era.
3. Geopolitical analysis - investigation of the strategic importance of the South Caucasus region, where Azerbaijan is located, and the role of energy and transport corridors in international politics.
4. Document and source analysis - analysis of documents of international organizations, official state strategies, academic sources and expert opinions.
5. Scenario approach - identification of prospects and challenges that Azerbaijan and other small states may face in the world order.

New world order and the growing role of small states. The transformation of the global order is already an undeniable fact in the modern system of international relations. In the post-Cold War period, in parallel with the weakening of the unipolar system based on the hegemony of the United States, a process of transition to a multipolar world order is observed. Along with the increasing activity of China, Russia, the European Union, India and other rising powers in international politics, it is noticeable that regional actors and small states also occupy a more influential position on the international agenda [18].

Theoretical approaches to the role of small and medium-sized states. The position of small states is explained in various ways within the framework of international relations theories. According to realism, small states mainly exist in the sphere of influence of great powers and their main goal is to ensure their national security [12]. Liberalism emphasizes that small states strengthen their position in the global system through international organizations, multilateral cooperation, and economic integration. According to the constructivist approach, small states can have a certain influence in the global arena by forming their international identities [17].

Opportunities of small and medium-sized states in the new world order

The increasing role of small and medium-sized states is due to a number of factors:

Geostrategic position: States located on major communication and energy lines play an important role in the intersection of interests of global powers.

Energy and natural resources: States possessing oil, gas and other strategic resources act as important actors in international energy security.

Diplomatic mediation: Maintaining the balance of interests between great powers and acting as mediators in resolving conflicts increases the prestige of small states.

Developing multilateral diplomacy: Within the framework of the UN, OSCE, Non-Aligned Movement and other organizations, the positions of small states based on international law are increasingly accepted.

The balancing function of small states in the competition of global powers. In the new world order, the competition between global powers is becoming increasingly acute. The strategic competition between the US and China, the tension in relations between Russia and the West, and the clash of interests in the Middle East and the South Caucasus force small and medium-sized states to take balancing positions. The most important challenge for these states is to pursue a multi-vector policy, while protecting their national interests, and not to choose between global powers.

Thus, in the new world order, small and medium-sized states are not just objects subject to the policies of great powers, as before, but act as subjects of international relations due to their national resources, geographical position and diplomatic activity. The example of Azerbaijan: geopolitical position and strategic importance

The Republic of Azerbaijan is one of the important examples that embodies the growing role of small and medium-sized states in the new world order. Located in the center of the South Caucasus, Azerbaijan has served as a bridge between East and West, North and South, both historically and in modern times. Its geopolitical position is of strategic importance in the context of regional security, energy policy and the interests of global powers.

The strategic essence of the geopolitical position. In addition to being located in the Caspian Sea basin, Azerbaijan is located in the geopolitical center of the South Caucasus. This position creates opportunities for strategic cooperation with regional powers such as Russia, Iran and Turkey, as well as global actors such as the European Union and the United States. Since the territory of Azerbaijan is located at the intersection of the "East-West" and "North-South" transport corridors, the country has become a key link in international trade and logistics networks [10].

Energy resources and energy diplomacy. Azerbaijan has rich oil and gas reserves. After the "Contract of the Century" (1994), the country's energy policy has begun to play an important role in global energy security. The Baku-Tbilisi-Ceyhan oil pipeline, the Baku-Tbilisi-Erzurum gas pipeline, and the Southern Gas Corridor have enabled Azerbaijan to export its energy resources to Europe and the world market. These projects have both accelerated Azerbaijan's economic development and made it an important provider of Europe's energy security [2].

Azerbaijan is located in the center of the South Caucasus, at the intersection of the East-West and North-South transit corridors. The Baku-Tbilisi-Ceyhan oil pipeline, the Baku-Tbilisi-Erzurum gas pipeline, and the Southern Gas Corridor strengthen the country's energy diplomacy [5].

Transport and transit functions. Azerbaijan is not only an exporter of energy resources, but also an important participant in international transit networks. Projects such as the Baku-Tbilisi-Kars railway, the "One Belt, One Road" initiative, and the Zangezur corridor expand Azerbaijan's transport and logistics capabilities. This creates conditions for the country to play an important role in regional and global economic processes.

Through the Baku-Tbilisi-Kars railway and the Zangezur corridor, Azerbaijan performs the function of a regional CENTRAL COUNTRY in terms of both energy and economic transit. This turns the country into a strategic transit center and increases its participation in global trade networks

Diplomatic activity and position in international organizations. Azerbaijan's foreign policy is based on a balanced multi-vector approach. The country actively participates in the UN, OSCE, Non-Aligned Movement, Organization of Islamic Cooperation, Organization of Turkic States and other international organizations. In particular, the chairmanship of the Non-Aligned Movement in 2019–2023 has increased Azerbaijan's international prestige and demonstrated the opportunities for small and medium-sized states to influence the global agenda through international organizations [6]. Azerbaijan actively participates in international platforms such as the UN, OSCE, Non-Aligned Movement and Organization of Turkic States. This increases its role in international politics such as the CENTRAL COUNTRY [7].

Role in regional security. Azerbaijan not only performs the function of a CSD, but also acts as a strategic actor.

Energy and transit resources: Azerbaijan plays an important role in global energy security.

Regional security: The Karabakh issue and active participation in regional stability strengthen its role as a strategic actor.

Multilateral diplomacy and soft power: Activity in international forums, cultural and humanitarian diplomacy increase Azerbaijan's influence.

Azerbaijan acts as an important actor in ensuring security and stability in the South Caucasus. The events that took place in 2020 and 2023, in addition to restoring the country's territorial integrity, have also created new realities in the regional balance of power. This reality has further strengthened Azerbaijan's strategic position both regionally and internationally. Thus, Azerbaijan is one of the most striking examples of the growing role of small and medium-sized states in the new world order. Its geopolitical position, energy resources, transit opportunities and diplomatic activity have made the country an important actor in the regional and global system.

A balanced approach and multilateral cooperation in Azerbaijan's foreign policy. Azerbaijan's foreign policy is based on a multifaceted and balanced approach:

Regional and global cooperation: Relations with the United States, China, Russia and the European Union are built in accordance with national interests.

Activity in multilateral platforms: Participation in the UN, the Non-Aligned Movement and the Turkic States Organization.

Balanced approach: Protection of national interests without biased choices.

This policy strengthens the role of Azerbaijan as a CSD and ensures regional stability. The successful existence of small and medium-sized states in the modern system of international relations is largely determined by the flexibility and pragmatism of their diplomatic strategies. In this regard, the foreign policy of the Republic of Azerbaijan is often mentioned in international relations theories as an example of "balancing" and "multi-vector diplomacy" [1].

Basis of the balance policy. In terms of its geopolitical location, Azerbaijan is located in a strategic area where the interests of major powers such as Russia, Iran, Turkey, the United States and the European Union collide. For this reason, balancing plays an important role in the country's

foreign policy to protect national interests. On the one hand, Azerbaijan cooperates with Russia in the field of energy and security, on the other hand, it establishes a strategic partnership with the European Union, and at the same time continues its security and energy dialogue with the United States. This approach allows the country to establish multifaceted relations without choosing between major powers.

Development of multilateral cooperation. One of the main pillars of Azerbaijan's foreign policy is multilateral cooperation. The country is distinguished by its active position in international organizations. Azerbaijan:

Contributed to making the voices of small and medium-sized states heard on the international stage by chairing the Non-Aligned Movement in 2019–2023;

Promoted the economic, political and cultural integration of Turkic states by playing a central role in the Organization of Turkic States;

Defended its position based on international law within the framework of the UN and the OSCE;

It has actively participated in strengthening solidarity in the Organization of Islamic Cooperation.

Energy and transport diplomacy. Azerbaijan implements multilateral cooperation not only in the political sphere, but also in the economic and energy spheres. The Southern Gas Corridor project has not only strengthened the energy security of European countries, but also increased Azerbaijan's international prestige. The Baku-Tbilisi-Kars railway and the Baku International Sea Trade Port have ensured Azerbaijan's transformation into a transit center.

Humanitarian and cultural diplomacy. Azerbaijan is also active in the field of intercultural dialogue and humanitarian cooperation. The Baku Process, the World Forum for Intercultural Dialogue and various international events have strengthened the country's image as a "bridge between civilizations". This approach is an indicator of the ability of small and medium-sized states to increase their influence through "soft power" in the international arena. Thus, Azerbaijan's foreign policy is based on a pragmatic and balanced approach, while multi-vector diplomacy increases the country's prestige both regionally and globally, presenting it as a successful model for small and medium-sized states.

Resolution of the Karabakh issue and regional impact. The military operations that took place in 2020 and the trilateral statement of November 10, 2020 restored the territorial integrity of Azerbaijan. This has created strategic results such as:

Change in the regional balance of power and strengthening of the strategic position;

Promotion of cross-border economic cooperation;

Increased international prestige and demonstration of the COD function;

Strengthening the security environment.

Soft power and increasing international prestige

Azerbaijan implements soft power through various means:

1 COP29 and international events. Hosting international events, including COP29, presents Azerbaijan as an active actor in global affairs.

2 Intercultural dialogue forums. Through forums, Azerbaijan is recognized as a tolerant and multicultural country, expanding its diplomatic influence.

3 Islamic Solidarity Games and European Games. Hosting major sports events increases international prestige by demonstrating national culture and hospitality.

4 Humanitarian and educational initiatives. Student exchanges, humanitarian projects and international cooperation programs strengthen Azerbaijan's role as a COD.

Challenges and prospects facing Azerbaijan. Although Azerbaijan is a successful example demonstrating the role of small and medium-sized states in the new world order, it faces a number

of challenges both regionally and globally. These challenges affect both foreign policy strategy, economic and energy sectors, and regional security.

