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Biological sciences

STUDY OF THE CYTOPATHIC EFFECT OF PLANT ESSENTIAL OIL ON CELL CULTURE AND HERPESVIRUSES

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Introduction

The flora of Azerbaijan is distinguished by its rich species composition. The first of the main reasons for this is that the chemical composition of plants and the biologically active substances obtained from them have not been sufficiently studied pharmacologically. Viral infections are an important global health problem, and the limited efficacy and toxicity of existing antiviral drugs and the emergence of drug resistance in viruses necessitate the exploration of new alternative and complementary approaches. In this regard, bioactive substances of natural origin, especially vegetable oils, have become the focus of scientific research due to their antiviral potential in recent years. Vegetable oils have a rich chemical composition, showing biological activity mainly through fatty acids, phenolic compounds, terpenes and other secondary metabolites. In vitro and limited in vivo studies have shown that some plant oils and their active components exhibit significant antiviral effects against various viruses, especially lipid-enveloped viruses. The main mechanisms of this effect are associated with the destabilization of the lipid envelope of the virus, the prevention of the adsorption and entry of the virus into the cell, as well as the inhibition of the viral replication stages. In particular, unsaturated and medium-chain fatty acids, such as lauric, oleic, and linoleic acids, have been reported to reduce virion infectivity by cleaving the viral envelope. In addition, it is noted that phenolic and terpenoid compounds contained in some vegetable oils affect viral enzymes and weaken genome synthesis and the formation of new virions. These properties allow vegetable oils to be evaluated as potential antiviral agents for herpesviruses, influenzaviruses, and other enveloped viruses. At the same time, the immunomodulatory and antioxidant properties of vegetable oils can contribute to the reduction of cell damage and inflammatory processes during viral infections. In addition to direct antiviral mechanisms, these effects are important in terms of strengthening the body's defense mechanisms against viruses. However, the antiviral effect of vegetable oils is mainly based on experimental studies and the limited clinical evidence makes it necessary to evaluate them as a complementary approach rather than as an independent treatment. As a result, the study of the mechanisms of the effect of vegetable oils against viruses is considered a relevant and promising research direction in terms of the development of new antiviral strategies and the improvement of the effectiveness of existing treatment methods. Human cell culture models are one of the main research tools of modern biomedical sciences, especially cell biology and virology. These models provide wide opportunities in the study of viral replication mechanisms, intracellular pathogenesis and virus-cell interactions. Untransformed, primary cell lines are of particular importance in this respect, as they exhibit biological responses closer to in vivo conditions. Human Foreskin Fibroblast (HFF) cells are primary fibroblast cells derived from neonatal foreskin tissue and have a normal diploid genome structure. These cells are characterized by maintenance of interferon responses, stable morphological characteristics and high sensitivity to various viruses, especially herpesviruses. The HFF cell line is considered the "gold standard" model in the international scientific literature for the study of cytomegalovirus (CMV) and herpes simplex virus (HSV) infections. The level of confluence in cell culture is directly related to the metabolic activity of the cells, the rate of proliferation and the response to viral infection. For this reason, the study of the

morphological and functional characteristics of HFF cells at the 100% confluence stage is considered as an actual scientific problem.

Keywords: *HFF, cell culture, fibroblast, herpesvirus, arthemisia, in vitro model*

RESEARCH MATERIALS AND METHODS

Human Foreskin Fibroblast (HFF) cell line was used in the study. Cells were cultured in vitro under standard aseptic conditions. A 2% aqueous solution of essential oil obtained from the aerial part of the plant by the hydrodistillation method of Artemisia species was used as the research object. The essential oil was obtained by the hydrodistillation method for 5 hours from the above-ground part of 500 g of finely chopped plants. A 2% aqueous solution of essential oil was used to test antiviral activity. Cells were kept in a 37°C, 5% CO₂ incubator. Cell growth dynamics were monitored daily. The effect of the mentioned tool on the primary cell culture was studied in the native case. An inverted microscope was used to evaluate cell morphology and confluence level. Microscopic images of cells at different confluence stages (low, medium, high and 100% confluence) were obtained and visual analysis was performed.

RESULT

As a result of the study, it was determined that the aqueous mixture of essential oil did not have a toxic effect on cells in the native state and prevented the cytopathic effect on herpesvirus cells in the primary cell culture of human fibroblasts in the native state. The results of the conducted research are as follows: the studied essential oil remedy prevented the cytopathic effect caused by herpes viruses by 50% in 35 samples, 25% in 20 samples, and 75% in 9 samples. The results of the research conducted in this way lead to the conclusion that the aqueous mixture of essential oil obtained from Artemisia species has antiviral activity in its native form and can be used as an antiviral agent in the prevention of some herpesvirus infections.

Economic sciences

THE IMPACT OF DIGITAL TECHNOLOGIES ON YOUTH PERCEPTION OF QUEST-BASED EXCURSIONS

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Abstract

The article examines the influence of digital technologies on how quest-based excursions are perceived by a youth audience in the context of the digitalization of the tourism industry. The popularity of interactive and gamified forms of cultural and educational tourism aimed at young consumers is increasing, whereas the factors determining the resulting user experience remain insufficiently explored. The study applies general scientific methods of analysis and synthesis, as well as empirical research methods, including a questionnaire survey and elements of correlation analysis. The research reviews digital tools used in quest-based excursions and evaluates their impact on the level of engagement, emotional assessment of the route, and participant satisfaction. The practical significance of the study involves the possibility of applying the findings to the development and improvement of quest-based excursions targeted at the 18-35 age group, along with the creation of competitive tourism products that align with current digital trends.

Keywords: *quest-based excursions, digital technologies, youth, gamification, perception, interactive tourism.*

In the context of the rapid development of digital technologies and their integration into nearly all areas of social life, the tourism market is increasingly shifting toward interactive and innovative forms of recreation associated with transformations in the consumption of cultural and educational services. These formats not only provide information but also actively engage tourists in the process of exploration.

The youth audience, who naturally use digital spaces for socializing, communication, and information acquisition, has shown a growing preference for interactive, gamified leisure activities. Consequently, this type of excursion, incorporating digital technologies, has the potential to become a product that ensures a high level of tourist engagement and encourages repeat visits. In contrast to earlier studies, this article focuses on conceptualizing the notion of the quest-based excursion and examines the specific features of how this format is perceived.

The relevance of the author's research is determined by the need for a systematic scholarly analysis of the influence of digital technologies on young people's perception of quest-based excursions. In recent years, the implementation of quest-based excursions has increasingly involved the use of mobile applications, QR codes, geolocation services, augmented reality (AR) and virtual reality (VR) elements, as well as interactive maps and digital game mechanics. These tools not only expand the functional capabilities of the excursion product but also influence the perception, the emotional characteristics of the route, and the level of participant engagement.

The aim of this study is to analyze the impact of digital technologies on youth perceptions of quest-based excursions. To achieve this goal, the study addresses the following objectives:

- 1. To examine theoretical approaches to defining the concepts of "quest-based excursion" and "digital technologies" within the context of excursion activities.*
- 2. To identify the specific features of how quest-based excursions are perceived by audiences aged 18-35.*
- 3. To determine the role and significance of digital technologies in shaping emotional engagement and the user experience of participants in quest-based excursions.*
- 4. To analyze the influence of digital tools on the assessment of the quality and attractiveness of quest-based excursions.*

To investigate this issue, it is necessary to clarify the meaning of the term "quest-based excursion," which emerges at the intersection of the concepts "quest" and "excursion." In academic literature, the

term “quest” is defined as a form of activity associated with searching for information and the sequential completion of tasks aimed at achieving a specific goal. According to I. V. Vorobyova, the word “quest” is of English origin and derives from the Latin *quaerere* - “to seek,” “to explore,” which reflects its meaning as a process of moving toward a goal through the overcoming of obstacles [1]. Subsequently, this approach was further developed within gaming and educational contexts, particularly in the format of web quests that involve active and independent engagement by participants, as introduced by American educators B. Dodge and T. March [2]. An excursion is traditionally defined as a methodologically organized process of presenting and interpreting objects of historical and cultural heritage, conducted in accordance with established standards [3; 4].

Accordingly, a quest-based excursion is considered to be a tourism service involving the organization and visitation of specially selected excursion sites, presented by a certified guide in accordance with established standards and using a set of methods specified in an officially approved route and methodological framework. Within this format, participants, over a period of up to 24 hours or including one overnight stay, follow a narrative storyline through which they become acquainted with objects of cultural or historical heritage, explore them, and complete tasks by applying knowledge, observation, and interaction with other participants. The format described above characterizes the excursion process as more active, engaging, and interactive [5].

Digital technologies in excursion activities constitute a set of information and communication tools, software solutions, and digital instruments used for the collection, transmission, and visualization of information in the course of excursion services [5, 6]. The concept of digital technologies in tourism has evolved alongside the development of data processing tools and digital platforms that enable expanded forms of interaction between visitors and excursion sites and services [7, 8]. The integration of digital technologies into the tourism sector began in the early twenty-first century and is associated with the dissemination of internet platforms, mobile devices, and digital services that facilitate the planning, organization, and delivery of tourism and excursion products [5, 7]. In contemporary excursion services, mobile audio guides, geolocation services, interactive maps, as well as augmented and virtual reality technologies (AR/VR) are widely employed, allowing for the creation of more illustrative and engaging excursion routes [8]. Emerging directions include extended reality (XR) and digital twins of tourism sites, which provide more flexible and visually enriched interaction with cultural heritage [5, 6].

According to research by Vasilchenko A. O., audiences aged 18-35 highly value interactive elements, including problem-solving tasks and engagement with narrative-based routes, which contributes to a deeper assimilation of information about cultural and historical heritage [9, 10]. Kolesnikova O. G. notes that quest excursions enhance motivation to participate, increase interest in local attractions, and promote the development of creative tourism, as well as support regenerative approaches in excursion activities [11].

To determine the role of digital technologies in shaping emotional engagement and the quality of user experience among participants in quest-based excursions, a survey was conducted with 109 respondents aged 18 to 35. The study employed correlation analysis to test the hypothesis that preference for digital formats in quest-based excursions is associated with respondents' interest in the educational-entertainment (edutainment format—a specific type of educational approach combining entertainment with the development of initial interest in a subject, providing enjoyment during the learning process while fostering sustained engagement) [12]. The variables were measured using five-point scales: “Preference for digital elements” (where 5 indicated a preference for quests incorporating AR elements and 1 indicated no interest in quests) and “Interest in the Edutainment format” (where 5 indicated “very high interest” and 1 indicated “no interest”). Spearman's rank correlation coefficient (ρ) was applied as an analytical method that does not require assumptions of normality. The results indicated a moderate positive correlation: $\rho = 0.500$ ($p < 0.05$), indicating a statistically significant relationship between the variables

(Figure 1). The calculated value of Student's t-test (5.972) exceeded the critical value (1.982) at 107 degrees of freedom, confirming the reliability of the observed relationship.

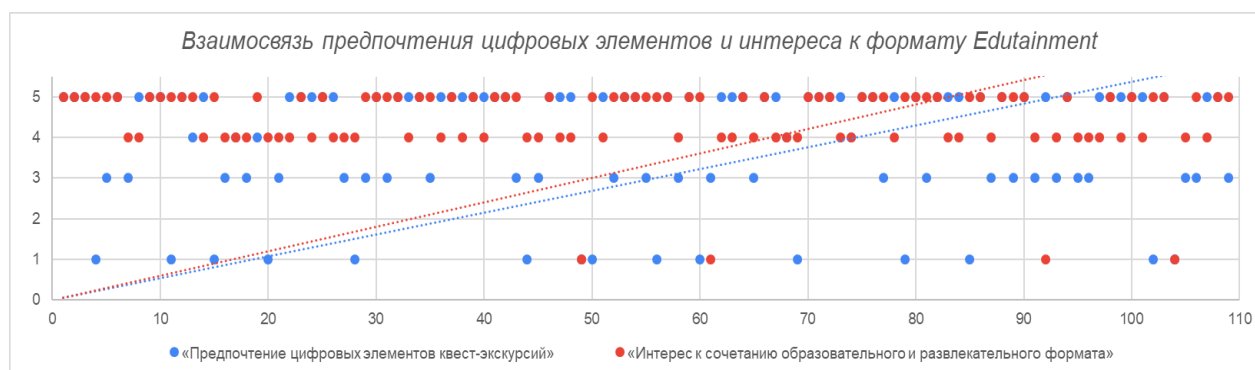


Figure 1. Correlation between preference for digital elements and interest in the edutainment format

The correlation analysis confirms that interest in the integration of educational and entertainment elements constitutes a significant factor influencing preferences for digital technologies in quest excursions among young people. Respondents who demonstrate a high level of interest in the edutainment format are more likely to prefer interactive formats incorporating AR, mobile applications, or chatbots. The findings provide empirical evidence for the role of digital technologies as a tool that enhances emotional engagement and shapes a positive user experience through the integration of game-based and cognitive elements, aligning with the expectations and values of contemporary youth audiences.

An analysis of respondent answers regarding the role of information technology in the perception of excursions made it possible to identify three key aspects of its influence on the quality and attractiveness of quest products. The largest group of respondents (more than 60 individuals) indicated that digital technologies "enhance perception and make events more interesting." This assessment is qualitatively transformative, as technologies are perceived not merely as tools but as components that redefines the interaction with the excursion material itself. The responses suggest that gamification and interactive augmented reality elements are precisely what drive emotional engagement—a factor the audience identifies as a crucial indicator of quality leisure and a primary motivation. For this group, digital tools thus directly shape the principal criterion of attractiveness: the capacity to capture and involve the participant.

The majority of respondents (38 individuals) noted that technologies "add convenience but are not critical." In this case, their impact on perceived quality is primarily instrumental rather than substantive. Digital solutions (e.g., in-app navigation, quick access to information via QR codes, audio guides) are perceived as service enhancements that increase comfort and smooth of route navigation, influencing evaluations of organizational quality and convenience. These factors remain supplementary rather than central in the overall assessment of a product's attractiveness. For this group, the absence of technology does not make the tour unattractive, but its presence makes it feel more modern and convenient.

A minor yet illustrative group of respondents (providing isolated answers) indicated that technologies 'do not affect perception' or that they 'prefer activities without technology.' This points to the existence of an audience segment in which the guide's competence, the depth of content, and historical accuracy remain absolute and self-sufficient. For these individuals, digital tools are neither a criterion of attractiveness nor a factor enhancing quality. However, the marginality of this group within the total sample—3.27%—confirms the overall trend: for the overwhelming majority of the youth audience, digitalization has become an integral element of expectations for a contemporary tourism product.