Key challenges facing

1. Regional security issues: Historical border conflicts in the South Caucasus region, Armenian-Azerbaijani conflicts and geopolitical interests of neighboring states pose potential risks to Azerbaijan's stability.
2. Maintaining a balance between global powers: Opportunities for cooperation with the US, Russia, China and the European Union should be in Azerbaijan's interests. However, competition and geopolitical clashes between global powers sometimes make it difficult to implement a balanced policy.
3. Energy and transit risks: Azerbaijan participates in strategic projects in energy exports. However, instability in energy prices, security of transit routes and opening up new energy projects to competition are potential challenges.
4. Sustainability of economic and social development: Political and economic stability in the region is a key condition for ensuring the socio-economic development of the country. Global economic crises and regional instability may create additional pressures on Azerbaijan.

Perspectives

Azerbaijan pursues a flexible and pragmatic policy towards these challenges. Strategic perspectives include the following areas:

Multilateral diplomacy and regional cooperation: Azerbaijan's voice is being more widely reflected on the global stage through the Non-Aligned Movement, the Turkic States Organization, the UN and other international platforms.

Expansion of energy and transport projects: Projects such as the Southern Gas Corridor, the Baku-Tbilisi-Kars railway and the Zangezur corridor strengthen regional integration and economic importance.

"Soft power" diplomacy: Intercultural dialogue, humanitarian initiatives and activity in international forums strengthen Azerbaijan's international image.

Strengthening national security: Strategies in the field of defense and security, as well as regional security cooperation, increase Azerbaijan's stability and prestige.

Thus, Azerbaijan successfully manages the challenges faced by small and medium-sized states, and continues to increase its influence at the regional and global levels by expanding its prospects through its strategic position and multilateral diplomacy.

1. Major changes in the new world order and the growing role of CSDs

The new world order refers to the following trends in the system of international relations:

The increase in non-traditional threats (climate change, pandemics, cyber threats, etc.),

The diversification of power centers and the activation of regional powers,

Weakening of faith in the universality of international law,

The actualization of multi-vector diplomacy.

In this environment, small and medium-sized states strengthen their positions in the following ways:

Creating mediation and dialogue platforms,

Using the advantages of location on energy and transport corridors,

Taking active diplomatic initiatives in global and regional organizations.

Major changes in the new world order and the growing role of CSDs. Since the second decade of the 21st century, the system of international relations has been undergoing significant transformations. The unipolar system that emerged after the end of the Cold War has weakened, and the transition to a multipolar and dynamic global order has accelerated [12]. This transformation is characterized by the following key changes:

Shifting balance of global powers: While the hegemony of the United States still exists to some extent, the rising role of China, Russia, India, and the European Union requires a new balance in international politics.

2. Increasing influence of regional actors and SNCs: Regional powers and small and medium-sized states (SMSs) are able to influence the international agenda by participating in global and regional projects. They play an important role in managing energy and transit corridors, ensuring regional security, and multilateral diplomacy [16].

3. Accelerating technological and economic global integration: Information technologies, the digital economy, and the expansion of global trade networks create new opportunities for SMSs in international politics. Small and medium-sized states can protect their national interests and increase their global influence through diplomatic agility and multilateral cooperation.

4. The rise of multi-vector diplomacy: SMSs, without choosing between global powers, take balancing positions at both the regional and global levels by applying multi-vector diplomacy. This approach allows them to protect both their security and economic interests.

5. The strategic importance of energy and transport projects: SNCs can influence global politics through energy resources and transit projects. In the case of Azerbaijan, this is manifested in projects such as the Southern Gas Corridor, the Baku-Tbilisi-Ceyhan oil pipeline, and the Baku-Tbilisi-Kars railway.

Thus, fundamental changes in the new world order have led to an increase in the role of small and medium-sized states. SNCs act as a balancer in regional stability, initiators through multilateral diplomacy, and active actors in global projects. This trend further strengthens the role of Azerbaijan as an exemplary model in international politics.

The case of Azerbaijan: The growing role as a SNC. The Republic of Azerbaijan is a vivid example of the growing role of small and medium-sized states (SMS) in the new world order. Its geopolitical position, energy resources, transit corridors, and multilateral diplomatic activity make the country an influential actor in regional and global politics.

Strategic importance of geopolitical position. Azerbaijan is located in the center of the South Caucasus, at the intersection of East-West and North-South transit corridors. This position expands the country's opportunities for cooperation with regional powers and creates favorable conditions for participation in global projects [15].

Energy diplomacy and economic influence. Azerbaijan has rich oil and gas resources. The Baku-Tbilisi-Ceyhan oil pipeline, the Baku-Tbilisi-Erzurum gas pipeline, and the Southern Gas Corridor strengthen the country's energy diplomacy. These projects contribute to Europe's energy security and increase Azerbaijan's economic and political influence [14].

Transit and transport functions. Azerbaijan performs the function of a regional COD in both energy and transport transit. The Baku-Tbilisi-Kars railway, the Zangezur corridor, and the "One Belt, One Road" initiative turn the country into a strategic transit center. This increases Azerbaijan's influence in global trade and logistics networks.

Multilateral diplomacy and international influence. Azerbaijan's foreign policy is based on a multi-vector and balanced approach. The country actively participates in platforms such as the UN, OSCE, the Non-Aligned Movement and the Turkic States Organization. Especially during its chairmanship of the Non-Aligned Movement, Azerbaijan has effectively demonstrated the role of small and medium-sized states in international politics.

The role of NAM in regional security. Azerbaijan's defense and security strategies are aimed at maintaining stability in the region. The events that took place in 2020 and 2023 showed that NAMs are not only diplomatic mediators, but also play an active role in maintaining the balance of power in the region. Thus, the example of Azerbaijan shows that small and medium-sized states can influence regional and global politics as NAMs in the new world order. Its energy,

transit and diplomatic capabilities further strengthen the role of NAM by increasing its influence on the international agenda.

Challenges and prospects facing Azerbaijan (in the context of NAM). Small and medium-sized states (NAMs) are playing an increasing role in the new world order, and Azerbaijan is a vivid embodiment of this example. However, Azerbaijan, playing an active role as NAM, faces a number of challenges.

Key Challenges

1. Regional Security and Geopolitical Risks:

The Armenian-Azerbaijani conflict in the South Caucasus region, border issues, and geopolitical interests of neighboring states affect Azerbaijan's stability. As a CSTO, Azerbaijan seeks to maintain regional balance through both diplomatic and military means.

2. Maintaining a balance between global powers:

Cooperation opportunities with the US, China, Russia, and the European Union must coincide with the country's national interests. As a CSTO, Azerbaijan's diplomatic flexibility and multi-vector policy play a crucial role in maintaining this balance.

3. Energy and transit security risks:

Azerbaijan's strategic projects – the Southern Gas Corridor, the Baku-Tbilisi-Ceyhan oil pipeline, the Baku-Tbilisi-Kars railway – are of critical importance in terms of global energy and transport security. However, price fluctuations, geopolitical pressures, and infrastructure risks pose key challenges for Azerbaijan as a CSTO.

4. Sustainability of economic and social development:

Global economic crises and regional instability can complicate Azerbaijan's socio-economic policy. Sustainable development, investment and strategic economic planning are essential to maintain the CSD function.

Promising opportunities

1. Multilateral diplomacy and activity in international platforms:

Azerbaijan's activity within the Non-Aligned Movement, the Turkic States Organization and the UN increases its international prestige as a CSD and strengthens its influence on the global agenda.

2. Expansion of energy and transit projects:

Projects such as the Southern Gas Corridor and the Baku-Tbilisi-Kars railway strengthen Azerbaijan's regional and global economic integration and enhance its role as a CSD.

3. Soft power diplomacy:

Intercultural dialogue, humanitarian initiatives and activity in international forums strengthen Azerbaijan's image. This means expanding the CSD function through soft power.

4. National security and defense strategies:

Azerbaijan is strengthening its defense and security strategies to maintain its position as a CSD. This ensures both regional stability and increases the country's international prestige.

Thus, in the context of the COD, Azerbaijan is both struggling with challenges and effectively realizing its prospective opportunities, strengthening its role as an influential actor in regional and global politics.

Azerbaijan: A strategic actor in the new world order. The new world order creates not only balanced diplomatic opportunities for small and medium-sized states, but also favorable conditions for acting as strategic actors. The Republic of Azerbaijan is recognized as a strategic actor in regional and global politics in this context. Its geopolitical position, the strategic importance of energy resources, transit and transport infrastructure, as well as multilateral diplomacy, strengthen this status.

Key components of the strategic position

1. Geopolitical and regional position:

Azerbaijan is located in the center of the South Caucasus, at the intersection of the East-West and North-South corridors. This position expands the country's opportunities for cooperation with regional powers and gives it an advantage for participation in strategic projects.

2. Energy and transit resources:

Azerbaijan acts as an important actor in global energy security through its rich oil and gas resources, as well as strategic transit corridors. The Baku-Tbilisi-Ceyhan, Southern Gas Corridor and Baku-Tbilisi-Kars railway projects strengthen Azerbaijan's position as a strategic actor.

3. Multilateral and balanced diplomacy:

Azerbaijan's foreign policy strategy is based on a multi-vector approach. By actively participating in the UN, OSCE, Non-Aligned Movement, Organization of Turkic States and other international platforms, the country both protects its national interests and increases its regional and global influence.

4. Security and defense strategies:

Azerbaijan's national security and defense policy strengthens its position as a strategic actor. The events of 2020 and 2023 have shown that the country plays an active role in the regional balance of power and effectively fulfills the function of a SNC (small and medium-sized state).

5. Soft power and humanitarian diplomacy:

Intercultural dialogue, humanitarian initiatives, and activity in international forums enhance Azerbaijan's international image and expand its influence as a strategic actor.

The importance of the status of a strategic actor.

Azerbaijan's position as a strategic actor creates a number of advantages:

Playing an initiative role in regional and global politics;

Influencing the international agenda through energy and transit resources;

Protecting national interests through multilateral diplomacy;

Contributing to regional stability and security;

Increasing international prestige through "soft power".

Thus, Azerbaijan, as a SNC, not only demonstrates the role of small and medium-sized states, but also acts as a strategic actor in the new world order by effectively using energy, diplomacy, and security capabilities. Azerbaijan's geographical location and resource potential create conditions for it to become an active actor in the region and on a broader scale:

Goeconomic position: Azerbaijan plays the role of a transit hub between Europe and Asia. The Baku-Tbilisi-Kars railway and the Middle Corridor initiatives are important links in the Eurasian logistics system.

Energy security: Azerbaijan offers an alternative source of energy supply to Europe through the "Southern Gas Corridor". This increases its geopolitical importance.

Cultural and religious diversity: Azerbaijan is known as an initiator of intercultural and interreligious dialogue.

3. Multifaceted and balanced foreign policy. In the new world order, small and medium-sized states (SMS) use flexible and multilateral diplomacy strategies to protect their national interests and increase their influence in regional and world politics. The Republic of Azerbaijan is a shining example in this regard, as the country's foreign policy is based on both a multifaceted and balanced approach.

Basic principles of multifaceted foreign policy

1. Regional and global cooperation:

Azerbaijan cooperates with both neighboring states and global powers. Relations with Russia, Turkey, Iran, the United States and the European Union are built in accordance with

national interests. This approach creates conditions for the country's participation in strategic projects and expansion of regional influence.

2. Activity in multilateral platforms:

Azerbaijan actively participates in international organizations such as the UN, OSCE, Non-Aligned Movement and the Turkic States Organization. Especially during its chairmanship of the Non-Aligned Movement, the country demonstrated the role of small and medium-sized states in international politics.

3. Balanced approach:

Azerbaijan cooperates with both sides, protecting its national interests, without choosing between global powers. Such a balanced policy provides both diplomatic flexibility and strengthens regional stability.

Strategic advantages of a multilateral policy.

Protection of national interests: Azerbaijan's interests in the fields of energy, transit and security are protected through multilateral diplomacy.

Regional stability: A balanced approach contributes to maintaining stable relations with neighboring states.

Increasing global influence: Activity in multilateral platforms strengthens Azerbaijan's international reputation.

Development of soft power: Intercultural dialogue, humanitarian initiatives and activity in international forums increase Azerbaijan's strategic influence.

A diversified and balanced foreign policy strengthens Azerbaijan's role as a CSD, allowing it to become an initiative actor in both regional and global politics. This strategy serves both to protect national interests and to increase international prestige.

By pursuing a multi-vector policy in international relations, Azerbaijan balances relations with various power centers:

Within the framework of its chairmanship of the Non-Aligned Movement (2019–2023), Azerbaijan's contribution to the protection of the principles of international justice and sovereignty has demonstrated the ability of small states to influence global dialogue.

Active participation in regional platforms such as the Organization of Turkic States, the Organization of Islamic Cooperation, and GUAM identifies Azerbaijan as a regional power oriented towards cooperation.

At the same time, the development of relations in various directions such as the European Union, NATO, Russia, Iran, and China demonstrates Azerbaijan's balance policy.

Resolution of the Karabakh issue and regional influence. Resolution of the Karabakh issue and regional influence. The resolution of the Karabakh issue is of strategic importance in Azerbaijan's international policy. This issue is not only related to national sovereignty and territorial integrity, but also determines its impact in the political, economic, and security context of the region.

Resolution of the Karabakh issue. As a result of the military operations between Azerbaijan and Armenia in the fall of 2020, Azerbaijan restored its territorial integrity. A fundamental resolution of the conflict in the region was ensured with the trilateral statement of November 10, 2020. This was a successful example of Azerbaijan's balanced and flexible diplomacy strategy as a SSM (small and medium-sized state) [8].

In the resolution process, Azerbaijan relied on the following diplomatic and strategic principles:

1. Multilateral diplomacy: balanced cooperation with Russia, Turkey and other regional actors;
2. Protection of international law principles: a position based on the UN Charter and other international documents;

3. Effective use of energy and transit opportunities: strengthening cooperation with regional partners through strategic projects.

Regional impacts

1. Geopolitical stability: The resolution of the Karabakh issue changed the balance of power in the South Caucasus and strengthened Azerbaijan's position as a regional power actor.
2. Cross-border economic cooperation: Regional economic integration is promoted through the Zangezur corridor and other transit projects. This serves the economic interests of both Azerbaijan and neighboring states.
3. Increased international influence: The resolution of the Karabakh issue demonstrated Azerbaijan's diplomatic flexibility and international influence opportunities as a SSM.
4. Strengthening the security environment: The resolution of the conflict and the deployment of peacekeeping forces ensured stability in the region, regulating the possibilities of action of other regional actors.

Strategic importance. The resolution of the Karabakh issue strengthened the role of Azerbaijan as a strategic actor in the new world order. This created conditions for ensuring regional stability, as well as for the effective realization of energy, transit and diplomatic opportunities. The restoration of Azerbaijan's territorial integrity and full restoration of sovereignty as a result of the Second Karabakh War in 2020 and the anti-terrorist measures in 2023:

Created a new balance of power in the region, demonstrated that Azerbaijan was able to effectively coordinate its military-political and diplomatic resources, and brought the country to the forefront of the peace and development agenda with reintegration and reconstruction initiatives in the post-conflict period. These events are an example of how small and medium-sized states can protect their national interests and create new realities.

5. Increasing soft power and international influence. In the new world order, military and economic power alone are not enough to expand the international influence of small and medium-sized states (SMS). In this regard, soft power cultural, humanitarian and diplomatic means of influence is of critical importance. The Republic of Azerbaijan also effectively uses soft power as a strategic tool in its policy.

Key components of soft power

1. Cultural diplomacy:

Azerbaijan's rich cultural heritage, national traditions and participation in international cultural events strengthen the country's image. Azerbaijan is known to a global audience through cultural festivals and exhibitions, international music and art projects.

2. Humanitarian and educational initiatives:

International humanitarian projects, educational programs and student exchange initiatives increase the country's international reputation and strengthen cooperation with other states. This strategy strengthens Azerbaijan's role as a CSO.

3. Activity in international forums:

Active participation in the UN, the Non-Aligned Movement, the Turkic States Organization and other international platforms brings the soft power components of Azerbaijani diplomacy to the fore. Here, Azerbaijan not only protects its national interests, but also expands its influence at the regional and global levels.

4. Influence through energy and economic diplomacy:

Using energy resources and transit projects as diplomatic tools, Azerbaijan increases both its economic and soft power. This expands the country's opportunities for both regional and global influence.

Strategic importance. Soft power expands Azerbaijan's international influence and strengthens its role as a CSD. Through these means: National image and prestige are enhanced;

Regional and global diplomatic relations are strengthened; The strategic importance of energy and transit projects is supported by diplomatic influence; Regional stability and multilateral cooperation are promoted. Thus, Azerbaijan effectively uses soft power as a strategic tool in protecting national interests, increasing international prestige, and strengthening its role as a CSD. Azerbaijan's use of soft power tools internationally has strengthened its global image:

Hosting international events like COP29. One of the important components of Azerbaijan's expansion of its international influence is hosting global-level events. Hosting events like COP29 (the United Nations Climate Change Conference) strengthens the country's soft power and increases its international prestige.

Key importance

1. Strengthening international image:

Events like COP29 demonstrate that Azerbaijan plays an active role in global issues and present the country as a flexible and reliable regional actor.

2. Promoting multilateral diplomacy:

Hosting international events makes Azerbaijan a center for dialogue and cooperation on global platforms. This strengthens the country's multilateral diplomacy capabilities.

3. Expanding soft power:

Through events like COP29, Azerbaijan demonstrates its cultural, hospitality, and environmental initiatives. This not only increases the country's international prestige, but also strengthens its influence as a strategic actor in regional and global politics.

4. Protection of national interests:

Hosting international events creates a platform for promoting Azerbaijan's environmental, energy and economic interests. This also strengthens the country's strategic position as a COP.

Strategic outcome. Hosting COP29 and other international events provides Azerbaijan with several strategic advantages:

Increasing regional and global diplomatic prestige;

Expanding multilateral cooperation and international networks;

Strengthening national image through soft power;

Bringing energy, economic and environmental interests to the global agenda.

Thus, hosting events such as COP29 expands Azerbaijan's international influence, strengthens its role as a COP and as a strategic actor.

Intercultural dialogue forums play an important role in increasing Azerbaijan's international prestige and strengthening its soft power policy. These forums provide the country with the opportunity to act as a regional and global actor on global platforms.

Key importance

1. Strengthening international image:

Intercultural dialogue forums promote Azerbaijan as a tolerant, multicultural and peace-loving country. This increases the country's international prestige and strengthens its role as a CSD.

2. Promotion of soft power:

Through the forums, Azerbaijan presents its cultural heritage, art and national traditions to an international audience. This expands its diplomatic influence and strengthens its position as a strategic actor in regional and global politics.

3. Multilateral cooperation:

Intercultural dialogue forums create a platform for cooperation with international state and non-state actors. This strengthens Azerbaijan's multilateral diplomacy capabilities and contributes to regional stability.

4. Promotion of national interests:

The projects and initiatives presented at the forums create an opportunity for Azerbaijan to promote its national interests, culture and diplomatic strategy. This also strengthens the country's role as a CSD.

Strategic Outcome

Intercultural dialogue forums provide several strategic advantages for Azerbaijan:

Increasing international influence and ensuring visibility on global platforms;

Effective application of soft power tools;

Expanding regional and global diplomatic relations;

Strengthening strategic influence by promoting national culture and values.

Thus, intercultural dialogue forums increase Azerbaijan's international influence, strengthen its role as a CSO and a strategic actor, and demonstrate the effectiveness of soft power policy.

With sports and cultural events such as the Islamic Solidarity Games and the European Games, Azerbaijan identifies itself as a tolerant and open country for global cooperation.

Sports diplomacy and hosting major international sports events play an important role in enhancing Azerbaijan's international reputation. In particular, the Islamic Solidarity Games (2017) and the European Games (2015) act as effective instruments of the country's soft power policy.

Key importance

1. Strengthening the international image:

Through these games, Azerbaijan is presented to the world as a tolerant, developed country that can successfully organize global sports events. This increases the country's international prestige and strengthens its role as a COD.

2. Expanding soft power:

Sports events allow the demonstration of national culture, hospitality and organizational skills. This expands the country's diplomatic influence and strengthens its position as a strategic actor in regional and global politics.

3. Multilateral cooperation:

The Islamic Solidarity Games and the European Games create a platform for cooperation with international state and non-state actors. This strengthens Azerbaijan's multilateral diplomacy capabilities and contributes to regional stability.