The results obtained allow for a more precise understanding of the mechanism through which digital technologies influence emotional engagement, a process often described in the literature in general terms [9, 10]. The observed correlation with interest in the Edutainment format ($p = 0.500$) indicates that technologies serve as a key tool in implementing the principle of "learning through entertainment." At the same time, our study demonstrates that "entertainment" in this context is not merely a cognitive game but a source of emotional engagement. Technologies (AR, interactive tasks within the application) create "emotional anchors"—moments of surprise, the joy of discovery, and a sense of participation—which significantly enhance the uniqueness of the tour experience. Consequently, the role of digital tools extends beyond functional convenience, shaping a deeply personal and emotionally charged user experience that fully aligns with the values of the youth audience. Based on the above, the influence of digital

tools on perceived quality and attractiveness is differentiated. For the majority, they act as a transformative factor, directly generating appeal through engagement and interactivity. For others, they function as an enhancing factor, improving evaluations through convenience and the modernity of the format. In the context of youth-oriented quest tours, digital technologies have shifted from being an optional and have become an expected condition, directly impacting the overall attractiveness of the product through parameters central to this audience: interactivity, engagement, and the modernity of content delivery.

Therefore, digital technologies should be regarded as one of the key factors in the competitiveness of quest tours within the youth segment, capable of shaping a modern, interactive format of cultural and educational tourism. The practical significance of the study lies in the potential application of the findings for designing hybrid tour products, in which digital solutions do not dominate but function as a connecting link between game mechanics, educational content, and users' emotional responses, thereby addressing the expectations of the digital generation without loss of meaning depth of the tour as a form of cultural communication. At the same time, the observed variability in evaluations highlights the continued importance of traditional elements of tour activities, underscoring the need for a balanced approach to the digitalization of the tour experience.

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CLUSTERS IN THE DEVELOPMENT OF OIL REFINING INDUSTRY ENTERPRISES IN THE MODERN ERA

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<https://orcid.org/0009-0007-1222-4238>**Abstract**

This article focuses on innovation in the development of oil refining enterprises within the 4C framework. It presents the results of a SWOT analysis of Europe, North America, the Persian Gulf, and the oil and gas cluster. In 2025, Azerbaijan's economy continued to grow amid complex global economic processes, demonstrating stability and resilience. Implemented economic reforms enabled an adequate response to risks and challenges in the country's economic security. Based on this research, the article outlines paths for the innovative development of the country's oil refining industry.

Keywords: innovation, petrochemical clusters, innovation activity, petroleum products, innovation strategy, modernization, processing industry, industrial parks.

Introduction

Azerbaijan is one of the most active members of the globalized world today. Fundamental steps have been taken in the country towards the establishment of a liberal economy, the process of forming a new economic system has been largely completed. Azerbaijan is an ancient oil country. The production that has been going on here for thousands of years has made an unparalleled contribution not only to the world economy, but also to the chronicle of the global oil economy as a whole.

It is known that the oil industry plays a special role in the economic and social progress of Azerbaijan. The development of this sector of the industry has also given impetus to the progress of other sectors of material production and has created favorable conditions for a significant expansion of social activities. At the same time, it should be noted that the level of development of the refining sectors still lags behind the capabilities of our country. The great potential of the oil refining industry in the republic, the wide capabilities of many scientific research and design and construction organizations are not being used to their full potential.

The issues of efficient use of raw materials such as oil, deepening of oil refining, improving the quality of oil products and especially lubricants, and increasing raw materials reserves for the production of petrochemical products should be in the spotlight. For this purpose, the necessary conditions are being created in the republic. It is necessary to implement programs for the fundamental reconstruction and modernization of the oil refining industry in a consistent manner. All this will significantly change the face of the sector, increase the efficiency and culture of production, and significantly deepen oil refining.

Discussion

Based on the essence of innovations and the issues of applying innovations in enterprises operating in the cluster, the management of innovative development in the country, the creation of a favorable environment for the activities of local and foreign investors, the attraction of modern equipment and technology, the improvement of the management sector, and the application of foreign experience here are the main directions of our country's development strategy. Thus, the main goal of our country's development strategy is to improve innovative development, integrate it into the world, and ensure the sustainability of the existing development in the country.

The essence of innovations is the use of scientific and technical achievements to increase the efficiency of human activity in one or another field. The types of innovations are as follows:

- Technological innovations imply new or improved equipment or technology.

-Production innovations are aimed at preparing goods in a new or more advanced form.

-Organizational and management innovations are implemented at the institutional level. That is, they imply new management mechanisms.

-Social innovations reflect the application of innovations in social areas.

-Basic innovations are the basis for the economy's movement from stagnation to revival, and then to growth. Basic innovations are scientific and technical innovations based on scientific discoveries and major inventions that form the basis of new generations of technology.

1. Azerbaijan Union of Economists, "Great Economic Encyclopedia", in 5 volumes. - Baku 2012.

The following types of innovation strategies are implemented in developed countries:

a) attack, goal - to occupy leading positions in the market, the goals of which are drawn to scientific innovations;

b) defense, goal - to firmly stand behind this pioneer (leader) by adopting some innovations and changes of the pioneer (leader), the costs of scientific innovations are lower than for the leader;

c) imitation, goal - to follow these leaders by repeating the achievements of both groups of leaders and using the specific advantages of the country or enterprise; the costs of scientific innovations are low;

ç) dependent, the goal is to protect oneself through the implementation of subcontracted work for innovative enterprises; the costs of scientific innovations are insignificant;

d) traditional, the goal is to protect oneself through the use of conservative technologies; the costs of scientific innovations are minimal;

e) opportunistic, the goal is to fill free (empty) holes in the market; the costs of scientific innovations are determined by tactical considerations.

The innovation process is the practical improvement and development of inventions in various fields. This is the transformation of scientific knowledge into innovation, which can be imagined as a chain of sequential events that occurs from an idea to a specific product, technology or service and spreads through practical use. The innovation process does not end with the application of the product to the field of activity, but continues to develop and improve after application. The innovation process is aimed at close interaction with the field of application; its direction, speed and goals depend on the socio-economic environment in which it operates and is created.

Innovation strategy is the selection of effective technical and technological development paths based on long-term forecasting, comparison of internal and external factors, and accounting for resource constraints. The formation and implementation of an innovation strategy is a necessary condition for the development of both the national economy as a whole and its individual sectors.

Innovation planning consists of developing the main directions and proportions of innovation activity in accordance with the established goals of innovation management, the possibilities of providing resources and the existing demand in the markets. In the process of innovation planning, the following problems are solved:

1) the goals of an innovative enterprise are detailed and brought to the attention of individual structural units and executors;

2) a list of implemented projects is formed;

3) the composition and sources of necessary resources are determined;

4) the sequence and terms of implementation of individual works and projects are agreed upon [1].

One of the factors determining the state's development strategy is the implementation of state regulatory measures in the direction of the state's application and management of innovations. The main goals and objectives of the state's innovation policy are to increase the competitiveness of the national economy and create favorable socio-economic, organizational and legal conditions for the development of innovation, as well as to create favorable conditions for investment in this area, to assist in the creation and development of innovation infrastructure, to develop cooperation in the field of innovation activity, to forecast technological development, organization of training, improvement and improvement of qualifications of personnel in the field of innovation activity, etc.

The main principles of the state innovation policy are as follows:

- freedom of scientific and technical creativity;

- protection of intellectual property;

- achievement of socio-economic development priorities, their orientation to innovation activity;

- ensuring effective interaction of the components of national innovation activity;

- optimal combination of methods and forms of state regulation of the development of innovation activity using market mechanisms;

- stimulation of innovation activity;

- economic efficiency and effectiveness of state support for innovation infrastructure and innovation activity subjects;
 - allocation of budget funds for the implementation of innovation projects on a competitive basis.
- Forms of state regulation of innovation activity are carried out in the following areas:
- adoption of regulatory legal acts in the field of innovation activity;
 - preparation and implementation of innovation development programs;
 - implementation of technical regulation and standardization;
 - organization of forecasting of technological development.

In connection with the transition to a modern innovation-oriented economy, the creation of local innovation companies contributes to a technological leap, attracting investment in high-tech sectors of the economy and the overall growth of the industry. Because enterprises with innovation infrastructure can support the entry of Azerbaijani oil products into foreign markets.

Conducted studies show that the correct organization of the application and management of innovations in oil refining enterprises is necessary to ensure a wide re-production process[2].

In the process of innovation activity, marketing is considered a management process that realizes demand and supply. Marketing is a concept that implements the production and consumption of innovative products that are effective for society.

Scientific and technical areas of activity in the country have not yet formed the basis of the socio-economic development of society. The basis of this activity in our republic is the attraction of direct foreign investments. New technologies, management methods and mechanisms are being introduced to the country. By purchasing foreign technology and licenses, companies can gain access to foreign markets. In addition, the flow of technologies without control over the country is considered dangerous for the country. In order to ensure the security of our country in the field of technology, it is necessary to create a technology transfer center.

In this regard, along with other management mechanisms, the organization and development of clusters also opens the way to innovative management.

A cluster is a set of elements with similar characteristics or parameters gathered in the same group.

In the cluster-based industrial policy of regional development, business leaders, state, institutional structures gain opportunities for active participation in the new competitive economy. This creates mutual dependence and collective responsibility in all subjects of the economy for effective competition conditions. It acts as an element of constructive interaction between the state and the private sector at the regional level in the direction of increasing economic growth and social welfare.

Studies show that the more efficient formation of a new industrial policy in the country will be associated with the tactics of improving and deepening regional economic reforms. On this basis, the widespread use of technoparks, business incubators networks in the regions, the establishment of free economic zones, the creation of modern science-intensive production areas, and industrial complexes will become another guarantee of economic security [3].

The reality is that in the Republic of Azerbaijan, appropriate specializations have been carried out in a number of provincial cities for the location of industry. In the regional policy being developed today, appropriate specializations should be deepened and continuously stimulated in cities and settlements based on a cluster approach. For this, first of all, a detailed assessment of the natural resources, economic potential, production infrastructure, budget process, internal investment opportunities, labor resources, and the state of the regional and integrated market within the framework of relevant marketing research and inventory processes is necessary.

The formation of industrial clusters in the regions should also be viewed as a necessary global competitiveness, and it should be used effectively as an important tool of economic specialization to overcome the barriers to globalization associated with foreign competition.

Stimulating the formation of regional clusters in Azerbaijan will essentially present itself as the first, initial stage of regional industrial policy, reflected in long-term parameters. Stimulating the development of clusters, on the other hand, will should not be of a regressive nature, but should set the main goal as the maximum use of regional competitive advantages and specializations.

The conducted analysis and research show that the construction of the state's new socio-economic development program of the regions in the perspective stage precisely on the industrial priority cluster strategy will ensure the stability and longevity of the overall economic development in a more complete system and will be accompanied by radical structural transformations [4].

The experience of petrochemical clusters in modernization shows that the experience of the formation and development of petrochemical clusters in foreign countries confirms that the cluster form of organization is one of the most promising development directions of the petrochemical industry.

The petrochemical industry is an actively developing sector of the world economy. It has a certain impact on such areas of industrial production as mechanical engineering, aviation and automotive industries, electricity generation and transmission, agriculture, light industry, etc.

The analysis of foreign and domestic sources made it possible to identify the following development trends of the world petrochemical industry:

1. Unstable situation in the world oil market. The decline in oil prices since 2014, due to the oversupply (due to the introduction of new oil extraction technologies) and the decline in demand as a result of the slowdown in the world economy, as well as the more efficient use of energy resources, has disrupted the stability of the situation in the world oil market.

2. Intensive development of the petrochemical industry in Asian countries. The main driving force for the sustainable development of Asian oil markets has been the development of China and India.

3. Extraction of raw materials from alternative sources: shale oil and gas, oil extraction from tar sands, methane extraction from coal seams, etc. Shale oil and gas deposits are extracted in many parts of the world, including the USA, Russia, China, Canada and other countries with large reserves. Industrial-scale work is underway in the USA and Canada. Methane is extracted from tar sands in the Canadian province of Alberta, and from shale seams in the USA and China.

4. In Europe, on the one hand, the process of obsolescence of the main production assets of the petrochemical industry is taking place, on the other hand, European countries remain the main producers of new technologies and know-how. Also, the European petrochemical products market is still the largest in the world.

5. Formation and development of petrochemical clusters at the regional, national and transnational levels of oil refining and petrochemical enterprises, enterprises of related and auxiliary industries, as well as financial and credit and other organizations.

In a number of countries, petrochemical clusters have already been formed, which determine the specialization of the economy of these countries and increase their competitiveness on an international scale they allow to increase [5].

Table. 1 The results of the SWOT analysis of North American petrochemical clusters are presented

Strengths	Weaknesses
- proximity to traditional and alternative sources of raw materials; -high innovation potential; -availability of highly qualified labor resources; -State support.	- high cost of doing business; -obsolescence and wear and tear of private infrastructure facilities and public infrastructure facilities (railways and highways, pipelines, ports, terminals, etc.).
Opportunities	Dangers
-future improvement of technologies and increased development of shale deposits; -development of high-tech petrochemical production.	-high level of development of traditional oil and gas fields; -relatively low profitability of shale extraction; -strong negative impact on the environment when extracting shale; -potential deficit of labor resources due to the aging of the workforce and the unattractiveness of these institutions for graduates of higher education institutions.

Source: Table prepared by the author.

In this regard, the study of foreign experience in the formation of petrochemical clusters is considered relevant. Let's take nine foreign petrochemical clusters as the object of research:

- In North America: Texas (USA), Alberta (Canada);

- In Europe: Antwerp (Belgium), Rotterdam (Netherlands), Rhine-Ruhr (Germany), Tarragona (Spain);

- In the Persian Gulf countries: Jubail (Saudi Arabia), Abu Dhabi (UAE);

- In the Asian region: Jurong (Singapore).

The first petrochemical clusters were formed in the USA and Europe. In the 1940s, the cluster in Houston (Texas, USA) accounted for 30% of the total volume of petroleum products and 50% of ethylene and propylene produced in the country.

Texas is a leading oil extraction, refining and petrochemical center with a concentration of large production capacities. Houston is a leader in the world in the production of petroleum products. The Houston Ship Channel is the largest petrochemical complex in the United States, where more than 125 oil refining and petrochemical companies are located.

Currently, the Texas oil refining and petrochemical cluster is one of the 6 clusters selected as one of the priority directions of the development of the US economy. The goal of the development of this cluster is to increase the competitiveness of Texas at the national and international levels. The head of the cluster is the management of the Port of Houston.

The structure of the petrochemical cluster located in Alberta, Canada includes 36 petrochemical enterprises, including one of the largest ethylene enterprises in the world - Nova Chemicals.

An important advantage of North American petrochemical clusters is the presence of the largest hydrocarbon reserves in the world. In recent years, there has been a trend of declining production from traditional oil and gas fields in the United States and Canada, but the extraction of hydrocarbon raw materials from unconventional sources (Canadian oil sands, shale oil and gas in the United States and Canada) is actively developing.

The emergence and development of petrochemical clusters in Europe dates back to the period after the Second World War: Rotterdam (Netherlands) in 1955, Antwerp, Tarragona and Rhine-Ruhr in the 1960s.

The Antwerp and Rotterdam petrochemical clusters are integrated into their respective seaports. The activities and development of the Rhine-Ruhr petrochemical cluster are managed by public-private companies: ChemSite and ChemCologne.