4. Promoting national interests:

Through the Games, Azerbaijan promotes its national symbols, culture and proactive role in international politics. This also strengthens the country's role as a COD.

Strategic outcome. The Islamic Solidarity Games and the European Games enhance Azerbaijan's international prestige, effectively implement its soft power policy, and expand its regional and global influence as a CSO. These events strengthen the country's strategic actor position, strengthen its national image, and strengthen international relations.

Conclusions and recommendations. The role of small and medium-sized states in the new world order continues to grow. The competitive environment of regional and global powers, the strategic importance of energy and transport corridors, as well as their activity in international organizations expand the influence of these states. The Republic of Azerbaijan is a shining example in this context. Its geopolitical position, energy resources, transit and transport opportunities, as well as multilateral and balanced diplomatic policy make the country an important actor in the region and the global system.

The following main conclusions were reached on the basis of the article:

1. The role of small and medium-sized states: In the new world order, they are not only objects within the sphere of influence of great powers, but also balancing and proactive subjects.

2. Strategic functions of Azerbaijan: Through energy exports, transit projects and regional diplomacy, Azerbaijan has become an important actor in both the South Caucasus and the Eurasian space.
3. Multilateral and balanced diplomacy: Azerbaijan's foreign policy strategy is aimed at protecting national interests in cooperation with global powers and ensuring regional stability.
4. Challenges ahead: Regional security, maintaining the balance between global powers, and energy-infrastructure risks require Azerbaijan's diplomatic agility.
5. Promising opportunities: Azerbaijan's influence can be further strengthened through multilateral cooperation, expansion of energy and transport projects, and humanitarian and cultural diplomacy.

Recommendations

It is important for Azerbaijan to maintain its foreign policy strategy and continue its multilateral and balanced approach. It is advisable to expand regional security cooperation projects and increase its activity in new multilateral platforms. It is recommended to strengthen sustainability and security measures in energy and transit projects, and strengthen its positions in the global energy market. More active implementation of the "soft power" strategy, intercultural dialogue, and humanitarian initiatives will contribute to strengthening Azerbaijan's image. Continuous research should be conducted to monitor and analyze Azerbaijan's successes and prospects at the academic and expert levels. Thus, the example of Azerbaijan shows that small and medium-sized states can play an active role in the new world order and, by effectively using their strategic positions, increase their opportunities for both regional and global influence. In the new world order, small and medium-sized states are no longer passive observers, but are agile and proactive actors that can contribute to regional and global politics. The example of Azerbaijan shows that the right geopolitical position, strategic use of energy and logistics resources, balanced foreign policy and soft power tools allow small states to play an active role in the international system. These factors give Azerbaijan an important position not only in regional stability, but also in shaping global dialogue.

References

1. Allison, R. (2022). *Russia, the West, and global order: Power shifts and small states' strategies*. International Affairs, 98(4), 975–993. <https://doi.org/10.1093/ia/iia089>
2. Cornell, S. E. (2011). *Azerbaijan since independence*. M.E. Sharpe.
3. Cornell, S. E. (2017). *Azerbaijan since independence*. Routledge.
4. Hunter, S. (2021). *The South Caucasus between Russia, Turkey, and Iran: Challenges and opportunities*. Caucasus Analytical Digest, 121, 2–6.
5. Hunter, S. (2021). *Security challenges in the South Caucasus*. Washington, DC: CSIS Press
6. Həsənov, F. (2021). *Azerbaijan in multilateral organizations: Opportunities and challenges*. Baku: Qanun Nəşriyyatı.
7. Ibrahimov, R. (2020). Azerbaijan's foreign policy in the changing international system. *Caucasus International Journal*, 10(1–2), 55–73.
8. Ibrahimov, R. (2020). *Diplomatic strategies of Azerbaijan in a multipolar world*. Baku: ADA University Press.
9. Ismayilov, M. & Papava, V. (2010). *A New Concept for the Caucasus*. *Caucasian Review of International Affairs*, 4(1), 34–41.
10. Ismayilov, T. (2022). *Azerbaijan's geopolitical significance in the South Caucasus*. Baku: Academy of Sciences.
11. Nye, J. S. (2004). *Soft Power: The Means to Success in World Politics*. Public Affairs
12. Nye, J. S. (2021). *Do morals matter? Presidents and foreign policy from FDR to Trump*. Oxford University Press.

13. Quliyev, F. (2023). Azərbaycanın xarici siyasətində balanslaşdırma strategiyası: Çağırışlar və imkanlar. *Azərbaycan Beynəlxalq Münasibətlər Jurnalı*, 15(2), 44–62.
14. Shiriyev, Z. (2022). Azerbaijan's strategic balancing: Between regional challenges and global opportunities. *Chatham House Research Paper*.
15. Shiriyev, Z. (2022). *Soft power and cultural diplomacy in Azerbaijan*. Baku: Center for Strategic Studies.
16. Vasquez, J. (2020). *The power of small states in the international system*. Palgrave Macmillan.
17. Vasquez, M. (2020). *Small states and international influence: Humanitarian and educational diplomacy*. New York: Springer.
18. Waltz, K. N. (1979). *Theory of International Politics*. McGraw-Hill
19. Əliyev, İ. (2022). Azərbaycanın qarşısında duran çağırışlar və perspektivlər. Bakı: Şərq-Qərb.
20. Əliyeva, L. (2021). Post-pandemiya dövründə Azərbaycanın sosial-iqtisadi inkişafı: perspektivlər və çağırışlar. *İqtisadiyyat və Cəmiyyət*, 4(36), 19–33.
21. Əliyeva, N. (2021). *Azərbaycanın sosial-iqtisadi inkişaf perspektivləri*. Bakı: Elm nəşriyyatı
22. Ministry of Foreign Affairs of Azerbaijan. (2023). *Azerbaijan's Chairmanship in the Non-Aligned Movement*. <https://mfa.gov.az>

Problems and Prospects of Developing Kazakhstan's Political Science at the Current Stage

V.A. Luzanov

Senior Lecturer, K.K. Kulazhanov Kazakh University of Technology and Business, Republic of Kazakhstan, Astana

N.G. Kabdii

Senior Lecturer, K.K. Kulazhanov Kazakh University of Technology and Business, Republic of Kazakhstan, Astana

A.M. Kenzhebulatova

Senior Lecturer, K.K. Kulazhanov Kazakh University of Technology and Business, Republic of Kazakhstan, Astana

Abstract

This article provides a critical analysis of the current state of political science in Kazakhstan amid ongoing political modernization and global challenges. It examines key issues hindering the full development of the discipline, including institutional constraints, methodological conservatism, dependence on state commissions, and insufficient integration into the global academic community. Simultaneously, the authors identify and analyze promising avenues for growth, related to strengthening academic freedom, diversifying research approaches (specifically, the development of empirical and quantitative methods), forming independent “think tanks,” and actively engaging in the study of new phenomena in Kazakh politics, such as the power transition, digitalization of governance, and civic participation. The conclusion emphasizes the necessity of comprehensive reforms aimed at improving the quality of education, stimulating independent research, and integrating Kazakh political scientists into the international scientific dialogue to ensure the relevance and predictive power of domestic political science.

Keywords: Kazakhstan political science, political modernization, academic freedom, methodology, state funding, think tanks, power transit, civil society, empirical research.

The development of political science in any country is closely linked to the nature and pace of political processes, as well as the level of institutionalization of academic freedom. For the Republic of Kazakhstan, which is undergoing a period of significant transformations associated with the declared “New Kazakhstan” program and the need to adapt to the changing global order, the role of political science as a discipline capable of critical reflection and prognostication increases manifold.

Kazakhstani political science has followed a difficult path since independence, gradually moving away from Marxist-Leninist dogmatism and adopting Western theoretical schools. However, at the current stage, characterized by a demand for profound analysis and independent expertise, the discipline faces a number of systemic problems that call into question its ability to effectively perform its functions. The goal of this article is to analyze key problematic areas and define realistic prospects for the development of Kazakhstani political science in the 21st century [3].

Despite the quantitative growth in the number of departments and specialists, political science in Kazakhstan has not yet achieved full institutional maturity and methodological autonomy.

One of the fundamental problems is the limited academic freedom and the high degree of dependence of research centers and individual scholars on state commissions. A significant portion of research is funded through grants from the Ministry of Science and Higher Education or through direct financing of analytical structures associated with government bodies [1].

This funding mechanism generates a "compliance effect": research is often geared toward confirming the official political line or developing recommendations that do not address sensitive aspects of the system. This limits critical analysis and impedes the development of alternative models of development. As a result, the analytical product often suffers from descriptiveness and normativity, losing its prognostic and critical power.

Table 1.

Comparative Analysis of Dominant Approaches in Kazakhstani Political Science

Characteristic	Dominant Approach (State Commission)	Desired Approach (Academic Independence)
Research Goal	Confirmation and justification of the government's course	Critical analysis and independent prognostication
Methodology	Normative, descriptive, institutional	Empirical, comparative, mixed methods
Data Sources	Official documents, expert assessments (close to the government)	Primary data, mass surveys, field research
Publication Activity	National journals, departmental reports	High-ranking international publications (Scopus, WoS)

Kazakhstani political science, largely retaining the traditions of the Soviet social science school, often demonstrates methodological conservatism. Qualitative, descriptive methods dominate, based on document analysis, expert interviews (often with a limited circle of informants), and theoretical generalization.

Empirical studies based on large-scale representative surveys, econometric analysis of political data, Social Network Analysis (SNA), and experimental methods are weakly developed. The lack of a strong quantitative data foundation and the skills to process them leads to many conclusions remaining at the level of hypotheses or intuitive assumptions, devoid of strict scientific substantiation [2]. This is particularly critical in the age of "big data" and digitalization, where the precise verification of hypotheses is becoming the standard of scientific rigor.

Despite the presence of talented young scholars, there is a gap between the older generation, often adhering to traditional approaches, and the youth familiar with international standards. Training programs for political scientists, especially at the Master's and Doctoral levels, do not always provide a deep immersion in modern theoretical debates (e.g., new institutionalism, political psychology, rational choice theory) and advanced research methods.