Although Antwerp, Rotterdam and Rhine-Ruhr are three independent clusters operating in three countries, in the scientific literature they are combined and referred to as a single megacluster (with the initials ARRR). The main factor in the combination of these 3 clusters in a megacluster is the technological interaction of enterprises with the help of a common infrastructure. ARRR is currently considered the most integrated petrochemical cluster in the world

Table.2 The results of the SWOT analysis of European petrochemical clusters are shown

Strengths	Weaknesses
- located at the intersection of international transport corridors; - provided with competitive raw materials; - high innovation potential; - availability of highly qualified labor resources.	-high cost of energy resources; -high cost of labor resources; -lack of central bodies coordinating the activities and development of the ARRR megacluster and the Tarragona cluster; -overloading of transport infrastructure.
Opportunities	Dangers
-attracting investments in the development of infrastructure facilities and fixed assets; -solving the problem of limiting the area of clusters in Tarragona and Rotterdam	-remoteness from hydrocarbon raw materials sources; -obsolescence and wear of basic production assets; -limited cluster areas for the placement of new production and the development of existing production.

Source: Table prepared by the author.

The emergence and development of petrochemical clusters in Europe dates back to the period after the Second World War: Rotterdam (Netherlands) in 1955, Antwerp, Tarragona and Rhine-Ruhr in the 1960s.

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As for the Tarragona cluster in Spain, here the North and South industrial parks have merged to create a cluster connected to the port of Tarragona. Oil refineries are concentrated in the northern industrial park, while petrochemical plants operate in the southern one. Unlike Antwerp and Rotterdam, the port of Tarragona is not included in the cluster structure. There is also no management company responsible for its activities and development in the Tarragona cluster.

Table.3 The results of the SWOT analysis of the petrochemical clusters of the Persian Gulf countries are presented

Strengths	Weaknesses
- proximity to the world's largest hydrocarbon resource base; - state support for the petrochemical industry; - availability of free trade and industrial zones for cluster development.	-relatively low innovation potential, which is associated with poorly developed innovation infrastructure; -insufficient skilled labor force; -dominance of state-owned enterprises in clusters; -insufficient support for small and medium-sized businesses.
Opportunities	Dangers
-Trade relations with large growing markets in Africa, Asia, especially India; -Proximity to the Asian labor market; -Introduction of new technologies (in the short term); -Increased innovation activity (in the long term).	- instability of financial support for the development of clusters; - weak development of high-tech petrochemical production.

Source: Table prepared by the author

When oil and gas prices rose sharply in the 1980s, the Persian Gulf countries used their cheap raw materials to develop their local petrochemical industries. As a result, two large petrochemical clusters were formed: Jubail (Saudi Arabia) and Abu Dhabi (UAE). The cluster in Abu Dhabi includes 4 state-owned petrochemical companies (Takreer, Borouge, Chemaweyat, Fertil). The supply and processing of oil and gas are also carried out by state-owned enterprises. The development of the oil, gas, and petrochemical industries is at the disposal of the state-owned company ADNOS, located in Abu Dhabi.

The leading company in the Jubail cluster is Saudi Basic Industries Corp. (SABIC). 70% of its assets are state-owned. SABIC is considered the largest corporation in the Middle East.

The main advantages of these clusters are that they have the largest oil and gas reserves in the world.

According to the RIA Rating Agency, the total value of oil and gas reserves in the UAE is 1.6 million dollars, in Saudi Arabia - 1.1 million dollars (3rd and 6th places in the world, respectively). The largest petrochemical cluster in the Asian region is located on Corung Island (Singapore).

The Corung cluster was created in 1976. The cluster consists of a separate artificially created Corung Island and part of Singapore Island. In the 1990s, the government invested 23 billion dollars in the development of the cluster. Higher educational institutions in the country were instructed to train a workforce and highly qualified personnel for this cluster. At the same time, specialists from foreign countries were invited, and a scientific base was created.

The opening of the cluster took place in 2000, and its territory is still being expanded to continue production. The cluster operates on the plug and play principle: this cluster is a petrochemical site with ready-made infrastructure (telecommunications, transport, utilities) and access to a logistics center [6].

The organization responsible for developing plans for industrial parks is Jurong Town Corporation (JTC), a state corporation that acts as the landowner and infrastructure owner, but is subordinate to the Singapore Ministry of Trade and Industry.

Table.4 SWOT analysis of the Curong petrochemical cluster is provided

Strengths	Weaknesses
-plug and pay operation; -high innovation potential; -active state support; -specialized labor resources	-high costs of doing business: rent, wages, energy resources, industrial and drinking water supply
Opportunities	Dangers
-attraction of new residents; -increasing domestic demand for the cluster's products by other industries in Singapore (electronics, plastics production, pharmaceutical industry)	- remoteness from hydrocarbon raw material sources; - limited cluster areas for the placement of new production and the development of existing production

Source: Table prepared by the author

These tables highlight the common strengths characteristic of the 9 petrochemical clusters. These clusters are located at the junction of major transport corridors and are in a favorable position. The main factors determining the location of clusters include: proximity to hydrocarbon raw materials (Jubail, Abu Dhabi, Texas), clusters located at the junction of logistics routes (Rotterdam, Antwerp, Corung, Texas), proximity to product sales markets (European clusters).

The clusters are provided with a developed transport infrastructure: pipelines, railways, automobiles and water transport. 8 of the 9 clusters we have considered have seaports on their territory.

For the sustainable development of enterprises included in petrochemical clusters, their interaction with mixed, neighboring sectors is necessary. Enterprises in these petrochemical clusters have established strong ties with such sectors of industry as mechanical engineering, electronics, and electricity generation and transmission.

The experience of forming petrochemical clusters in foreign countries proves that an important condition for their successful development is state support and participation. State participation and support is carried out in the following main directions:

1. Management of the formation, activity and development of the petrochemical cluster. In 6 of the 9 clusters we considered above, the body responsible for the activity and development of the cluster is a state company.

2. Financial support for the development of clusters. This is manifested in the allocation of subsidies to enterprises included in the cluster. One of the forms of financial support is the implementation of joint public-private projects. These projects are aimed at the development of cluster infrastructure. Table 6 gives examples of public-private projects in petrochemical clusters of a number of countries.

Creating favorable conditions for the development of clusters: developing an appropriate legislative framework, providing tax breaks, stimulating domestic demand and product exports, etc. So, for example, in Texas, the main tools for supporting clusters are favorable tax policies and reducing administrative barriers for enterprises included in clusters.

Overall, the experience of the formation and development of petrochemical clusters in foreign countries confirms the effectiveness of the application of the cluster form of organization in the petrochemical industry [7].

Table.5 Public-private projects in petrochemical clusters of the regions

Cluster	Project	Effect
Rotterdam	Construction of the MultiCore pipeline (joint project of the Port of Rotterdam and Vopak)	A 20 km long pipeline network has been created connecting the cluster's enterprises.
Jurong (Singapore)	Establishment of a chemical technology center (currently a joint venture between the Singapore government and Petrofac)	Trainings are held at this center. The trainees are provided with conditions to work in the training auditorium as if they were in a real factory.
Tarragona (Ispaniya)	Construction of a water pipeline to supply water to the cluster's enterprises Creation of a security system for the chemical parks of Tarragona. Pipeline system connecting the port of Tarragona with the Southern Industrial Park - Dixquimics project	The 100 km pipeline from the Ebro River to Tarragona supplies water to petrochemical plants and the city districts (60% and 40% respectively). Special fire-fighting zones have been created on the territory of the North and South chemical parks, as well as in the port of Tarragona, and the cluster is equipped with fire-fighting vehicles. A system of 60 pipelines connects the port of Tarragona with the South industrial park. Currently, 16 petrochemical plants are involved in the project

Source: Table prepared by the author

Territorial-field oil cluster as a form of effective strategic management Industrial cluster - a group of industries interconnected by common technologies, common buyers or distribution channels, or common scientific research.

Regional cluster - an industrial cluster whose participants are located in close geographical proximity to each other (geographical agglomeration of firms in one or similar industries).

Industrial district - a concentration of firms involved in the production process, usually in one industry or industry segment. Business networks include several enterprises connected by communications and mutual relations.

The difference between a regional cluster and an industrial district is that an industrial district is formed on the basis of a single industry or even a segment of an industry, while regional clusters mainly consist of a number of interconnected industries.

It is possible to build industrial clusters on the basis of selected key enterprises - this is a group of enterprises that meet the latest needs, united by scientific research and close cooperation, starting from sales. More specifically, a cluster is a network of independent creators of innovative technologies, concentrated by geographical features and interacting with each other, competing with each other in order to create value. In this context, the definition of the products of oil production and oil refining manufacturers allows us to say that the oil cluster is equivalent to a regional territorial-sectoral oil complex.

There are other classifications of clusters, for example, a cluster of squeezed enterprises, a leading cluster, a transnational cluster.

Table 6. Important types of clusters and their characteristics

	Industrial district	Wheel cluster	Satellite cluster
<i>Important characteristics</i>	-first of all, small and medium-sized enterprises; -high specialization; -strong local competition and networking (cooperation); -relationships based on trust	- large local enterprises and local small and medium enterprises; - precise hierarchical relationships	-small and medium-sized enterprises, primarily dependent on foreign firms; -local advantages based on costs; -"Extended production chain
<i>Strengths</i>	-flexible specialization; -high product quality; -innovation potential	-cost advantages; -flexibility; -power and potential of large firms	-cost advantages; -development of science and secret knowledge
<i>Weaknesses</i>	-long-term adaptation to radical changes in economic conditions or technologies	-cluster dependent on productivity of small firms	-dependence on sales, semi-finished products and know-how firms; -limited scope for local regional policy
<i>Development directions</i>	-recession/depression; -change in internal division of labor; -location of certain types of activity to other regions	-recession/depression (if large firms go into recession); -increase in value; -change in the division of labor in the cluster (large firms transfer part of their activities to small and medium-sized enterprises)	-decline; -increase in value; -increase in activity (up and down),
<i>Regional policy</i>	-a common effort to create local specific advantages; -public-private partnership	-cooperation between large enterprises, unions and institutions to strengthen local small and medium-sized enterprises	- standard tools to stimulate small and medium-sized enterprises

Source: Table prepared by the author

The characteristic features of a cluster of compacted enterprises include limited social capital, distrust, destructive competition, and limited innovation. The weakest point in this cluster is that all its enterprises produce more or less the same goods, successful product innovations in one enterprise are quickly absorbed by other enterprises, and all enterprises produce the same product again. In addition, the technical and commercial potential of enterprises is very weak [8].

The Diamond model, developed by the famous American economist M. Porter, which describes the factors that determine the ability of the subject of analysis to form, support, develop, and use competitive advantages, identifies the following main sources of competitiveness:

- conditions defined as the emerging potential of the region, which include geographical, natural-climatic, demographic, production, scientific, and other conditions;
- aggregate demand arising from local and external (local, regional) sources, - this is also the source of the formation of the necessary competitiveness of the cluster;
- the degree of connection with other areas. This reflects the level of cooperation and integration in the production of goods and services and is a source of competitiveness due to increased production efficiency as a result of specialization;
- the structure of the firm, general and functional strategies, the level of competitive struggle in this region make their development more intensive, stimulate the introduction of new technologies, increase labor productivity and reduce costs, which is also a source of competitiveness.

The following can also be cited as necessary elements of the Porter model:

- favorable opportunities; in this case, coincidences associated with sharp positive changes in world financial markets, changes in currency quotes, unexpected increases in demand, as well as other force majeure circumstances are considered;
- the influence of the government on the economic activities of economic entities, which determines the effectiveness of the work of economic management systems at various levels.

As is known, the cluster includes enterprises of various industries, federal and regional government bodies, scientific research organizations, and educational institutions of various levels. All of them, participating in the development of the cluster, contribute to the concentration of all forces and capabilities, which determines the competitiveness of the cluster [9].

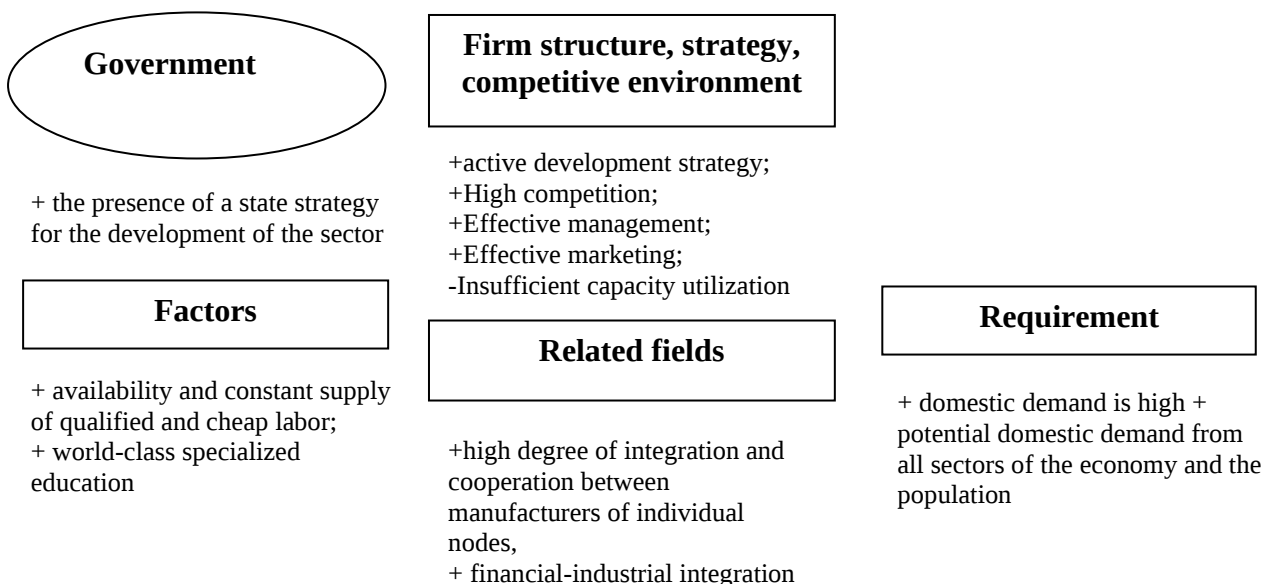
The state, represented by local executive and legislative bodies, can take the initiative to create and develop clusters in the region. In fact, initiatives for the development of clusters come, first of all,

from the business sector, and the state plays a secondary role. Let us list the factors that allow cluster participants to benefit from clustering:

- competition - as the driving force of cluster development;
- localization of enterprises within a closed space;
- territorial proximity of the production process and consumption (suppliers, equipment installation companies, distributors and end consumers);
- the presence of social infrastructure within the cluster. This makes it possible to simplify the transfer of technologies and knowledge, which contributes to the growth of the cluster.

Using a vertical integration strategy, enterprises increase the efficiency of production within the cluster. Vertical inter-sectoral connections between industries and infrastructure contribute to overall development.

The formation of clusters on a regional basis can be observed in places where the geographical concentration of interconnected areas is high. This also allows for an increase in the flow of capital and technologies with the help of direct investments. The formation of the oil complex in the form of a cluster is more effective in regions where oil production and oil refining are more concentrated. However, their distribution across regions is not at all equal. This is observed in the following regions: in the Volga region - 39.9%, in Western Siberia - 35.8%, in the Caspian - 11.3%, in Eastern Siberia - 6%, in the North-West - 2.1%, in the Far East - 4.9%. All of the above-mentioned organizations participate in the development of the cluster, and thus, cooperating with each other, they complement each other and thereby contribute to the creation of a particularly effective concentration of their strength and capabilities in the region, which allows them to successfully win sales markets.



Scheme 1. Competitiveness factors for the territorial-field oil cluster

Source: Table prepared by the author

Cluster analysis assumes that each specific sector can be considered separately from the others and can develop systematically within the cluster. Any diversified economy can increase the competitiveness of its main products more quickly by improving the situation of related sectors (on which the cost, quality and service characteristics of the main product depend). It is obvious that when a base sector is formed, both the supplier sectors and the consumer sectors belonging to the cluster development will occur [10].

The regional oil complex belongs to such clusters where the subjects of the cluster have the opportunity to achieve greater profits compared to their competitors

It should be noted that the influence and composition of these factors may vary in individual regions.

The unification of the goals of oil complex enterprises included in the relevant cluster cannot be implemented solely on the basis of market relations. In our opinion, there should be a complex of measures implemented in the system of state regulation for all economic entities [95.p.86].

Conclusion

As a result of the study, it was determined that structural changes in the country's economy, modernization, are accompanied by increasing dynamics, which necessitates the formation of clusters, which in turn necessitates the formation of clusters in the context of changing the structure and volume of demand for oil and gas products.

The conducted studies show that the proper organization of the application and management of innovations in oil refining enterprises is necessary to ensure a wide re-production process.

In terms of ensuring the security of our country in the technological field, it is necessary to create a technology transfer center.

In this regard, the organization and development of clusters, along with other management mechanisms, also paves the way for innovative management.

A cluster is a set of elements with similar characteristics or parameters gathered in the same group.

In the cluster-based industrial policy of regional development, business leaders, state, institutional structures gain opportunities for active participation in the new competitive economy. This creates mutual dependence and collective responsibility in all subjects of the economy for effective competition. It acts as an element of constructive interaction between the state and the private sector at the regional level in the direction of increasing economic growth and social welfare.

The conducted research shows that the construction of the new socio-economic development program of the regions in the perspective stage on the industrial priority cluster strategy will ensure the stability and long-term sustainability of the overall economic development in a more complete system and will lead to radical structural changes. As a result of the analysis conducted in the article, we can note that the experience of the formation and development of petrochemical clusters in foreign countries proves that the cluster form in the petrochemical sector of our country is one of the most promising development directions.

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THE IMPACT OF THE DEVELOPMENT OF ENTREPRENEURIAL ACTIVITY ON THE STRUCTURE OF THE LABOR MARKET IN AZERBAIJAN AND ITS MATHEMATICAL STATISTICS

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Introduction

Entrepreneurship, which is the main attribute of a liberal economy, is one of the main economic tools in the formation and development of the labor market. Especially in countries that have experienced a period of transition to a market economy, the expansion of entrepreneurship has led to an increase in employment, the creation of new professions and qualitative changes in the structure of the labor market. In the Republic of Azerbaijan, the development of entrepreneurship has also had a significant impact on the structure of the labor market. The priority of the economic policy implemented in Azerbaijan over the past 30 years has been to apply all elements of a liberal economy in the business environment formed in the country in connection with the transition from an administrative command system to a market economy, as well as to protect the principle of social orientation, and to prevent the chaotic situation that may arise in the labor market as much as possible. In this regard, the adoption of the socially oriented market economy model, which is the most optimal market economy model for the Azerbaijani economy, by our state and the maximum support of entrepreneurial entities necessary for its development, has been the formation of stimulating mechanisms necessary for the sustainability of their activities. It is no coincidence that in the 35 years since the restoration of state independence, all indicators of regional, mental and economic potential have been analyzed to form an efficient and specific economic model, which can quickly integrate the Azerbaijani economy into the world economy by moving away from the remnants of the administrative command system with the least possible damage. Large-scale projects and state programs have been implemented to form an efficient and specific economic model. In order to maintain a high level of employment in the labor market, an efficient business environment has been formed despite the impact of technological innovations taking place on a global scale. Necessary reforms are being rapidly continued today [2, p. 25].

Stages of development of entrepreneurship in Azerbaijan and specific features of the labor market in a market economy

Since the period of independence, the formation of the private sector and the promotion of entrepreneurship have been one of the priority directions of state policy in Azerbaijan. In this area, institutional support mechanisms have been created, the business environment has been simplified, and financial support has been provided to entrepreneurs [1, p. 12]. The Small and Medium Business Development Agency (SMEDA) and the Ministry of Economy of the Republic of Azerbaijan play an important role in the development of entrepreneurship. These institutions provide entrepreneurs with legal, financial and advisory support, creating conditions for the creation of new jobs in the labor market. When analyzing the economic importance of entrepreneurial activity, it can be said that it plays an important role in the following areas.

Employment growth

The expansion of entrepreneurship leads to the creation of new enterprises and, as a result, the creation of new jobs. In particular, small and medium-sized businesses have become one of the main sources of employment in the labor market. This process in itself leads to a decrease in unemployment, an increase in employment in the regions, and the expansion of self-employment.

Structural changes across sectors. The development of entrepreneurship affects the distribution of labor in various sectors of the economy. Labor resources, previously concentrated mainly in industry and agriculture, are gradually directed to: the service sector, trade and logistics, tourism and information technologies. This has led to the diversification of the sectoral structure of the labor market.

The emergence of new professions and specialties. Entrepreneurial activity accelerates the development of innovative areas. As a result of the growth of startups and digital businesses:

- Programming;
- Marketing and SMM
- Electronic commerce
- New professions such as financial management are in greater demand in the labor market.

These changes are leading to a renewal of the professional structure of the labor market.

Formation of labor relations

The growth of entrepreneurship also creates changes in labor relations. In the private sector:

Contract-based work;

Flexible work schedule;

The differential wage system based on the coefficient of useful work is more widespread. This creates conditions for the modernization of the institutional structure of the labor market.

Studies show that certain structural changes are observed in the share of the employed population by sectors. The analysis shows that there are both stability and gradual transformation tendencies in the sectoral distribution of the economy.

1. Agriculture, forestry and fishing are changing at a rate of 36% → 35.4%. This sector is one of the directions with the highest employment share. However, a slight decrease in indicators is observed over the years (0.6 percentage points). This trend in itself reflects the acceleration of the urbanization process, the expansion of the service sector, and the transfer of labor resources to other sectors.

2. Manufacturing industry is changing at a rate of 5.4% → 5.8%. Studies show that the share of employment in the manufacturing industry has gradually increased. This increase may indicate: the development of the non-oil industry, the expansion of production areas, and the fact that the state's industrialization policy covers a wide spectrum. This is considered a positive trend in structural terms.

3. Transport and warehousing changes from 4.2% → 4.1%. The indicators in this area have remained stable. A small decrease (0.1 percentage point) is not considered a serious change in structural terms. The expansion of logistics and transit opportunities may lead to an increase in the share of this area in the future.

4. The employment level in the construction sector is observed at a rate of 7.6% → 8.0%. The growth in the construction sector can be mainly attributed to the implementation of infrastructure projects in the country, the development of urbanization and regions, the expansion of housing construction, and especially the construction work carried out in accordance with the Great Return Plan in our regions liberated from occupation after 30 years of enemy occupation thanks to the bravery of the Victorious Supreme Commander-in-Chief and our heroic army. The construction sector is one of the main sectors contributing to the growth of employment in the last 20 years.

5. The contribution of the education sector to employment in the last 5 years has been 7.8% → 7.4%. A slight decrease is observed in the education sector. This can be explained by structural optimization in the public sector or faster employment growth in other areas.

6. Other sectors have changed from 39% → 39.3% in the post-pandemic period. The largest share falls on the share of services and other areas of activity. This group includes: Trade, financial services, public administration, tourism, information technologies. The high share indicates that the economy is developing in a service-oriented manner. A general analysis shows that: The share of agriculture is gradually decreasing, there is an increase in the processing industry and construction sectors, and services and other sectors remain in a leading position in employment. Structural changes reflect the process of diversification and modernization of the economy.

Current state of entrepreneurship development:

The development of entrepreneurship in the regions also affects the territorial structure of the labor market. Supporting small and medium-sized businesses in the regions reduces the migration of the population to the capital to some extent and increases local employment. In this regard, state programs and preferential credit mechanisms play an important role.

The analysis for 2010–2024 shows that:

-The added value created by small businesses has increased significantly;

-Employment has demonstrated a stable growth trend;

-The wage level has more than doubled;

-Investment activity has expanded.

These indicators confirm that the role of small businesses in the country's economy has strengthened and they occupy an important place in the macroeconomic structure. Small businesses are of strategic importance both in the formation of GDP and in ensuring employment.

Table 1.

Main macroeconomic indicators of small business entities in the Republic of Azerbaijan [8]

Indicators	Years					
	2010	2020	2022	2023	2024	% in 2024 compared to 2010
Added value created, million manats	1 466,2	1 617,9	2796,1	3 254,9	3 469,6	2, 37 times
Average annual number of employees, thousand people	109,0	92,1	104,8	110,3	121,5	110,0%
Average monthly nominal wage, manat	303,5	533,8	575,6	642,8	679,2	2.24 times
Investments in fixed capital, million manats	486,5	380,4	955,1	794,0	821,4	169,0

Source: State Statistics official website www.stat.gov.az.

Studies show that the development dynamics of small business entities in the Republic of Azerbaijan for 2010–2024 was quite high. Thus:

1. Added value created

- 2010: 1,466.2 million manat

- 2024: 3,469.6 million manat

- Growth: 2.37 times

This indicator indicates a significant increase in the role of small businesses in the economy. Although growth was relatively weak in the 2010–2020 period, rapid growth has been observed since 2022. This dynamics can be explained by the restoration of business activity and state support mechanisms in the post-pandemic period.

2. Average annual number of employees

-2010: 109.0 thousand people

-2024: 121.5 thousand people

-Increase: 110% (i.e. 10% increase)

Although the employment indicator decreased in 2020 (92.1 thousand people), recovery and growth occurred in subsequent years. The increase in employment in 2024 compared to 2010 indicates that small businesses maintain a stable position in the labor market.

3. Average monthly nominal wage

- 2010: 303.5 manat

- 2024: 679.2 manat

- Increase: 2.24 times

A more than 2-fold increase in wages indicates an increase in labor productivity and economic activity. This increase is due to both the inflation factor and qualitative changes in the labor market.

4. Investments in fixed capital

2010: 486.5 million manat

2024: 821.4 million manat

Increase: 169%

The increase in investments indicates the strengthening of the material and technical base of small business entities. In 2022, a sharp increase in investments (955.1 million manat) was observed, and in subsequent years a certain stabilization occurred.

A number of factors influence the development of entrepreneurship and the increase in the level of employment:

-Informal employment;

-Mismatch between professional qualifications and labor market requirements;

-Low labor productivity in small businesses;

To solve these problems, it is important to strengthen vocational education and further improve the business environment.

Currently, the impact of a number of factors on the structure of the labor market in our country is clearly manifested:

1. Economic structural problems. These arise with the economic structural changes taking place in the country's economy [3, p. 43]. We can classify them as follows:

Inter-sectoral imbalance – Concentration of a large part of labor resources in low-productivity sectors (for example, in agriculture).

Insufficient development of the non-oil sector – The long-term orientation of the economy on raw materials limits the creation of new and sustainable jobs.

Regional development differences – Unequal distribution of economic activity between the capital and the regions.

2. Mismatch between education and the labor market.

This factor is currently emerging as perhaps the most pressing issue in ensuring economic dynamism. Especially in the era of rapid integration of education into production sectors in the age of artificial intelligence, one of the most important problems of the Azerbaijani economy is the mismatch between the education sector and the requirements of the labor market. From this point of view, the problems it creates are characterized as follows:

Incomplete compliance of personnel trained in the higher and secondary specialized education systems with the real needs of the labor market;

Poor development of vocational education;

Lack of practical skills.

Conclusion

Entrepreneurship in Azerbaijan should have a significant impact on the structure of the labor market, creating conditions for increasing employment, the formation of new professions, and sectoral diversification of the economy. As a result of effective state support and institutional reforms, entrepreneurship has become a leading force in the modernization of the labor market. In the future, the development of an innovation-oriented and sustainable entrepreneurship model will lead to further improvement in the quality indicators of the labor market. Our research shows that during the analyzed period, the entrepreneurship sector has developed in terms of quantity and quality, becoming one of the important sources of economic growth and employment. In the future, the expansion of innovation-oriented investments and digitalization may create conditions for more sustainable development of the sector.

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ARTIFICIAL INTELLIGENCE IN FINANCIAL OPERATIONS: EFFICIENCY OUTCOMES AND IMPLEMENTATION CHALLENGES

Shalala Ch. Safarli

Abstract

This paper seeks to identify which finance operations are transformed, disrupted, or complicated by the application of artificial intelligence. For the purpose of this research paper, the term financial operations, in its practical day-to-day sense, refers to operationally intensive finance activities. These activities include: document review, data extraction from contracts, client onboarding and KYC screening, transaction monitoring, reconciliation support, preparation for audits (internal/external), payment activities, and customer servicing. Despite rhetoric about improved speed and cost-effectiveness, we found that the main practical challenges facing AI initiatives in practice are due to implementation infrastructure (i.e. workflows, data architecture, internal controls and accountability structures). As such, we develop two parallel lines of analysis. The first strand investigates the macroeconomic impacts of the growth in automation in finance and includes investment into AI and growth in AI-related job postings in the finance and insurance sectors. The paper also considers the use of quantitative methods in large finance companies, specifically the intensity of automation. In the empirical section, we estimate AI investments in the AI sector from 2015 to 2024 by using the latest available databases and industry reports. Finally, we estimate demand for labor in the finance and insurance sector through 2023-2024 by analysing the cost savings and revenue generated by each function and the extent to which rapid generative AI uptake in 2024 aligns with the reality of financial operations. The second theme focuses on barriers and implementation risks such as governance and control, data quality, privacy, third-party dependence, definitional issues, technology and explainability, cyber risk, and limited organization-wide understanding of AI. The analysis challenges the notion that these are exogenous risks intrinsic to the technology rather than side effects of operational change. It also shows that AI creates value through efficiency improvements, but that these are largely uneven, creating the potential for inequality and misallocation of resources. This case study indicates that the highest potential for AI is in processes that have high transaction frequency and low variation with defined performance measures and are complemented by improvements in controls and re-designing surrounding processes. Therefore, this study argues that when implementing AI in financial functions, companies should think of the transformation as an operational and governance change, rather than solely an implementation of new software. However, unless the earlier parts of the process are redesigned in a systemic way, bottlenecks may occur in the new parts, limiting the sustainability of efficiency improvements.