The low level of integration into the global academic community is manifested in the small number of publications by Kazakhstani political scientists in leading international journals indexed in Scopus and Web of Science (Q1/Q2). This limits the influence of domestic science on global

debates and deprives Kazakhstani researchers of the opportunity to receive critical feedback from foreign colleagues [4].

Contemporary political realities in Kazakhstan and the world set new tasks for political science that can serve as a catalyst for its development.

The events of January 2022 and the subsequent constitutional reforms (the transition from a super-presidential to a presidential-parliamentary form) have made the study of transition and institutional sustainability a key area.

Prospects:

1. Analysis of Political Elites: It is necessary to move away from superficial biographical studies toward a deep analysis of informal networks, mechanisms of co-optation, and elite recruitment, using SNA and political clustering theory.
2. Research on the Regional Dimension of Politics: Kazakhstani politics is often viewed as monolithic. Research is needed on regional differences in political culture, electoral behavior, and the effectiveness of local self-governance (akimats).
3. Evaluation of Reform Effectiveness: Not just description but rigorous empirical evaluation of the results of political reforms is required, including changes in the distribution of power between branches of government and the actual role of Parliament.

In the context of growing demand for civic participation and pluralism, the study of civil society and public opinion becomes critically important [9].

The problem is that most public opinion studies are conducted by structures affiliated with the state, which often raises doubts about their impartiality.

Prospects:

1. Development of Independent Public Opinion Centers: Creating academically independent, non-profit structures capable of conducting regular, transparent, and methodologically rigorous surveys on key political issues.
2. Study of Social Protests and Mobilization: Analysis of the causes, mechanisms, and consequences of protest actions (including the January events) using methods of political sociology and media analysis.
3. Research on Political Culture: Deep analysis of citizens' values, attitudes, and behavioral patterns affecting political participation and the perception of democratic institutions [8].

Digitalization is radically changing the political environment. Social networks have become the main arena for political debates, mobilization, and the dissemination of information (and disinformation).

Prospects:

1. Analysis of Online Political Discourse: Using methods of Text Mining and Machine Learning to study the tone, themes, and subjectivity of political discussions in the Kazakh segment of the internet.
2. Research on Cybersecurity and Digital Governance: Analyzing the impact of digital technologies on increasing government transparency, as well as the risks associated with cyberattacks and manipulation of public consciousness.
3. Study of the Role of Influencers and Bloggers: Assessing their influence on shaping political agendas and electoral behavior, and analyzing the mechanisms for forming a "digital public."

To overcome systemic problems and realize the outlined prospects, a comprehensive approach is necessary, affecting education, funding, and international integration.

The key task is to shift the emphasis in education from theoretical descriptivism to the practical application of methods. It is necessary to:

- Integrate Quantitative Methods Courses: Introducing mandatory courses on statistics, econometrics, working with databases (e.g., R or Python), and mastering specialized software (SPSS, Stata) [6].
- Stimulate Comparative Research: Engaging students and young scholars in the analysis of Kazakhstani cases in the context of Central Asia and the post-Soviet space, using comparative political science.
- Develop Professional Skills: Training in grant proposal writing, publishing in international journals, and working in interdisciplinary teams (political science, sociology, economics).

Kazakhstan needs the creation and support of independent analytical centers that do not rely directly on state funding and can generate alternative political recommendations.

Support Mechanisms:

1. Diversification of Funding Sources: Attracting grants from international foundations, private businesses, and forming endowments to ensure long-term financial stability.
2. Creating Platforms for Public Discussion: Forming a media and expert environment where independent political science findings can be presented to the wider public and decision-makers.
3. Competitive Environment: Ensuring transparency in state grant competitions and mandatory engagement of independent expertise [7].

The political science community must strive for maximum integration into the international academic circulation.

- Incentivizing Q1/Q2 Publications: Implementing mechanisms to encourage publications in leading global journals and supporting participation in major international conferences (e.g., ECPR, APSA) [5].
- Attracting Foreign Specialists: Organizing joint research projects with leading global centers and inviting foreign scholars to teach and consult. This will not only improve the quality of research but also help Kazakhstani scholars master advanced methodologies.

Kazakhstani political science stands at a crossroads. On the one hand, systemic problems exist related to institutional dependence, methodological conservatism, and insufficient integration. These factors slow down the development of the discipline and limit its ability to act as an independent consultant and critic of the political process.

On the other hand, the political demand for modernization, transparency, and high-quality analysis, along with a growing civil society, create unique opportunities for a breakthrough. The prospects for development are tied to a decisive shift towards empirical, quantitative, and comparative methods, the strengthening of academic freedom, the diversification of funding, and active integration into the global scientific dialogue.

Only through structural reforms in education and funding can Kazakhstani political science step out of the shadow of political expediency, become a relevant science with high prognostic power, and effectively contribute to the democratization and sustainable development of Kazakhstan.

List of References

1. Ашимбаев М. С. Политическая модернизация в Казахстане: этапы и перспективы. – Алматы: Институт философии, политологии и религиоведения, 2021.
2. Байзакова К. И. Проблемы институционализации политологического знания в Казахстане. // Вестник КазНУ. Серия политология. – 2019. – № 3(62). – С. 15-24.
3. Ертаев Б. Е. Академическая свобода и государственный заказ в казахстанской политологии: конфликт интересов. // Политическая наука и современность. – 2020. – Т. 7. – № 1. – С. 45-58.

4. Исаков У. А. Методологические вызовы перед политологией Центральной Азии: необходимость эмпирического поворота. – Нур-Султан: Фолиант, 2022.
5. Лаумулин М. Т. Политические трансформации в Казахстане и роль экспертного сообщества. // Центральная Азия и Кавказ. – 2021. – № 4. – С. 101-115.
6. Сариев А. С. Элиты и неформальные институты в политике Казахстана: к новому аналитическому подходу. – Алматы: Дайк-Пресс, 2023.
7. Schatz E. The Limits of Academic Freedom in Central Asia: Politics and Scholarship in Kazakhstan. // Journal of Academic Freedom. – 2018. – Vol. 9. – P. 1-15.
8. Tussupova A. Digitalization and Political Communication in Kazakhstan: New Tools, Old Problems. // Post-Soviet Affairs. – 2023. – DOI: 10.1080/1060586X.2023.2201015.
9. Кузембаев Б. С. Состояние и перспективы развития социологии и политологии в независимом Казахстане. – Астана: Евразийский университет, 2020.

Geographic Sciences

İqlim Dəyişikliyi və Yeni Pandemiylər: Xəstəliklərin Coğrafi Xəritəsi Necə Dəyişir?

Əliyeva Şəfəq Məmməd qızı

ADPU-nun Şəki filialı, müəllim

Açar sözlər: Antroposen, Vahid Sağlamlıq, Zombi Viruslar, Vektor Miqrasiyası, Zoonoz Sıçrayış, Rəqəmsal Epidemiologiya

Giriş

Bəşəriyyət "Antroposen" adlanan yeni bir geoloji dövrə qədəm qoyub. Bu dövrün ən bariz xüsusiyyəti insan fəaliyyətinin yer kürəsinin ekosistemləri, iqlimi və bioloji müxtəlifliyi üzərində dominant qüvvəyə çevrilməsidir. 2025-ci ilin reallıqları göstərir ki, iqlim dəyişikliyi artıq yalnız fiziki mühiti (temperatur artımı, buzlaqların əriməsi) deyil, həm də planetin mikrobioloji mənzərəsini fundamental şəkildə dəyişir. Bioloji təhlükəsizlik anlayışı əvvəllər yalnız laboratoriya sızmaları və ya bioterrorizmlə məhdudlaşdırsa, bu gün o, ekoloji transformasiyanın ayrılmaz hissəsinə çevrilib.

İqlim dəyişikliyi patogenlər üçün "təkamül sürətləndiricisi" rolunu oynayır. Ekosistemlərin pozulması patogenləri öz təbii rezervuarlarından çıxararaq yeni coğrafi ərazilərə və yeni sahiblərə (insanlara) yönəldir. Bu proses "Bioloji Sürüşmə" kimi xarakterizə olunur. Biz artıq xəstəliklərin "coğrafi determinizminin" sonuna çatmışıq; yəni "tropik xəstəlik" anlayışı öz mənasını itirir, çünki tropiklər şimala doğru genişlənir. 2025-ci ildə bioloji təhlükəsizlik artıq milli sərhədlərlə deyil, ekoloji zonalarla ölçülür. Bu giriş, bəşəriyyətin üzləşdiyi bu görünməz təhlükənin miqyasını və iqlim siyasətinin əslində bir səhiyyə siyasəti olduğunu vurğulayır.



Termodinamik Təsir: Vektorların Miqrasiyası və Şimal Ekspansiyası

İqlimin istiləşməsi bioloji vektorların — xəstəlik daşıyan ağcaqanadlar, gənələr və milçəklərin — həyat dövrünə termodinamik təsir göstərir. 2025-ci ilin elmi məlumatları göstərir ki, orta temperaturun hər 1 dərəcə artması həşəratların maddələr mübadiləsini sürətləndirir, onların daha tez çoxalmasına və daha uzun müddət aktiv qalmasına səbəb olur.

Xüsusilə *Aedes aegypti* və *Aedes albopictus* ağcaqanadlarının coğrafi arealı son 5 ildə kəskin şəkildə şimala doğru sürüşüb. Əvvəllər yalnız Cənub-Şərqi Asiya və ekvatorial Afrika üçün xarakterik olan Denq qızdırması, Zika virusu və Çikunqunya artıq Avropanın cənubunda (Fransa, İtaliya, Yunanıstan) endemik ocaqlar yaradıb. 2024-2025-ci illərdə qeydə alınan rekord istilər bu həşəratların hətta Almaniya və Polşa kimi ölkələrdə qışlamasına şərait yaradıb. Digər tərəfdən, malyariya ağcaqanadlarının dağlıq ərazilərə "dırmaşması" müşahidə olunur. Efiopiya və Kolumbiya kimi ölkələrdə əvvəllər "soyuq zona" hesab edilən yüksək yaylalarda artıq malyariya halları kütləviləşib. Bu, iqlim dəyişikliyinə tibbi coğrafiyanı necə amansızcasına dəyişdiyinin ən bariz sübutudur.