Keywords: *Artificial Intelligence; financial operations; productivity effects; model risk; implementation constraints.*

INTRODUCTION

Financial operations implies neatness, but the work itself is complex and labour-intensive: parsing and entering data into operating systems, responding to alerts, reconciling discrepancies, building audit trails, dealing with customer requests, and untangling minor issues before they become material risk events. When it comes to automation, the question is rarely whether AI leads to better performance without context. Most commonly, it is which dimension is affected first, e.g. speed, correctness, or cost base, and what other dimensions are exposed to downside pressure, e.g. transparency, accountability, and security. The aim of this paper is to remain relevant to these operational realities, while remaining academic and analytical.

In the context of research and policy, this implies that, besides the innovation aspect of products and services, there are implications for the information collection on the financial system and how that information is used in how decisions are made in the sector. The BIS working paper suggests that successive waves of information-processing technology have expanded the range of finance tasks in which automation is possible, from customary analytics to machine learning and, more recently, generative models, already influencing back-end processing and compliance (Aldasoro et al., 2024). This framing is consequential because it moves AI from a marginal feature attached/added to a product, to an operational infrastructure embedded in institutional routines, that is evaluated through the lens of

not only performance gains, but also reliability of controls, integrity of data handling, and clarity of accountability structures.

There is consistency in policy-facing literature on the channels for efficiency gains, with risk amplification and risk creation as complements. For example, the Financial Stability Board report on the financial stability implications of AI lists operational efficiency and compliance support as benefits, and scope for amplification of existing sources of vulnerability and creation of new sources of vulnerability (in particular through third-party dependencies, concentration in specialist providers, and difficulties in monitoring through complex models) as vulnerabilities [FSB, 2024]. The supervisory perspective complements management-oriented perspectives of efficiency that see risk as merely a downstream problem in the technology transition. Instead, it sees efficiency and systemic exposure as formulated through the same technological transition.

This balancing between the efficiency benefits from AI in terms of cost and quality and the risk stemming from AI appears in the OECD report on AI, machine learning and big data in finance, which explicitly relates this aspect to efficiency in credit underwriting, trading and data-driven business models [OECD, 2021]. Financial efficiency is thus not just a firm or industry issue but also a market and competition issue, which is partly why efficiency keeps being revisited by regulators and treated as an issue of wider financial stability.

When viewed through the lens of adoption in the operating environment (the real world) data shows that three quarters of companies surveyed in a report by the Bank of England and the Financial Conduct Authority in 2024 already used AI, with a further 10% intending to adopt it over the next three years. Around a third of AI use cases are provided by third-party firms, and firms know a limited amount or nothing about the AI technology embedded in their business [Bank of England and FCA, 2024]. The operational findings in this section show that many firms are at the early stages of implementing AI rather than making aspirational statements. They explain why efficiency narratives get entangled with governance questions: when capabilities are procured from the market, it is harder to stress control and accountability as core values.

On the empirical side, productivity effects of AI in operational service contexts have been studied extensively. For example, a well-known study, Generative AI at Work, by Brynjolfsson and his coauthors investigates the effects of AI assistance in a large customer service context and finds an overall productivity increase. For less-skilled workers, these effects are more pronounced [Brynjolfsson et al. 2023, 11]. Although the bank context does not apply here, the task characteristics are similar to those of financial operations where exceptions are rare, workflows are well-defined, and responses are at least partially scripted. This study thus provides an empirical reference point to interpret the nature of the efficiency gains that are possible at the level of teams and routine processes.

If we combine the three strands, we see that policy documents focus on risks, surveys describe overall patterns of adoption and dependence, and selected case-based studies report performance gains. One simple comparison question remains unanswered: if AI improves a financial process, is the main benefit operational, organisational or financial? A benefit could be a shortening of process cycle times, an increase in process accuracy, fewer escalations and better resource allocation and predictability, or reduced costs of particular process activities. Many studies measure one dimension and impute the others. In practice, these inferred dimensions are often the points at which the implementation fails, for example due to a trade-off between cost savings and auditability, explainability, and risk containment. Thus, measurable indicators for these dimensions of impact need to be established.

In this context, the aims of this paper are more modest and do not attempt to identify causal effects in the econometric sense. An evidence-based operational picture is presented using public data sources and case studies which have become available recently. Where time-series are available, the period of analysis is set to run from 2015 to 2024, and 2024 is the last year included in the tables. Events that continued into 2025 are discussed narratively, where relevant, but the tabulated analysis does not go beyond the period where stable public time series data are available.

MATERIALS AND METHODS

This study employs an empirical document design, using time series data on corporate investment in AI, from 2015 to 2024, included in the Economy chapter of the AI Index Report 2025 published by Stanford University HAI [Maslej et al., 2025] as a proxy for the overall investment environment within which financial operations teams source tools, vendors, and specialist talent. Among other influences, investment cycles impact entry and exit of providers, pricing power, off-the-shelf maturity of solutions, and the labour force available to do implementation and control functions.

Second, the study assumes that the increase in AI job ads in U.S. finance and insurance industries between 2023 and 2024, as captured in the AI Index labour-demand dataset (sourced from Lightcast), is an observable signal of skills constraints. [Maslej et al., 2025] This is because operationalisation of AI systems requires practitioners who can deploy, validate, monitor, and govern them; job ads are consequently a concrete signal of organisational demand for skills and the resulting pressure on the recruitment market.

Third, the paper draws on sectoral evidence from the 2024 AI/ML survey of UK financial services firms by the Bank of England and the Financial Conduct Authority. This survey is used to identify measures of AI/ML use, third-party driven use and the governance of use in the sector, and is interpreted as providing descriptive evidence on which impediments may be particularly pronounced in practice [Bank of England and FCA, 2024]. It is not taken as evidence of causation, but rather illustrates these efficiency claims set against the realities of institutional outsourcing and the limited knowledge of deployed systems from the inside.

Fourth, it builds on Table 1 with the function-level cost and revenue effects of generative AI in 2024, found in the same chapter of the same AI Index report. These underlying numbers are collected by the AI Index and reported as a McKinsey survey. Raw percentages are used without rescaling or other transformation [Maslej et al., 2025] because this preserves the comparative nature that the authors used in their analysis, and the modelling assumptions cannot be verified through the public version of the dataset.

The empirical section concludes with a few examples of organizations, in which the outcome is captured by concrete performance indicators such as time saved in hours, number of alerts reduced, response time, and time to detection. Example cases are the contract intelligence system of a large US bank described in the annual report's CEO letter [Zames, 2016], AI outcomes in a global bank to increase efficiency in anti-money laundering [May, 2023; HSBC, 2024], automation in audit delivery [UiPath, 2018], and digital assistant productivity metrics [Bank of America, 2024]. These are not representative but illustrative and operationalise what we mean by "efficiency outcomes" at the level of measurable delivery metrics.

RESULTS AND DISCUSSION

First, the AI investment environment has dramatically increased over the last decade, albeit in a non-linear manner: as can be seen in Table 1, corporate AI investment increased from 2015 to 2021, decreased from 2021 to 2023, and, most recently, increased from 2023 to 2024, peaking in 2021. This pattern is also relevant to financial institutions due to the fact that a large share of their back-office and control AI skills are sourced through the vendor ecosystem, which in turn, is cyclical to investment cycles. As such, these tools become more common during phases of expansion, which are accompanied by increasing talent in the organization. Towards the end of expansion, during the contraction phase, organizations consolidate these tools and increase governance while shutting down less visible initiatives.

Table 1. Total corporate AI investment, 2015–2024 (usd, billions)

year	total corporate AI investment	year-over-year change, %	index, 2015=100
2015	25.43	0.00	100.00
2016	33.82	32.99	132.99
2017	53.72	58.84	211.25
2018	79.62	48.21	313.09
2019	103.27	29.70	406.10
2020	221.87	114.84	872.47
2021	360.73	62.59	1418.52
2022	253.25	-29.80	995.87
2023	201.00	-20.63	790.41
2024	252.33	25.54	992.25

Source: AI Index Report 2025, Chapter 4 "Economy," Figure 4.3.1 [Maslej et al., 2025].

Note: this table reflects global corporate AI investment across industries; it is used here as a context indicator for the financial-operations technology environment.

A second observation is that the demand for talent in finance-related sectors is increasing, but at a slower pace than in other sectors. Table 3 shows the share of AI-related job postings as a fraction of all job postings in select sectors in the U.S. The share of finance and insurance in total employment was 3.24% in 2023 and 3.76% in 2024, but, as noted, the increase in the information sector was larger than this. This is not just an abstract fact about the labor market. This evidence suggests that finance may have a practical implementation problem, where other sectors with more money or faster project speeds are competing for AI talent.

Table 2. AI job postings in selected U.S. sectors, 2023–2024 (% of all job postings)

Sector	2023	2024	Change, percentage points	Relative change, %
Finance and insurance	3.24	3.76	0.52	16.15
Manufacturing	2.88	3.75	0.87	30.21
Professional, scientific, and technical services	4.00	5.25	1.25	31.20
Information	5.19	9.33	4.14	79.56
Public administration	1.76	1.29	-0.47	-26.93

Source: AI Index Report 2025, Chapter 4 “Economy,” Figure 4.2.7 (Lightcast data) [Maslej et al., 2025].

Note: the indicator captures demand for AI skills in job postings; it does not measure installed AI systems directly, but it reflects organizational hiring behavior.

Shifting focus back to the environment, we can also use the survey data to analyse direct evidence of adoption in the financial services sector. As the UK survey data covers governance and outsourcing, the data is collated in summary Table 3 comparing selected metrics of adoption as reported, over a 2022–2024 time range. While the share of firms using AI technologies increases, the more substantial changes are in third-party exposure and provider concentration. The share of third-party use cases increases from 17% to 33% and the share provided by the three largest model providers increases from 18% to 44%. In short, more companies are using AI, and more of that use is coming from a concentrated set of external model providers. That is exactly the situation where efficiency can grow quickly while resilience and control become harder.

Table 3. UK financial services AI adoption and third-party exposure, 2022 vs 2024 (%)

Indicator	2022	2024	Absolute change, pp	Relative change, %
Firms currently using ai	58	75	17	29.31
Firms planning to use ai over next three years	14	10	-4	-28.57
AI use cases implemented by third parties	17	33	16	94.12
Top three model providers' share of named model providers	18	44	26	144.44

Source: AI in UK financial services survey report (2024), with 2022 comparisons as reported in the same document [Bank of England and FCA, 2024].

Note: the third-party and provider-share indicators are important because they link operational AI adoption to external dependency.

An additional question is: why would the push towards more rapid adoption coincide with more vertical consolidation of the providers? If there is indeed increasing reliance on a more limited group of external suppliers, then one would expect to see positive evidence of increased efficiency from that reliance compared to the governance and operational costs of that increased reliance. A way to assess the function-level generative AI adoption is to ask respondents whether they believe generative AI will be used to reduce costs and drive revenue in 2024 (Table 4). The strategy and corporate finance functions report that 56% have used generative AI to reduce costs and 70% to generate revenue. Fifty-one per cent of risk, legal and compliance function respondents were aware of realised cost savings. This does not equate to a net financial impact, nor does it act as a metric for quantum, duration or distribution. From the point of view of finance operations as an integrated system, these results do indicate that finance-adjacent functions have started generating measurable benefits, even if the size of these gains is often small.

Table 4. Cost decrease and revenue increase from generative AI use by function, 2024 (% of respondents)

Function	Cost decrease reported	Revenue increase reported
Marketing and sales	47	66
Risk, legal, and compliance	51	0
Human resources	56	0
Product or service development	43	51
Supply chain and inventory management	61	67
Service operations	58	63
IT	44	0
Software engineering	52	57
Strategy and corporate finance	56	70
Knowledge management and other internal functions	44	0

Source: AI Index Report 2025, Chapter 4 “Economy,” Figure 4.4.6 (McKinsey survey, 2024) [Maslej et al., 2025].

Note: “0” indicates that revenue effects are not reported for functions where the survey output is presented as cost-only in the published figure.

Despite the fact that the Table 4 data suggests hard evidence, it is at the macro level, and is not enough to support day to day decision making at the process level. In practice, financial operations

functions work on the basis of delivery metrics: hours saved, cycle time (day), alerts reduced, and response time benchmarks. This is why case-based evidence, despite its inability to achieve the 'quantitative precision' of survey-based evidence, has analytical value. Table 5 below provides a selection of publicly available case evidence, where quantifiable metrics are presented. Despite differences in scale, baseline conditions, and chosen measurement methodology, the cases illustrate the categories of operational metric that boards, auditors, and control functions can interrogate to show whether the use of AI has led to efficiency gains in a given process.

Table 5. Documented operational outcomes from AI deployments in financial operations, 2016–2024

Organization and year	Operational area	Baseline indicator	AI-enabled indicator	Stated efficiency outcome
JPMorgan Chase, 2016	contract intelligence for credit agreements	manual review up to 360,000 hours/year; 12,000 annual commercial credit agreements	extract 150 attributes from 12,000 agreements in seconds	time reduced from annual hours to seconds-scale extraction
HSBC, 2023	transaction monitoring and aml alerting	rules-based system with high false positives; 1.2 billion transactions screened per month	alerts reduced by 60%; suspicious activity identified 2–4 times more; suspicious accounts detected in 8 days after first alert	lower alert load with higher signal; faster detection cycle
UiPath client case, 2018	audit delivery automation in finance and accounting	prior solution delivered 25% accuracy improvement	rpa+ai delivered up to 85% accuracy improvement; 45% of audit process automated	54,000 hours saved annually with higher accuracy improvement
Bank of America, 2024	virtual assistant supporting retail and institutional client servicing	high volume of client inquiries and routine requests	over 2 billion interactions since launch; 98% of clients receive answers within 44 seconds (average)	faster response for routine service operations at scale
Generative AI field study, 2023	AI assistant in customer support work	productivity measured by issues resolved per hour without assistance	average productivity increase reported after AI assistance	14% average productivity gain; 34% gain for novice/low-skilled cohorts

Source: Annual Report 2016 letter [Zames, 2016]; AML AI case documentation [May, 2023; HSBC, 2024]; finance and accounting automation case note [UiPath, 2018]; digital assistant performance release [Bank of America, 2024]; generative AI productivity study [Brynjolfsson et al., 2023].

Note: the cases use different metrics and domains; the purpose is to show what “efficiency” looks like when it is stated in operational terms.

Internal implementation realities are also illustrated by case evidence, such as a contract intelligence project reducing processing time from hours to seconds requiring document standardisation and legal data governance as well as a structured model update process. Even if an AML-focused AI system can reduce alert volumes and time to detection, this change in the control environment does not mean the risks are lower. Lower alert volumes may simply encourage institutions to assume more risk or relax their detection threshold. Digital assistants face a similar issue: While reducing response time, organizations are responsible for the active maintenance of the knowledge base and the monitoring of model performance during particularly sensitive customer service interactions.