Permafrostun "Zombi" Virusları: Arktikada Gizlənən Təhlükə

Arktika qlobal orta göstəricidən dörd dəfə daha sürətlə isinir. Bu sürətli ərimə, "permafrost" adı verilən və min illərlə donmuş vəziyyətdə qalan torpaq təbəqələrinin açılmasına səbəb olur. Permafrost sadəcə donmuş torpaq deyil, o, bəşəriyyətin təkamül prosesində unutduğu qədim patogenlərin nəhəng bir "bioloji arxividir".

2025-ci ildə aparılan tədqiqatlar göstərir ki, bu donmuş təbəqələrdə 50.000 il əvvələ aid olan viruslar (məsələn, *Pithovirus* və *Pandoravirus*) hələ də yoluxdurma qabiliyyətini saxlaya bilər. Alimlər bu patogenləri "zombi viruslar" adlandırırlar. Ən böyük təhlükə isə qədim heyvan qəbiristanlıqlarının (məsələn, Sibir yarası — Antraks sporları ilə yoluxmuş maralların) buz altından çıxmasıdır. 2016-cı ildə Yamal yarımadasında baş verən lokal alovlanma, 2025-ci ildə daha böyük miqyasda təkrarlanma riski daşıyır. Müasir insanların bu qədim mikrob və viruslara qarşı immun yaddaşının olmaması, mümkün bir sızmanın sürətlə global pandemiya çevrilmə ehtimalını artırır. Arktikada neft, qaz və qızıl hasilatının genişlənməsi insan-permafrost təması artıraraq bu riski pik həddə çatdırır.

Hidrosfer və Patogenlər: Okeanların İsinməsinin Mikrobioloji Nəticələri

Yer kürəsindəki istilik balansının tənzimləyicisi olan okeanlar, istiliyin 90%-dən çoxunu udur. Bu termal enerji okeanları nəhəng bir mikrobioloji inkubatora çevirir. 2025-ci ilin okeanoqrafik hesabatları dəniz sularında bakterial konsentrasiyanın rekord həddə çatdığını göstərir.

Xüsusilə *Vibrio* cinsi bakteriyalar, o cümlədən "ət yeyən" bakteriya kimi tanınan *Vibrio vulnificus*, isinən və duzluluğu azalan sahil sularında kütləvi şəkildə çoxalır. Əvvəllər yalnız tropik körfəzlərdə rast gəlinən bu bakteriyalar artıq Baltik dənizi və Şimal dənizi sahillərində çimənlər və dəniz məhsulları istehlakçıları üçün ciddi təhlükə yaradır. Bundan əlavə, "qırmızı qabarma" (zəhərli yosunların kütləvi artımı) fenomeni daha tez-tez baş verir. Bu yosunların ifraz etdiyi neyrotoksinlər balıqlar və molyusklar vasitəsilə insan qida zəncirinə daxil olur, iflic və digər ağır sinir sistemi xəstəliklərinə səbəb olur. Okeanların turşulaşması və istiləşməsi dəniz ekosistemlərinin özünü təmizləmə qabiliyyətini zəiflədir, bu da su vasitəsilə keçən xəstəliklərin (məsələn, vəba) yayılma radiusunu genişləndirir.

Zoonoz Sıçrayışlar: Meşəsizləşmə və Heyvan-İnsan Təması

Yeni yaranan infeksiya xəstəliklərin 75%-i zoonoz mənşəlidir, yəni heyvanlardan insanlara keçir. İqlim dəyişikliyi və intensiv meşəsizləşmə bu "növlər sıçrayışı" (spillover) hadisələrini sürətləndirən əsas amillərdir. 2025-ci ildə vəhşi təbiətin yaşayış sahələrinin daralması heyvanları yeni yaşayış yerləri axtarmağa — çox vaxt insanların sıx yaşadığı ərazilərə köç etməyə məcbur edir.

Məsələn, yarasaların (bir çox virusun təbii rezervuarı) quraqlıq və meşə yanğınları səbəbindən kənd təsərrüfatı zonalarına miqrasiyası, virusların ev heyvanları vasitəsilə insanlara keçməsinə zəmin yaradır. Alimlərin proqnozuna görə, yaxın onilliklərdə müxtəlif heyvan növləri arasında 15.000-dən çox yeni virus mübadiləsi baş verəcək. Bu "virus kokteyli" Ebola, Lassa qızdırması və yeni koronavirus ştammlarının yaranma tezliyini artırır. Biz vəhşi təbiəti küncə sıxışdırdıqca, təbiət də öz mikrob dünyasını bizim gündəlik həyatımıza "ixrac" edir. Bu fəsil, ekosistemlərin qorunmasının əslində növbəti pandemiya qorunmaq üçün ən ucuz və effektiv "vaksin" olduğunu sübut edir.

Azərbaycan və Region üçün İqlim-Səhiyyə Proqnozları

Cənubi Qafqaz, xüsusilə Azərbaycan, iqlim dəyişikliyinə bioloji təsirlərinə qarşı həssas bir regiondur. 2025-ci ilin regional iqlim modelləri göstərir ki, Xəzər dənizinin səviyyəsinin aşağı düşməsi və Kür-Araz ovalığında artan quraqlıq regional patogen xəritəsini dəyişir.

Azərbaycan üçün əsas risklər aşağıdakılardır:

1. Su vasitəsilə keçən infeksiyalar: İçməli su qıtlığı və su mənbələrinin temperaturunun artması bağırşaq infeksiyalarının və tulyaremiya kimi xəstəliklərin yayılma riskini artırır.
2. Vektor-borne xəstəliklər: Arandakı rütubətli rayonlarda ağcaqanad populyasiyasının artması malyariyanın geri qayıtma riskini (re-emergence) gündəmə gətirir. Həmçinin, gənə yayılımının artması Krim-Konqo hemorragik qızdırması kimi xəstəliklər üçün yeni ocaqlar yaradır.
3. Xəzər dənizinin ekoloji vəziyyəti: Sahil sularının istiləşməsi *Vibrio* növü bakteriyaların artmasına və dəniz məhsullarının bioloji təhlükəsizliyinə təsir edə bilər. Bu fəsil, Azərbaycanın səhiyyə sisteminin iqlimə davamlı (climate-resilient) modelə keçməsinin zəruriliyini vurğulayır.

Süni İntellekt və Rəqəmsal Nəzarət: Yeni Epidemiologiya

Xəstəliklərin coğrafiyası belə sürətlə dəyişdiyi bir dövrdə klassik epidemioloji nəzarət metodları yetərsiz qalır. 2025-ci ilin texnoloji inqilabı süni intellekt (AI) və böyük verilənlər (Big Data) əsaslı proqnozlaşdırma sistemlərini ön plana çıxarıb.

Rəqəmsal epidemiologiya artıq peyk görüntülərini, rütubət datalarını və hətta sosial media trendlərini analiz edərək epidemiya ocaqlarını o yaranmazdan bir neçə həftə öncə müəyyən edə bilər. Məsələn, BlueDot kimi platformalar və genomik nəzarət şəbəkələri yeni bir virusun DNT strukturunu saniyələr içində analiz edərək onun yayılma trayektoriyasını modelləşdirir. Portativ genom sekvensərləri sayəsində həkimlər ucqar kəndlərdə belə patogeni dərhal tanıya bilirlər. Bu texnoloji sıçrayış bəşəriyyətə iqlim dəyişikliyinə gətirdiyi bioloji xaosa qarşı ən güclü müdafiə xəttini təqdim edir: Məlumatın sürəti patogenin sürətini üstələməlidir.

Nəticə və Təvsiyələr: "Vahid Sağlamlıq" Strategiyası

Xəstəliklərin dəyişən coğrafi xəritəsi bizə bir fundamental dərsi öyrətdi: İnsan sağlamlığı təcrid olunmuş bir anlayış deyil. 2025-ci ildən etibarən qlobal səhiyyə siyasətinin mərkəzində "Vahid Sağlamlıq" (One Health) konsepsiyası dayanmalıdır. Bu yanaşma insan, heyvan və ətraf mühit sağlamlığının ayrılmaz vəhdətini qəbul edir.

Strateji Təvsiyələr:

1. İqlim və Səhiyyə İntegrasiyası: İqlim dəyişikliyi ilə mübarizə proqramları birbaşa epidemioloji nəzarət sistemləri ilə əlaqələndirilməlidir.
2. Erkən Xəbərdarlıq Sistemləri: Arktikadan tropiklərə qədər bioloji monitoring şəbəkələri genişləndirilməli, süni intellekt əsaslı proqnozlaşdırma dövlət dəstəyi artırılmalıdır.
3. Ekosistemlərin Bərpası: Meşələrin qorunması və vəhşi təbiət ticarətinin sərt tənzimlənməsi zoonoz sıçrayışların qarşısını almaq üçün ən effektiv yoldur.
4. Qlobal Əməkdaşlıq: Patogenlər pasport və sərhəd tanımadığı üçün, ölkələr arasında bioloji məlumatların şəffaf və sürətli paylaşımı təmin edilməlidir.

Nəticə olaraq, xəritələr dəyişə bilər, lakin bu dəyişikliyin gətirdiyi riskləri idarə etmək üçün bəşəriyyətin əlində hələ də kifayət qədər elm və texnologiya var. Əsas məsələ — bu resursları planetar miqyasda birləşdirməkdir.

ƏDƏBİYYAT

1. Ümumdünya Səhiyyə Təşkilatı (WHO). (2025). *World Health Report: Climate Change and the Pathogen Frontier*. who.int – İqlim dəyişikliyinə infeksiya xəstəliklərinin coğrafiyasına təsiri haqqında illik icmal.
2. IPCC (Intergovernmental Panel on Climate Change). (2024/2025). *Sixth Assessment Report (AR6) - Update on Health and Environment*. ipcc.ch – İqlim dəyişikliyi və ekosistemlərin bioloji transformasiyası üzrə əsas elmi konsensus.
3. The Lancet Countdown. (2025). *Tracking Progress on Health and Climate Change: 2025 Report*. lancetcountdown.org – Sağlamlıq və iqlim indikatorları üzrə ən nüfuzlu tibbi monitoring hesabatı.
4. Nature Climate Change. (2024). *Over 50% of human pathogenic diseases aggravated by climate change*. nature.com – Patogenlərin iqlim faktorları ilə əlaqəsini təhlil edən fundamental tədqiqat.
5. Science Mag. (2025). *Permafrost Thaw and the Re-emergence of Ancient Viruses: A Genomic Perspective*. science.org – Arktika və paleo-virologiya üzrə laboratoriya tədqiqatları.
6. Journal of Travel Medicine. (2025). *The Expansion of Vector-Borne Diseases in Europe: A 2025 Update*. – Ağcaqanad və gənə miqrasiyası üzrə regional analizlər.
7. GISAID (Global Initiative on Sharing All Influenza Data). gisaid.org – Virusların genomik seqvensiyası və qlobal rəqəmsal izləmə databazası.

8. BlueDot Ecosystem. (2025). *Infectious Disease Intelligence and AI Forecasting*. bluedot.global – Süni intellekt vasitəsilə epidemiya proqnozlaşdırılması üzrə texnoloji icmalar.
9. HealthMap. (2025). *Real-time surveillance of emerging public health threats*. healthmap.org – Xəstəlik ocaqlarının interaktiv coğrafi xəritəsi.

Journalism

Digital Communication Technologies as Means of Effective Communication in Organisations

Ľudovít Hajduk

Professor, Faculty of Mass-Media, Paneuropean University, Bratislava, Slovakia

Stanislav Benčíč

Professor, Faculty of Public Administration, Danubius University, Sládkovičovo, Slovakia

Abstract

Digital communication technologies (DCTs) have become essential tools for managing information and communication within modern organisations. This study examines their impact on organisational efficiency, employee engagement, and decision-making, with a focus on media and information management. Using surveys of 500 employees across finance, healthcare, and education sectors, and interviews with 30 organisational leaders, the research identifies key benefits and challenges of digital communication. Findings reveal that DCTs enhance connectivity, collaboration, and knowledge sharing, but issues such as technological disparities, information overload, and reduced social presence can limit effectiveness. The study highlights the importance of strategic implementation, ongoing training, and fostering a digital communication culture to ensure effective organisational messaging and sustainable information practices.

Keywords: digital communication technologies, organizational communication, media management, internal messaging, information flow, journalism

1 Introduction

The digital revolution has profoundly transformed organizational communication paradigms, reshaping how information flows within and outside institutions. Traditional face-to-face interactions, once considered the cornerstone of organizational coordination, have increasingly been supplemented or replaced by digital communication technologies (DCTs) such as email, instant messaging, video conferencing, collaborative platforms, and internal social media networks (Huang and Rust). The accelerated adoption of these tools, especially under the influence of global crises such as the COVID-19 pandemic, underscores their critical role in enabling organizations to maintain operational continuity, support remote work, and facilitate rapid decision-making processes.

Effective communication is central to organizational success, influencing coordination, innovation, employee engagement, and competitive advantage (Daft and Lengel). DCTs offer opportunities for real-time information sharing, increased flexibility, and enhanced collaboration across geographically dispersed teams. They also play a crucial role in internal media management, shaping how messages are crafted, disseminated, and received within organizations, which is particularly relevant for sectors emphasizing information accuracy and transparency, such as journalism, education, and healthcare.

However, the widespread implementation of digital tools also presents significant challenges. Technological disparities among employees, information overload, and the absence of non-verbal cues can reduce the effectiveness of communication, potentially causing misunderstandings,

social isolation, or technostress (Walther, 2011; Ayyagari et al., 2011). Additionally, over-reliance on digital channels without appropriate training or cultural adaptation can hinder meaningful interaction and reduce employee satisfaction.

This study aims to investigate the role of DCTs in facilitating effective communication within organizations, exploring both their benefits and limitations. By combining quantitative survey data from 500 employees across finance, healthcare, and education sectors with qualitative interviews of 30 organizational leaders, the research provides a comprehensive view of current practices, challenges, and strategies for optimizing digital communication. Insights from this study are intended to inform best practices not only for organizational management but also for professionals in media-intensive fields, highlighting the intersection between technology, communication, and organizational performance.

2 Literature Review

2.1 Evolution of Organizational Communication and Digital Technologies

Organizational communication has undergone a profound transformation over the past few decades, driven by advances in technology, globalization, and changing workforce dynamics (Brynjolfsson and McAfee). Traditional face-to-face meetings, memos, and printed reports have increasingly been replaced or supplemented by digital communication technologies (DCTs), including email, instant messaging platforms, video conferencing tools, collaborative document editing systems, and internal social media networks. This shift reflects a broader digital transformation affecting not only how work is coordinated but also how information is curated, shared, and interpreted within organizations (García-Orosa, 2019).

Scholars emphasize that digital communication enhances transparency, accelerates decision-making, and fosters inclusivity by enabling geographically dispersed teams to collaborate effectively (Huang and Rust, 2021). In media-intensive environments such as journalism, healthcare, and education, the adoption of DCTs has become particularly critical for ensuring timely dissemination of accurate information, coordination among teams, and the maintenance of organizational credibility.

2.2 Benefits of Digital Communication Technologies

Research consistently highlights several advantages of DCT adoption in organizational settings. DCTs support **real-time communication**, allowing employees to respond quickly to dynamic situations and make informed decisions (Cascio and Shurygino, 2003). They also enhance **knowledge sharing** and collaboration across departments, fostering innovation and collective problem-solving (Majchrzak et al., 2013). From a media management perspective, digital tools allow organizations to maintain a consistent narrative and align internal messaging with broader strategic objectives.

Additionally, DCTs contribute to **operational efficiency** by reducing costs associated with travel, physical meetings, and paper-based documentation (Brynjolfsson and McAfee, 2014). Hybrid and remote work models, increasingly prevalent in contemporary organizations, rely heavily on these technologies to sustain productivity and engagement, demonstrating their integral role in organizational design and strategy.

2.3 Challenges and Limitations

Despite their advantages, DCTs also present several challenges that can compromise communication effectiveness. **Technological disparities** among employees, such as differences in digital literacy or access to reliable devices and internet connections, can create inequalities in information access and participation (Walther, 2018). **Information overload** is another critical issue; the constant influx of messages, notifications, and documents can lead to cognitive fatigue, reduced focus, and increased stress levels (Ayyagari et al., 2011).

The absence of **non-verbal cues** in digital communication can also impede nuanced understanding, leading to misinterpretation or reduced social cohesion. In professional media environments, where clarity and accuracy are paramount, these limitations can affect both organizational performance and public perception. Furthermore, over-reliance on digital channels without adequate training or cultural adaptation may reduce employee engagement and satisfaction, highlighting the need for intentional implementation strategies.

2.4 Organizational Strategies for Optimizing DCT Use

Effective use of DCTs requires **strategic planning, leadership, and a supportive organizational culture**. Investments in reliable digital infrastructure, ongoing user training, and clear communication policies are essential to maximize the benefits of these tools (Müller and Maier, 2020). Leaders play a pivotal role in modeling healthy digital behaviors, balancing technological efficiency with human-centric approaches, and promoting inclusivity across all levels of the organization.

In media-related fields, organizations must also consider **information governance, message consistency, and audience engagement** when implementing digital tools. Establishing protocols for internal messaging, content review, and cross-departmental collaboration helps ensure that information shared via DCTs maintains accuracy, clarity, and organizational alignment.

Overall, the literature suggests that DCTs have the potential to significantly enhance organizational communication, but their effectiveness depends on careful implementation, user competence, and a culture that values both technological and interpersonal dimensions of communication.

3 Methodology

This study employed a mixed-methods research design to comprehensively examine the role of digital communication technologies (DCTs) in organizational communication. The mixed-methods approach combines quantitative survey data with qualitative interviews, allowing for both statistical analysis and contextual understanding of organizational practices.

3.1 Quantitative Data Collection

Quantitative data were collected through an online survey administered to 500 employees from diverse sectors, including finance, healthcare, and education. The survey was designed to capture perceptions of communication effectiveness, frequency and type of DCT usage, technological challenges, and psychological well-being. Likert-scale items (ranging from 1 = strongly disagree to 5 = strongly agree) were used to measure respondents' experiences with digital communication, including aspects such as collaboration, information flow, and clarity of messaging.

3.2 Qualitative Data Collection

To complement survey findings, semi-structured interviews were conducted with 30 organizational leaders, including managers and communication officers. Interview questions explored strategic initiatives for DCT adoption, approaches to training and employee engagement, challenges encountered during implementation, and best practices for maintaining effective organizational messaging. Interviews were recorded, transcribed, and coded thematically.

3.3 Data Analysis

Quantitative data were analyzed using descriptive statistics, frequency distributions, and correlation analysis to identify relationships between DCT usage, communication effectiveness, and employee well-being. Qualitative data were analyzed through thematic coding, identifying patterns and recurrent themes related to leadership strategies, organizational culture, and the management of digital communication channels. Ethical approval was obtained prior to data collection, and all participants provided informed consent.

3 Methodology

This study employed a mixed-methods research design to comprehensively examine the role of digital communication technologies (DCTs) in organizational communication. The mixed-methods approach combines quantitative survey data with qualitative interviews, allowing for both statistical analysis and contextual understanding of organizational practices.

3.1 Quantitative Data Collection

Quantitative data were collected through an online survey administered to 500 employees from diverse sectors, including finance, healthcare, and education. The survey was designed to capture perceptions of communication effectiveness, frequency and type of DCT usage, technological challenges, and psychological well-being. Likert-scale items (ranging from 1 = strongly disagree to 5 = strongly agree) were used to measure respondents' experiences with digital communication, including aspects such as collaboration, information flow, and clarity of messaging.

3.2 Qualitative Data Collection

To complement survey findings, semi-structured interviews were conducted with 30 organizational leaders, including managers and communication officers. Interview questions explored strategic initiatives for DCT adoption, approaches to training and employee engagement, challenges encountered during implementation, and best practices for maintaining effective organizational messaging. Interviews were recorded, transcribed, and coded thematically.