Often, the constraints to achieving a desired change can be focused on particular bottlenecks. The most frequent are the data. The potential issues around data including privacy and protection, quality, security, and bias or representativeness were cited as the largest risks in the UK AI/ML survey [Bank of England and FCA, 2024]. In practice, operationally even a technically resilient model can be weakened where the data structures are weak. This misalignment across customer identifiers, incomplete timestamps, or lack of clarity over ownership of the system of record can disrupt end to end automated processes and create expensive manual exception workflows for operations teams resulting in a large portion of potential efficiency being lost.

Third-party dependency and market concentration are other bottlenecks mentioned in the UK survey and the FSB discussion document. The governance of models becomes more complex when institutions rely on external cloud infrastructure, external model providers and/or external data vendors. From an operational perspective, this raises the question of who will be held accountable in the event of a failure of the system for which accountability cannot easily be articulated to a supervisory authority. Research indicates that 84% of surveyed firms have an accountable individual for the AI system, although accountability is often divided among different roles [Bank of England and FCA, 2024]. While distributed

accountability is common in large organizations, it slows incident response and complicates regulatory interaction, making governance architecture more important than technology in most organizations.

Third, there are trade-offs in relation to explainability and model risk houses. The BIS working paper notes that model complexity hampers explainability and model risk governance, especially if models are widely used and lead to correlated decision-making patterns or herding behaviour (Aldasoro et al., 2024). In finance, explainability is not only an abstract fairness question, but it takes place in the demands for audit. Banks are required to explain why a transaction was flagged, an account was blocked, or a payment delayed. When models are not interpretable, institutions create additional layers of explanation. Additional controls can increase defensibility but they also add to operating costs and complexity.

A fourth bottleneck relates to resilience and cybersecurity. The FSB has recognised the exposure to cybersecurity events and reliance on third parties as systemic vulnerabilities. Regulation of resilience and cybersecurity is likewise identified as a key bottleneck to implementation in the UK [FSB, 2024; Bank of England and FCA, 2024]. Operationally, every model API, data pipeline and vendor integration is an attack surface, while efficiency gains from automation are structurally fragile in the case of core system outages or security incidents.

The fifth barrier concerns skills and change management. In particular, the inability to recruit people with the right talent and technical skills was highlighted as a meaningful non-regulatory barrier in the UK survey [Bank of England and FCA, 2024]. The finance and insurance sector has seen an increase in demand for AI-based jobs. However, staff may be poached by other industries with similar demands, indicating that internal upskilling and process redesign may be the answer to sustainable implementation. This is consistent with the management literature call for companies to invest in their own AI capabilities using bounded and small-scale experiments rather than taking on large-scale and risky AI projects within their organizations [Davenport, Ronanki, 2018].

A final consideration is measurement. AI projects in financial operations are often launched with broad, imprecise goals around reducing cost, improving efficiency, or improving compliance. Other metrics in operational contexts focus more on cycle time per case, false positive rate, cost per transaction, time to detection, straight-through processing rates, etc. A further consideration is that the objectives for metrics associated with AI systems may be intrinsically different from what would be an improvement, e.g. a decrease in AML alerts might be seen as a good outcome, but this could also increase risk exposure. Accordingly, it is increasingly considered essential for governance frameworks to view model lifecycle management and control mechanisms as core responsibilities [Bank of England, 2022].

CONCLUSION

Overall, and based on the evidence of this research, we can conclude that AI can be effective in achieving operational efficiency in financial processes, but that the magnitude and longevity of effects are dependent on pre-existing process structure and governance arrangements. Corporate AI investment in financial processes follows a cyclical pattern of growth followed by contraction between 2015 and 2024, with an upturn in AI investment in 2024. From 2023 to 2024, demand for AI-related jobs in the finance and insurance sector continues to rise, as firms transition from experimentation to deeper integration. Process level measurable gains are most frequently seen in high transaction volume processes with some degree of standardisation. Common use cases include contract data extraction, anti-money laundering checks, audit preparation and digital customer servicing. Common measurable gains are in terms of time saved, reduction in alert/progress volume or second-to-minute response time. They correspond to the concepts used to define efficiency in financial transactions, that is, throughput, cycle time, and workload intensity, rather than the productivity ratio of the finance domain.

However, those same data point to the measurement problems surrounding quality, privacy, and structural integrity with regard to data, which represent the core issues surrounding risk assessment. Third-party dependence arises when companies depend on cloud, model vendors and data vendors. Second, provider firms can become concentrated, generating additional governance challenges. Additionally, an important portion of firms report only partial understanding of the AI capabilities deployed throughout their business. Banking supervisors and financial stability authorities have previously warned regarding the potential for such granular operational gains to contribute to broader resilience challenges.

Thus, from an operational perspective, AI implementation in financial services must not be regarded only as a technology project but as a combination of process reengineering, data governance, model risk management and operational incident preparedness to ensure holistic controls. In weak spots, intention, authority, and understanding have in pilot programs increased efficiency, only to be undone by

exception handling, auditability, and security. This means that success is short-lived, with some other form of operational complexity taking its place.

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COMPLEMENTARITY AND SYNERGY OF THE MANUFACTURING INDUSTRIES OF THE RUSSIAN FEDERATION AND CHINA: THE CASE OF ALTAI AND XINJIANG

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КОМПЛЕМЕНТАРНОСТЬ И СИНЕРГИЯ ОБРАБАТЫВАЮЩЕЙ ПРОМЫШЛЕННОСТИ РФ И КИТАЯ: НА ПРИМЕРЕ АЛТАЯ И СИНЬЦЗЯНА

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Актуальность исследования. Современная глобальная экономика характеризуется геополитической конкуренцией, интеграцией региональных пространств и развитием трансграничного сотрудничества. Россия и Китай как стратегические партнеры углубляют экономическое взаимодействие, а пограничные регионы являются ключевым плацдармом для совместных проектов. Алтайский край РФ и Синьцзян-Уйгурский автономный район Китая – географически смежные территории «Большого Алтая» с богатым природно-ресурсным потенциалом и развитой базой обрабатывающей промышленности.

Реализация стратегии РФ «поворота на Восток» и китайской инициативы «Один пояс — один путь» создала уникальные условия для глубокого сотрудничества этих регионов. Обрабатывающая промышленность является ядром регионального хозяйства, ее развитие способствует росту конкурентоспособности, улучшению инфраструктуры и снижению безработицы. Алтайский край сталкивается с модернизацией производственных мощностей, а Синьцзян – с диверсификацией структуры и расширением сырьевой базы. Комплементарность их промышленных структур создает предпосылки для решения этих проблем, определяющую актуальность темы.

Степень разработанности проблемы. Проблемы трансграничного сотрудничества в «Большом Алтае» изучены в работах российских (Красноярова Б., Гвоздев Н.К., Кашин В.) и китайских ученых (Кан Л., Лю Ю.). Российские авторы анализировали региональную интеграцию, ресурсную комплементарность и институциональные препятствия, китайские – развитие обрабатывающей промышленности Синьцзяна и сотрудничество с Россией в рамках «Один пояс — один путь».

Однако существующие исследования имеют ограничения: большинство посвящены общему анализу сотрудничества, отсутствуют комплексные оценки структурной комплементарности обрабатывающей промышленности Алтая и Синьцзяна, недостаточно изучены модели совместного развития с учетом региональных особенностей. Эти пробелы определяют необходимость дальнейшего исследования.

Целью исследования Цель – выявить потенциал структурного эволюционирования и совместного развития обрабатывающей промышленности Алтайского края и Синьцзяна, разработать практические модели и рекомендации по углублению трансграничного сотрудничества.

Задачи:

- 1) Систематизировать научные исследования и выявить препятствия трансграничного сотрудничества;
- 2) Анализировать и сравнить структурные особенности обрабатывающей промышленности двух регионов;
- 3) Разработать методологию оценки комплементарности и выявить перспективные направления сотрудничества;
- 4) Создать адаптированные модели совместного развития и определить их реализацию;
- 5) Сформулировать рекомендации для органов власти и предприятий;
- 6) Сделать выводы и определить перспективы дальнейшего изучения темы.

Объектом исследования Объект – процессы структурного эволюционирования и трансграничного развития обрабатывающей промышленности Алтайского края и Синьцзяна.

Предмет – экономические отношения при интеграции обрабатывающей промышленности двух регионов, факторы комплементарности и механизмы преодоления препятствий сотрудничества.

Методология и методы исследования. Исследование основано на общенаучных и специальных методах: абстрактно-логическом (систематизация теории, формулирование выводов), сравнительно-сопоставительном (анализ особенностей промышленности двух регионов), экономико-статистическом (обработка официальных статистических данных), эконометрическом (расчет индекса комплементарности) и моделировании (разработка сотрудничества моделей). Источниками данных являются Росстат, Национальное бюро статистики Китая, региональные документы и научные работы авторов двух стран.

ГЛАВА 1. Анализ современного состояния исследований и препятствий трансграничного сотрудничества

1.1. Обзор современного состояния научных исследований

Теоретическая база исследования формируется работами российских и китайских ученых. Российские исследователи являются пионерами изучения интеграции в «Большом Алтае»: Красноярская Б. (2014) выявляла ресурсную комплементарность и инфраструктурные ограничения, Гвоздев Н.К. и Марш С. (2013) рассматривали сотрудничество Алтая с Синьцзяном в рамках «поворота на Восток», Кашин В. и Янкова А. (2021) анализировали институциональные препятствия и потенциал переработки сельхозпродукции, Понкина Е.В. (2025) оценивала сельскохозяйственное сотрудничество, Ключев Н.Н. (2020) отметил роль российско-китайских проектов в модернизации сибирской промышленности.

Китайские ученые (Кан Л., Лю Ю., 2020) анализировали промышленную структуру Синьцзяна и его конкурентоспособность, а иностранные авторы (Варику К., 2017) подчеркивали значение «Большого Алтая» как узла евразийской интеграции. Общий недостаток исследований – отсутствие комплексного анализа структурной комплементарности обрабатывающей промышленности двух регионов и адаптированных моделей совместного развития.

1.2. Основные препятствия трансграничного сотрудничества

На основе анализа научных работ и практики сотрудничества выделены четыре группы основных препятствий:

1) Ограничения доступа к статистическим данным – официальная статистика Алтая представлена в макрорегиональном разрезе, отсутствуют детализированные данные по подотраслям; различия в статистических подходах РФ и Китая исключают прямое сравнение показателей.

2) Институциональные различия – существенные различия в законодательстве, налоговой системе, стандартах качества и защите интеллектуальной собственности создают высокие транзакционные издержки; ограниченные права региональных органов на заключение соглашений усложняют координацию политики.

3) Ограничения движения факторов производства – финансовое сотрудничество на ранней стадии, отсутствие специальных механизмов финансирования проектов; движение специалистов ограничено визовым режимом; передача технологий затруднена недостатком защиты интеллектуальной собственности.

4) Геополитические и инфраструктурные ограничения – геополитические неопределенности на глобальном уровне; низкий уровень развития дорожной сети и логистических центров в пограничной зоне увеличивает издержки движения сырья и продукции.

ГЛАВА 2. Структурные особенности обрабатывающей промышленности Алтайского края и Синьцзяна

Обрабатывающая промышленность двух регионов развивается на основе местных ресурсов, но имеет существенные структурные различия, формирующие выраженную комплементарность. Обе отрасли характеризуются ресурсозависимостью, но различаются по доминирующим подотраслям, уровню технологического развития и рыночной ориентации.

2.1. Структурные особенности Алтайского края РФ

Алтайский край – регион Сибири с агропромышленным развитием, его обрабатывающая промышленность ориентирована на переработку местного сырья и имеет ключевые особенности:

Доминирование легкой промышленности (45% производства) – переработка сельхозпродукции (зерно, мясо, молоко) мелкими и средними предприятиями с низким уровнем глубокой переработки;

Слабая развитость тяжелой промышленности – только производство строительных материалов, ремонт энергетического оборудования и первичную переработку минералов; практически отсутствуют крупные машиностроительные предприятия;

Низкая инновационная активность – инвестиции в НИОКР менее 1% от ВВП, отсутствие современной научно-производственной инфраструктуры, отток высококвалифицированных специалистов;

Ориентация на внутренний рынок – экспорт менее 10% производства, направлен на соседние регионы Сибири; исключают участие в международных рынках -> исключают выход на международные рынки.

Основные проблемы – модернизация мощностей, привлечение инвестиций и технологий; основная возможность – сотрудничество с Синьцзяном для доступа к китайским ресурсам и рынку.

2.2. Структурные особенности Синьцзян-Уйгурского автономного района Китая

Синьцзян – ключевой узел «Один пояс — один путь», его обрабатывающая промышленность развивается на основе богатых ресурсов и государственной поддержки, имеет особенности:

Доминирование тяжелой промышленности (60% производства) – энергетика, глубокая переработка минералов и производство энергетического оборудования крупными государственными предприятиями с высоким технологическим оснащением;

Развитая легкая промышленность с ограниченной сырьевой базой – текстильное производство и переработка плодово-ягодной продукции, ограниченное недостатком высококачественного сельхозсырья;

Средняя инновационная активность – инвестиции в инновации 2,5% от ВВП, государственная поддержка через научно-производственные парки и привлечение специалистов;

Высокая ориентация на экспорт – экспорт 30% производства в страны Центральной Азии, Россию и Европу; развитая логистическая инфраструктура обеспечивает трансграничное движение продукции.

Основные проблемы – диверсификация структуры и расширение сырьевой базы; основная возможность – сотрудничество с Алтаем для получения сельхозсырья и доступа к рынку Сибири.

2.3. Сравнительный анализ двух регионов

Ключевые сходства – ресурсозависимость промышленности и потребность в трансграничном сотрудничестве для решения внутренних проблем. Основные различия формируют комплементарность:

Алтай специализируется на легкой промышленности, Синьцзян – на тяжелой;

Алтай обладает сельскохозяйственной сырьевой базой, Синьцзян – современными технологиями, инвестициями и логистикой;

Промышленность Алтая ориентирована на внутренний рынок, Синьцзяна – на экспорт;

Алтай имеет низкую инновационную активность, Синьцзян – развивает инновации при государственной поддержке.

Эти различия создают предпосылки для интеграции производственных процессов и формирования единых трансграничных цепочек.

ГЛАВА 3. Оценка структурной комплементарности и выявление перспективных направлений сотрудничества

3.1. Методология оценки структурной комплементарности

Для оценки комплементарности обрабатывающей промышленности двух регионов разработана адаптированная система индикаторов, учитывающая ограничения в доступе к статистике. Система включает четыре блока с весами, определенными экспертным методом:

1) Ресурсная комплементарность (35%) – запасы ресурсов, объем сельхозпроизводства, численность промышленного персонала;

2) Производственная комплементарность (30%) – объем выпуска продукции по подотраслям, производственные мощности, уровень кооперации;

3) Технологическая комплементарность (20%) – технологическое оснащение, инвестиции в инновации, количество высококвалифицированных специалистов;

4) Рыночная комплементарность (15%) – объем внутреннего рынка, структура экспорта/импорта, наличие логистической инфраструктуры.

Для каждого блока рассчитывается индекс в шкале 0-1, рассчитывается как средневзвешенное значение по всем блокам.

3.2. Результаты оценки структурной комплементарности

На основе разработанной системы индикаторов проведена комплексная оценка, результаты представлены в таблице 1.