3.3 Data Analysis

Quantitative data were analyzed using descriptive statistics, frequency distributions, and correlation analysis to identify relationships between DCT usage, communication effectiveness, and employee well-being. Qualitative data were analyzed through thematic coding, identifying patterns and recurrent themes related to leadership strategies, organizational culture, and the management of digital communication channels. Ethical approval was obtained before data collection, and all participants provided informed consent.

4 Results

4.1 Sample Characteristics

The survey sample consisted of 500 respondents, representing a diverse cross-section of organizational roles, age groups, and work arrangements. Participants included 46% males, 52% females, and 2% identifying as other or preferring not to disclose gender. Age distribution ranged from 20–29 (24%), 30–39 (36%), 40–49 (26%), to 50+ (14%). Work arrangements included on-site (28%), hybrid (44%), and remote (28%) roles. Representation across sectors was balanced, with finance and education each contributing 34% of respondents, and healthcare 32%. The sample reflects contemporary organizational structures and hybrid work models, providing a relevant context for examining DCT use.

4.2 Frequency and Type of Digital Communication Technologies Used

Analysis revealed that **email** and **instant messaging platforms** (e.g., Teams, Slack) were the most frequently used DCTs, followed by **video conferencing** and **collaborative document platforms** (e.g., Google Docs). Internal social media networks were used less frequently, indicating potential underutilization of these channels for organizational communication. High-frequency use of email and instant messaging underscores their central role in day-to-day operations, while collaborative tools facilitate cross-functional projects.

4.3 Perceived Impact on Communication Effectiveness

Respondents reported that DCTs significantly **enhance information flow, collaboration, and decision-making speed**, with slightly lower ratings for reducing misunderstandings. These findings indicate that while DCTs are generally effective, certain limitations—such as reduced social

presence and absence of non-verbal cues—persist. Effectiveness is contingent not only on tool usage but also on the organizational context, user competence, and communication culture.

4.4 Challenges Associated with Digital Communication

Respondents identified several challenges, including information overload, technostress, reduced social interaction, lack of non-verbal cues, and insufficient training. Correlation analysis revealed that a higher frequency of DCT usage positively correlates with perceived communication effectiveness but negatively correlates with psychological well-being, indicating potential trade-offs between productivity and employee stress levels. Organizations must balance technological efficiency with human-centric considerations to prevent burnout and maintain engagement.

4.5 Qualitative Themes from Leader Interviews

Analysis of leader interviews identified several recurrent themes:

1. Strategic use of DCTs: Alignment of tools with organizational goals and processes.
2. Importance of training: Continuous development to ensure effective use of technologies.
3. Digital overload management: Implementation of protocols and norms to prevent employee fatigue.
4. Leadership modeling: Leaders exemplifying effective digital communication behaviors.
5. Maintaining social connection: Efforts to sustain engagement in hybrid or remote environments.

Leadership, strategy, and organizational culture are critical determinants of successful DCT adoption.

4.6 Summary of Results

Overall, findings indicate that DCTs enhance connectivity, collaboration, and information flow, yet challenges such as technological disparities, information overload, and reduced social presence persist. Both quantitative and qualitative data suggest that strategic planning, leadership involvement, and ongoing training are essential for maximizing the benefits of DCTs while mitigating negative effects on employee well-being.

Table 1. Sample Characteristics of Respondents (N = 500)

Variable	Category	Frequency	Percentage
Gender	Male	230	46.0%
	Female	260	52.0%
	Other / Prefer not to say	10	2.0%
Age	20–29	120	24.0%
	30–39	180	36.0%
	40–49	130	26.0%
	50+	70	14.0%
Sector	Finance	170	34.0%
	Healthcare	160	32.0%
	Education	170	34.0%
Work Mode	On-site	140	28.0%
	Hybrid	220	44.0%
	Remote	140	28.0%

The sample was well distributed across sectors and work arrangements. The majority of respondents worked in hybrid mode, highlighting the importance of DCTs in contemporary organizational contexts.

Table 2. Frequency of Use of Digital Communication Technologies

Digital Tool	Mean	SD
Email	4.72	0.51
Instant Messaging (Teams, Slack)	4.35	0.68
Video Conferencing	3.98	0.81
Collaborative Platforms (Google Docs)	3.76	0.84
Social Media (internal)	2.41	0.97

Email and instant messaging dominate daily communication, while social media is less frequently used.

Table 3. Perceived Impact of DCTs on Communication Effectiveness

Statement	Mean	SD
DCTs improve information flow	4.21	0.73
Enhance collaboration	4.08	0.79
Support faster decision-making	4.15	0.76
Improve communication clarity	3.89	0.85
Reduce misunderstandings	3.42	0.91

Respondents generally perceive DCTs as effective, though misunderstandings remain a concern (Walther, 2011).

Table 4. Perceived Challenges

Challenge	Mean	SD
Information overload	4.03	0.82
Technostress	3.78	0.88
Reduced social interaction	3.95	0.86
Lack of non-verbal cues	4.12	0.74
Insufficient training	3.61	0.90

Challenges highlight the psychological and social costs of digital communication (Ayyagari et al., 2011; Walther, 2018).

Table 5. Correlation Between DCT Use, Communication Effectiveness, and Well-being

Variables	1	2	3
1. Frequency of DCT use	1		
2. Communication effectiveness	0.48**	1	
3. Psychological well-being	-0.32**	0.41**	1

Note: $p < 0.01$

Increased use improves communication but may reduce well-being (technostress effect).

Table 6. Themes Identified from Leader Interviews (n = 30)

Theme	Description	Frequency
Strategic use of DCTs	Alignment with goals	24
Importance of training	Continuous development	21
Digital overload management	Setting boundaries	19
Leadership modeling	Setting norms	17
Maintaining social connections	Hybrid interaction	22

Leadership and strategy are critical for effective DCT use (Müller and Maier, 2020).

5 Conclusion

This study demonstrates that digital communication technologies are indispensable tools for effective organizational communication, enhancing connectivity, collaboration, and knowledge sharing across diverse sectors. While the benefits of DCTs are substantial, challenges such as technological disparities, information overload, and reduced social presence must be proactively addressed to optimize their impact.

Strategic implementation, continuous training, and leadership modeling are essential for maximizing the advantages of digital tools while minimizing negative effects on employee well-being. Organizations should adopt hybrid communication strategies that combine digital and face-to-face interactions, ensuring both efficiency and social cohesion.

From a media and journalism perspective, the findings underscore the critical role of internal communication in shaping organizational messaging, maintaining transparency, and ensuring accurate information flow. By fostering a supportive digital culture and aligning technology use with organizational goals, institutions can achieve sustainable communication practices that benefit both employees and stakeholders.

Future research could explore sector-specific differences in DCT adoption, longitudinal effects on employee engagement and well-being, and the role of emerging technologies such as AI-driven communication platforms in organizational contexts.

This article is part of the project GAAA/2022/9: Digital Communication Technologies as a Means of Effective Communication in Organizations.

Sources

Ayyagari, Ritu, Varun Grover, and Vijay S. Purvis. "Technostress: Implications for Individuals, Teams, and Organizations." *Information Systems Research*, vol. 22, no. 4, 2011, pp. 831–856.

Brynjolfsson, Erik, and Andrew McAfee. *The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies*. W. W. Norton & Company, 2014.

Daft, Richard L., and Robert H. Lengel. "Organizational Information Requirements, Media Richness and Structural Design." *Management Science*, vol. 32, no. 5, 1986, pp. 554–571.

García-Orosa, Bernardo. "25 Years of Research in Online Organizational Communication." *Profesional de la Información*, vol. 28, no. 6, 2019, pp. 1–14, <https://revista.profesionaldelainformacion.com/index.php/EPI/article/view/epi.2019.sep.17>.

Huang, Ming-Hui, and Roland T. Rust. "Artificial Intelligence in Service." *Journal of Service Research*, vol. 24, no. 1, 2021, pp. 3–24.

Korunovska, Jana, and Stefan Spiekermann. "The Effects of Information and Communication Technology Use on Human Energy and Fatigue: A Review." *arXiv*, 2019, <https://arxiv.org/abs/1910.01970>.

Majchrzak, Ann, et al. "The Contradictory Influence of Social Media Affordances on Knowledge Sharing." *Journal of Computer-Mediated Communication*, vol. 19, no. 1, 2013, pp. 38–55.

Müller, Heiko, and Günter Maier. "Optimizing Digital Communication in Organizations: Strategies and Best Practices." *Management Review Quarterly*, vol. 70, 2020, pp. 321–342.

Short, John, Ederyn Williams, and Bruce Christie. *The Social Psychology of Telecommunications*. John Wiley & Sons, 1976.

Springer, Ulrich J. "Analyzing Digital Communication: A Comprehensive Literature Review." *Management Review Quarterly*, vol. 75, 2025, pp. 3119–3157, <https://link.springer.com/article/10.1007/s11301-024-00455-8>.

Thompson, James E. "Leveraging Digital Communication Strategies for Organizational Success." *Journal of Organizational Culture, Communications and Conflict*, vol. 28, suppl. 2, 2024, pp. 1–3,

<https://www.abacademies.org/articles/leveraging-digital-communication-strategies-for-organizational-success.pdf>.

Umoren, Peter E., and Augustine P. Ukpe. "Digital Communication in Organisations: Trends, Strengths and Weaknesses." *Direct Research Journal of Management and Strategic Studies*, vol. 6, no. 1, 2025, pp. 55–64,

https://www.researchgate.net/publication/392666472_Digital_Communication_in_Organizations_Trends_Strengths_and_Weaknesses.

Walther, Joseph B. "Computer-Mediated Communication: Impersonal, Interpersonal, and Hyperpersonal Interaction." *Communication Research*, vol. 23, no. 1, 2011, pp. 3–43.

Walther, Joseph B. *The Handbook of Interpersonal Communication*. 2nd ed., SAGE Publications, 2018.



Proceedings of the 12th International Scientific Conference
«Theoretical Hypotheses and Empirical results» (December 18-19, 2025).
Oslo, Norway, 2025. 350p

editor@publisher.agency

<https://publisher.agency>

University of Norway

PO Box 1012 Blindern

0224 Oslo