Таблица 1 – Оценка структурной комплементарности обрабатывающей промышленности Алтайского края и Синьцзяна

Блок индикаторов	Индекс комплементарности	Вес (%)	Взвешенное значение
Ресурсная	0,85	35	0,2975
Производственная	0,81	30	0,2430
Технологическая	0,72	20	0,1440
Рыночная	0,68	15	0,1020
Общая комплементарность	-	100	0,7865

Интегральный индекс составил 0,7865, свидетельствуя о высоком уровне комплементарности двух регионов. Наиболее высокий показатель по ресурсному блоку (0,85) – обусловлено противоположным ресурсным потенциалом. Высокий производственный индекс (0,81) связан с различием специализации подотраслей. Средний-высокие технологический (0,72) и рыночный (0,68) индексы ограничены существующими препятствиями, но подтверждают потенциал для развития сотрудничества.

3.3. Перспективные направления трансграничного сотрудничества

На основе оценки комплементарности выявлены четыре перспективных направления сотрудничества, соответствующие преимуществам каждого региона:

Переработка сельскохозяйственной продукции. Наиболее перспективное направление (индекс ресурсной комплементарности 0,85): Алтай поставляет высококачественное сельхозсырье, Синьцзян предоставляет технологии глубокой переработки, инвестиции и доступ к китайскому и международным рынкам. Совместные проекты – создание предприятий переработки на Алтае, долгосрочные поставки сырья, совместное производство продукции для реализации в РФ и Китае.

Машиностроение для энергетической отрасли. Основано на производственной и технологической комплементарности: Синьцзян производит энергетическое оборудование (нефтяное, газовое, ветряной энергетики) с экспортным опытом, Алтай и Сибирь имеют высокий спрос на такое оборудование. Проекты – поставка оборудования, создание предприятий ремонта на Алтае, разработка адаптированного оборудования для сибирских условий.

Глубокая переработка минеральных ресурсов. Алтай обладает богатыми запасами минералов, но осуществляет только их первичную переработку; Синьцзян имеет современные технологии глубокой переработки и стабильный спрос на продукцию. Сотрудничество – совместное разведание месторождений, поставки сырья в Синьцзян, создание совместных предприятий глубокой переработки на Алтае.

Производство строительных материалов. Оба региона имеют высокий спрос на строительные материалы в рамках инфраструктурного развития: Алтай обладает сырьевой базой (камень, известняк, древесина), Синьцзян – технологиями производства высококачественных материалов. Проекты – создание совместных предприятий на Алтае, модернизация местных производств, поставки материалов для трансграничных инфраструктурных проектов.

ГЛАВА 4. Модели совместного развития обрабатывающей промышленности двух регионов

На основе анализа комплементарности и учета препятствий разработаны три взаимодополняющие модели совместного развития обрабатывающей промышленности, адаптированные к особенностям РФ и Китая.

4.1. Модель совместного создания трансграничных промышленных парков

Базовая модель – создание специализированных промышленных парков на территории двух регионов как платформ для совместных проектов. Принципы реализации:

Специализация парков по четырем перспективным направлениям сотрудничества;

Межгосударственное соглашение РФ и Китая с предоставлением налоговых льгот, льготного режима доступа к земле;

Совместное финансирование инфраструктуры (дороги, коммуникации, логистические центры) из бюджетов двух стран и международных фондов;

Аттракция предприятий двух регионов с льготными условиями ведения деятельности.

Преимущества – создание унифицированного институционального пространства, снижение транзакционных издержек, развитие инфраструктуры пограничной зоны, создание рабочих мест.

4.2. Модель интеграции трансграничных производственных цепочек

Продвинутая модель – объединение производственных процессов в единые цепочки от сырья до готовой продукции. Принципы:

Деление функций: Алтай производит сырье и осуществляет первичную переработку, Синьцзян – глубокую переработку и реализацию продукции;

Создание совместного управленческого органа для координации производства и поставок;

Унификация стандартов качества и сертификации для устранения технических барьеров;

Развитие совместных логистических центров и оптимизация транспортных маршрутов.

Преимущества – повышение производственной эффективности, расширение рынка сбыта, развитие промышленной кооперации, повышение конкурентоспособности продукции.

4.3. Модель совместных научных исследований и разработок (НИОКР)

Долгосрочная модель – повышение инновационной активности через совместные НИОКР и разработку новых технологий. Принципы:

На базе вузов и научных организаций обоих регионов ;

Совместное финансирование проектов из бюджетов стран, региональных средств и предприятийных инвестиций;

Обмен специалистами и создание совместных программ подготовки кадров;

Коммерциализация результатов НИОКР через создание совместных предприятий.

Преимущества – повышение инновационного потенциала, разработка адаптированных технологий, подготовка квалифицированных кадров, долгосрочная устойчивость сотрудничества.

4.4. Общие пути реализации разработанных моделей

Для успешной реализации моделей необходимы общие пути преодоления препятствий:

1) Упрощение административных процедур регистрации совместных предприятий и визового режима для специалистов;

2) Развитие финансового сотрудничества – создание специального фонда для проектов, расширение использования национальных валют, льготные кредиты;

3) Совместное развитие инфраструктуры – модернизация дорог, увеличение мощностей пограничных переходов, создание логистических центров;

4) Создание постоянного механизма координации – межрегиональный комиссариат, регулярные форумы, совместный информационный портал.

ГЛАВА 5. Практические рекомендации по углублению трансграничного сотрудничества

Разработаны комплексные рекомендации для органов власти РФ, Китая и предприятий двух регионов, разделенные по краткосрочному (1-2 года), среднесрочному (3-5 лет) и долгосрочному (более 5 лет) периодам.

5.1. Рекомендации для органов власти РФ

Краткосрочно: Упростить процедуры создания совместных предприятий, предоставить налоговые льготы, расширить доступ к статистической информации, упростить визовый режим для китайских специалистов.

Среднесрочно: Заключить межгосударственное соглашение о трансграничных промышленных парках, унифицировать стандарты качества, создать специальный фонд поддержки проектов, модернизировать транспортную инфраструктуру.

Долгосрочно: Усилить поддержку инновационного развития, создать совместные научные центры с Китаем, разработать долгосрочную стратегию развития Алтая с учетом сотрудничества с Китаем, организовать совместное обучение кадров.

5.2. Рекомендации для органов власти Китая

Краткосрочно: Предоставить льготные кредиты для китайских предприятий, расширить поставки оборудования в Алтай, упростить административные процедуры, организовать информационное взаимодействие между предприятиями.

Среднесрочно: Поддержать создание трансграничных промышленных парков, оптимизировать логистические маршруты в Алтай, унифицировать стандарты качества с РФ, усилить защиту интеллектуальной собственности.

Долгосрочно: Организовать обмен специалистами, поддержать коммерциализацию результатов НИОКР, разработать стратегию сотрудничества Синьцзяна с Россией, расширить использование юаня в торговых операциях.

5.3. Рекомендации для предприятий двух регионов

Краткосрочно: Организовать взаимные визиты и переговоры, заключить предварительные договоры поставок сырья и продукции, разработать бизнес-планы совместных проектов, участвовать в выставках и форумах.

Среднесрочно: Участвовать в создании трансграничных промышленных парков, создать совместные предприятия по перспективным направлениям, развивать промышленную кооперацию, инвестировать в модернизацию мощностей.

Долгосрочно: Участвовать в совместных НИОКР, интегрироваться в трансграничные производственные цепи, формировать объединения для участия в крупных проектах, расширить экспорт в третьи страны, инвестировать в подготовку кадров.

ГЛАВА 6. Выводы и перспективы дальнейшего исследования

6.1. Основные результаты исследования

В ходе комплексного анализа получены следующие ключевые результаты:

1) Систематизирован научный литература и выявлены основные недостатки существующих исследований – отсутствие специализированного анализа обрабатывающей промышленности и адаптированных моделей сотрудничества;

2) Выделены четыре группы препятствий трансграничного сотрудничества: статистические, институциональные, ограничения движения факторов производства, геополитико-инфраструктурные;

3) Проведен сравнительный анализ структурных особенностей промышленности двух регионов и выявлена их выраженная комплементарность;

4) Разработана система индикаторов оценки комплементарности, интегральный индекс которой составил 0,7865 (высокий уровень);

5) Выявлены четыре перспективные направления сотрудничества: переработка сельхозпродукции, энергетическое машиностроение, глубокая переработка минералов, производство строительных материалов;

6) Разработаны три взаимодополняющие модели совместного развития и определены общие пути их реализации;

7) Сформулированы комплексные рекомендации для органов власти и предприятий, разделенные по временным периодам.

Полученные результаты подтверждают уникальный потенциал двух регионов для совместного развития обрабатывающей промышленности.

6.2. Перспективы дальнейшего развития сотрудничества

Перспективы сотрудничества связаны с реализацией стратегий «поворота на Восток» и «Один пояс — один путь», а также интеграцией ЕАЭС и Шелкового пути, и разделяются на три уровня:

1) Региональный – модернизация промышленности, развитие инфраструктуры, создание рабочих мест, рост производства и экспорта;

2) Межгосударственный – расширение товарооборота РФ и Китая, развитие инвестиционного сотрудничества, укрепление стратегического партнерства;

3) Международный – расширенный экспорт совместной продукции в третьи страны, повышение конкурентоспособности российско-китайской продукции на глобальных рынках.

Ключевой фактор успеха – совместная работа органов власти и предприятий по преодолению препятствий и реализации разработанных рекомендаций.

6.3. Направления будущих научных исследований

Основное ограничение исследования – ограниченность доступа к детализированной статистике, потребовавшая использования экспертных оценок. Основные направления будущих исследований:

1) Улучшение методологии оценки комплементарности с учетом цифровой трансформации и экологических факторов;

2) Эмпирический анализ функционирующих российско-китайских совместных предприятий и оценка их эффективности;

3) Разработка методики количественной оценки экономических эффектов сотрудничества для двух регионов;

4) Анализ влияния цифровых технологий на трансграничное сотрудничество и разработка моделей цифровой интеграции;

5) Исследование экологически устойчивого развития промышленности и создание зеленых трансграничных цепочек;

6) Расширение исследования на другие российско-китайские пограничные регионы и разработка унифицированных моделей сотрудничества.

ЗАКЛЮЧЕНИЕ

Данное исследование посвящено анализу структурного эволюционирования и совместного развития обрабатывающей промышленности Алтайского края РФ и Синьцзян-Уйгурского автономного района Китая – регионов с высоким потенциалом трансграничного сотрудничества. Актуальность исследования обусловлена необходимостью реализации стратегических задач двух стран и решения внутренних проблем социально-экономического развития регионов.

В ходе исследования систематизирована научная литература, выявлены препятствия сотрудничества, проведен сравнительный анализ структурных особенностей промышленности двух регионов. Разработана система индикаторов оценки структурной комплементарности, интегральный индекс которой составил 0,7865, что подтверждает высокий потенциал сотрудничества. Выявлены четыре перспективные направления и разработаны три взаимодополняющие модели совместного развития – создание трансграничных промышленных парков, интеграция производственных цепочек, совместные НИОКР, а также определены пути их реализации.

Формулированы комплексные рекомендации для органов власти РФ, Китая и предприятий, разделенные по краткосрочному, среднесрочному и долгосрочному периодам. Реализация этих рекомендаций позволит создать благоприятные условия для глубокого трансграничного сотрудничества.

Полученные результаты имеют высокую теоретическую и практическую ценность: они дополняют научную базу исследования трансграничного сотрудничества в «Большом Алтае» и могут быть использованы органами власти при разработке стратегий развития, а также предприятиями при формировании бизнес-планов совместных проектов.

Реализация потенциала совместного развития обрабатывающей промышленности Алтая и Синьцзяна станет важным шагом в укреплении российско-китайского стратегического партнерства, развитии экономики «Большого Алтая» и формировании интегрированных трансграничных производственных пространств Евразии.

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Medical sciences

THE LEVEL OF AWARENESS OF WOMEN HAS INCREASED PRODUCTIVELY ABOUT MODERN METHODS OF CONTRACEPTION

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УРОВЕНЬ ИНФОРМИРОВАННОСТИ ЖЕНЩИН РЕПРОДУКТИВНОГО ВОЗРАСТА О СОВРЕМЕННЫХ МЕТОДАХ КОНТРАЦЕПЦИИ

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Abstract

In this study, a comparative assessment of the level of knowledge of women of reproductive age about contraceptive methods was carried out, the contraceptives used were analyzed, the reasons for their refusal to use them were identified, and sources of information among women of different ages were identified.

Аннотация

В настоящем исследовании проведена сравнительная оценка уровня знаний женщин репродуктивного возраста о методах контрацепции, проанализированы используемые противозачаточные средства, выявлены причины отказа от их применения, определены источники информирования среди женщин разных возрастов.

Keywords: methods of contraception, contraceptives, women of reproductive age

Ключевые слова: методы контрацепции, противозачаточные средства, женщины репродуктивного возраста.

Введение. Планирование семьи — это основное право человека, которое позволяет отдельным лицам и парам принимать независимые и ответственные решения о количестве детей, времени их рождения и интервале между их рождением, что достигается благодаря свободному выбору современных методов предупреждения нежелательной беременности в целях планирования семьи и охраны своего здоровья.

Контрацепция – методы и средства предупреждения нежелательной беременности.

Сохранение репродуктивного здоровья женщин является одной из приоритетных задач современной системы здравоохранения. Рациональное планирование семьи, предупреждение нежелательной беременности и снижение частоты абортов напрямую связаны с доступностью и правильным использованием современных методов контрацепции. Несмотря на широкий выбор средств предупреждения беременности, уровень информированности женщин репродуктивного возраста о механизмах действия, эффективности, преимуществах и возможных рисках различных методов контрацепции остается неоднородным.

Современные контрацептивные технологии включают гормональные, барьерные, внутриматочные, хирургические и естественные методы, отличающиеся по степени

надежности, безопасности и удобству применения. Однако выбор конкретного способа нередко определяется не только медицинскими показаниями, но и уровнем знаний женщины, доступностью достоверной информации, культурными установками и влиянием социальных факторов. Недостаточная осведомленность может приводить к неправильному применению контрацептивов, снижению их эффективности и формированию мифов, препятствующих рациональному выбору.

В условиях активного развития медицинской науки и расширения спектра современных контрацептивных средств особое значение приобретает оценка уровня информированности женщин репродуктивного возраста. Изучение данного показателя позволяет выявить пробелы в знаниях, определить основные источники получения информации и разработать мероприятия, направленные на повышение медицинской грамотности населения.

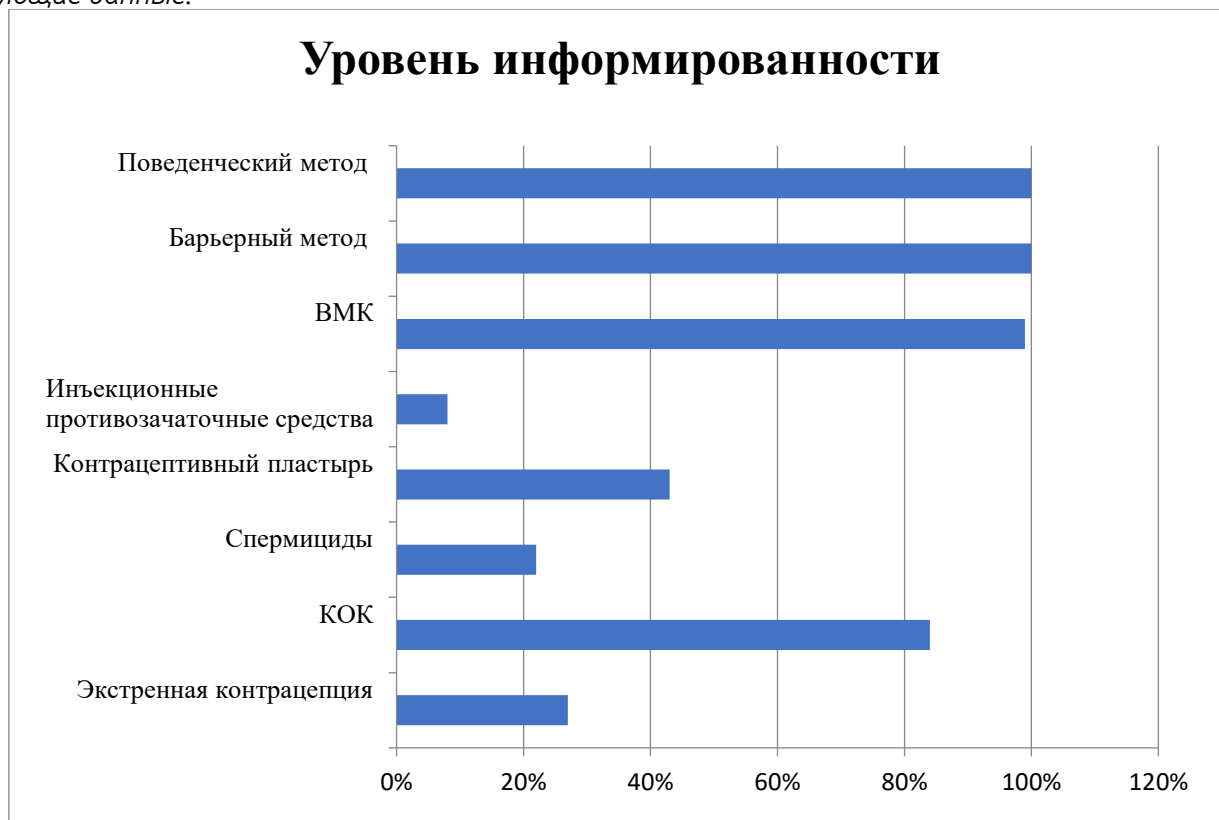
Таким образом, анализ уровня осведомленности женщин о современных методах контрацепции является важным этапом в формировании эффективных профилактических программ и укреплении репродуктивного здоровья общества в целом.

Цель исследования: Оценить уровень информированности женщин репродуктивного возраста о современных методах контрацепции, выявить основные источники получения информации и определить факторы, влияющие на выбор и использование средств контрацепции.

Материалы и методы исследования. В исследовании приняло участие женское население с Казахстана (г.Астана, г.Алматы, г.Шымкент, Алматинская область, Туркестанская область) в возрасте 18 до 52 лет. Анкетирование проводилось согласно разработанной нами онлайн-анкете, в котором было 25 вопросов о знании различных способов контрацепции.

Результаты. Для изучения информированности о методах контрацепции проведено анкетирование 87 женщин репродуктивного возраста.

При анализе знаний женщин о предназначении контрацептивов и их разнообразии получены следующие данные:



Частота использования различных методов контрацепции

Метод контрацепции	Частота использования (%)
Барьерный метод	87%
Поведенческий метод	69%
ВМК	57%
КОК	38%
Инъекционные противозачаточные средства	0%
Контрацептивный пластырь	5%
Спермициды	0%
Экстренная контрацепция	1%

Выводы по результатам:

Проведённый анализ результатов анкетирования показал, что среди женщин репродуктивного возраста наиболее часто используемым методом контрацепции являются барьерные средства. Их популярность, вероятно, обусловлена доступностью, относительной простотой применения, отсутствием системного воздействия на организм и возможностью одновременной защиты от инфекций, передающихся половым путём. Барьерный метод продолжает занимать лидирующую позицию в структуре контрацептивного поведения респонденток.

Второе по распространённости место занимает поведенческий (естественный) метод контрацепции. Его выбор во многом объясняется простотой использования, отсутствием финансовых затрат и медицинского вмешательства. Вместе с тем, значительная доля женщин и их партнёров прибегают к данному способу вследствие недостаточной осведомлённости о современных, более эффективных методах предупреждения беременности, а также под влиянием распространённых стереотипов и мифов относительно гормональных средств.

Полученные данные свидетельствуют о том, что большинство респондентов в целом осведомлены о разнообразии существующих методов контрацепции. Однако практический выбор зачастую определяется не уровнем доказательной информации, а субъективным доверием, сформированным на основе личного опыта, рекомендаций знакомых и распространённых социальных представлений. Таким образом, приоритет в принятии решения нередко отдаётся тем методам, которые воспринимаются как «проверенные» в окружении, даже если их эффективность уступает альтернативным вариантам.

Отдельного внимания заслуживает низкий уровень узнаваемости и, соответственно, использования таких методов, как спермициды, средства экстренной контрацепции и инъекционные гормональные препараты. Ограниченная информированность о механизмах их действия, показаниях и преимуществах снижает интерес к данным способам предупреждения беременности. Это указывает на необходимость усиления образовательной работы и повышения доступности достоверной медицинской информации среди населения.

В целом результаты исследования демонстрируют, что несмотря на формальное знание вариативности методов контрацепции, практическое применение современных и высокоэффективных средств остаётся недостаточным. Повышение уровня медицинской грамотности женщин и их партнёров является важным направлением в формировании ответственного репродуктивного поведения.

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THE ROLE OF ANTI-MÜLLERIAN HORMONE IN DECISION-MAKING FOR OOCYTE CRYOPRESERVATION**Zhuldyz Talgatkyzy Alipbekova**Intern, 1st year, Department of Obstetrics and Gynecology No. 2
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Astana, Republic of Kazakhstan**Nuraiym Abzalkyzy Moldasheva**Intern, 1st year, Department of Obstetrics and Gynecology No. 2
NJSC "Astana Medical University"
Astana, Republic of Kazakhstan**КРИОКОНСЕРВАЦИЯ ООЦИТОВ: РОЛЬ АНТИМЮЛЛЕРОВА ГОРМОНА В ПРИНЯТИИ РЕШЕНИЯ****Әліпбекова Жұлдыз Талғатқызы**Интерн 1 года обучения кафедры акушерства и гинекологии № 2
НАО «Медицинский университет Астана»
Астана, Республика Казахстан**Молдашева Нұрайым Абзалқызы**Интерн 1 года обучения кафедры акушерства и гинекологии № 2
НАО «Медицинский университет Астана»
Астана, Республика Казахстан**Abstract**

In recent years, a growing number of women have postponed childbearing due to social, professional, and medical factors. Simultaneously, advances in reproductive medicine have significantly expanded fertility preservation strategies. Oocyte cryopreservation has become an effective method for maintaining reproductive potential, particularly for women facing gonadotoxic therapy or those choosing to delay pregnancy for personal reasons. The effectiveness of this approach largely depends on the ovarian reserve, which reflects both the quantity and quality of remaining follicles.

Anti-Müllerian hormone (AMH) is considered one of the most reliable biomarkers for assessing ovarian reserve. It is secreted by granulosa cells of preantral and small antral follicles and demonstrates minimal fluctuations throughout the menstrual cycle. This biological stability makes AMH a practical tool for predicting ovarian response to controlled stimulation prior to oocyte retrieval.

AMH levels help estimate the expected number of retrieved oocytes and allow clinicians to individualize stimulation protocols. Higher AMH concentrations are generally associated with a stronger response to gonadotropins and a greater number of collected oocytes. However, elevated levels may also increase the risk of ovarian hyperstimulation syndrome. In contrast, low AMH values indicate diminished ovarian reserve and may predict a limited number of oocytes obtained in a single cycle, which directly influences counseling and treatment planning. In such situations, multiple stimulation cycles or alternative fertility preservation strategies may be considered to achieve an adequate number of cryopreserved oocytes.

Despite its high predictive value, AMH should not be interpreted in isolation. Its clinical utility improves when combined with other parameters, including antral follicle count, follicle-stimulating hormone, estradiol levels, and ultrasound findings. Comprehensive evaluation enhances prognostic accuracy and supports individualized decision-making.

Thus, AMH plays a central role in counseling, protocol optimization, and improving clinical outcomes in oocyte cryopreservation programs. A personalized approach based on hormonal assessment contributes to greater safety and effectiveness in fertility preservation.

Аннотация

В последние годы отмечается устойчивый рост числа женщин, откладывающих рождение ребёнка по социальным, профессиональным и медицинским причинам. Одновременно развитие вспомогательных репродуктивных технологий расширило возможности сохранения фертильности. Криоконсервация ооцитов стала эффективным методом поддержания репродуктивного потенциала, особенно у пациенток, которым предстоит гонадотоксическая терапия, а также у женщин, планирующих беременность в более позднем возрасте. Эффективность данной процедуры во многом определяется состоянием овариального резерва,

отражающего количественные и качественные характеристики фолликулярного аппарата яичников.

Антимюллеров гормон является одним из наиболее информативных маркеров оценки овариального резерва. Он продуцируется гранулёзными клетками преантральных и малых антральных фолликулов и отличается относительной стабильностью концентрации в течение менструального цикла. Это свойство делает его удобным инструментом для прогнозирования ответа яичников на контролируемую стимуляцию перед получением ооцитов.

Определение уровня антимюллерова гормона позволяет предварительно оценить предполагаемое количество извлекаемых ооцитов и индивидуализировать протокол стимуляции. Повышенные значения гормона обычно коррелируют с выраженным ответом на введение гонадотропинов и получением большего числа ооцитов, однако сопровождаются повышенным риском развития синдрома гиперстимуляции яичников. Низкие показатели свидетельствуют о снижении овариального резерва и могут прогнозировать ограниченное число ооцитов в одном цикле, что требует корректировки тактики ведения пациентки и возможного проведения нескольких циклов стимуляции.

Несмотря на высокую прогностическую ценность, интерпретация уровня гормона должна проводиться в комплексе с другими клинико-лабораторными показателями, включая подсчёт антральных фолликулов, уровень фолликулостимулирующего гормона, эстрадиола и данные ультразвукового исследования. Комплексный подход повышает точность прогноза и способствует принятию обоснованных клинических решений.

Таким образом, антимюллеров гормон играет ключевую роль в процессе консультирования пациенток, выборе оптимального протокола стимуляции и повышении эффективности программ криоконсервации ооцитов.

Keywords: ovarian reserve, granulosa cells, fertility preservation, controlled ovarian stimulation, antral follicle count, ovarian response prediction, ovarian hyperstimulation syndrome, reproductive endocrinology

Ключевые слова: овариальный резерв, гранулёзные клетки, сохранение фертильности, контролируемая стимуляция яичников, антральные фолликулы, прогноз овариального ответа, синдром гиперстимуляции яичников, репродуктивная эндокринология

Введение

Овариальный резерв — это совокупность примордиальных фолликулов, которые могут дальше расти и созревать. С возрастом естественным путём уменьшается запас яйцеклеток, при этом наблюдается уменьшение количества фолликулов и снижение качества яйцеклеток. В связи с этим оценка запаса яйцеклеток считается важным этапом при планировании заморозной консервации. В практике врачей применяются разные показатели, и один из них — антимюллеров гормон (АМГ), который особенно важен. АМГ производится гранулоцитами преантральных и антральных фолликулов и показывает, сколько фолликулов доступно в яичнике. Уровень АМГ остается практически неизменным в течение менструального цикла, что делает его удобным точным показателем для оценки овариального резерва. Антимюллеров гормон часто применяется в репродуктивной медицине для предсказания результата овариальной стимуляции, анализа риска развития гиперстимуляции яичников и для выбора лучшего времени и способа заморозить яйца. Высокий уровень АМГ обычно связан с хорошим реагированием на стимуляцию и возможностью получить большое количество ооцитов, что увеличивает шансы на успешное сохранение фертильности. Однако при высоком уровне АМГ увеличивается вероятность гиперстимуляции, поэтому необходимо изменить схему стимуляции. Низкий уровень АМГ говорит о том, что резерв яичников уменьшился, и это может означать, что организм плохо реагирует на стимуляцию, что снижает эффективность процедуры. В таком случае нужен индивидуальный подход, который может включать проведение нескольких циклов или выбор других методов. В последние годы технология криоконсервации значительно лучше стала благодаря использованию витрификации — метода быстрого замораживания, который помогает защитить клетки, предотвращая образование ледяных кристаллов. Витрификация увеличила шансы на выживание ооцитов после разморозки и улучшила результаты лечения, поэтому этот метод стал распространенным в большинстве клиник по репродуктивному здоровью. Однако эффективность криоконсервации всё ещё в большой степени зависит от исходного запаса яйцеклеток, поэтому правильная оценка запаса

яйцеклеток остаётся важным этапом подготовки к процедуре. Поэтому изучение роли АМГ в процессе криоконсервации ооцитов имеет большое практическое значение. Анализ зависимости между уровнем АМГ и результатами криоконсервации помогает лучше подобрать методы стимуляции, увеличить шансы на получение нужного количества хороших ооцитов и тем самым повысить вероятность успешной беременности в будущем. В этом случае изучение АМГ как показателя, который помогает предсказать исход, и включение его в методики криоконсервации продолжают оставаться важной задачей в современной репродуктивной медицине.

Криоконсервация ооцитов это способ, при котором яйцеклетки, которые находятся в запасе у женщины, берутся и хранятся при очень низких температурах, чтобы потом их можно было использовать снова. Технология начала появляться в 1980–1990-е годы, а после применения метода витрификации её результаты и польза стали лучше. Витрификация — это быстрая заморозка, которая помогает меньше повреждать ооциты и делает их более жизнеспособными. В настоящее время криоконсервация ооцитов часто используется в медицинской практике и считается важным способом сохранить фертильность, в зависимости от планов жизни и медицинских причин [2]. Роль криоконсервации ооцитов в репродуктивной медицине многогранна. Первое, это важная профилактическая мера для пациентов с онкологическими заболеваниями. Современные способы лечения рака, такие как химиотерапия, радиация и операции, могут вредить работе яичников, уменьшать возможность получить детей или совсем привести к потере детородной способности. Поэтому женщинам советуют взять и сохранить яйцеклетки до начала лечения от онкологии. Это помогает вернуть возможность забеременеть в будущем и повысить качество жизни после лечения от рака. Во вторых, криоконсервация ооцитов часто применяется для сохранения фертильности по социальным причинам. Женщины могут решать не заводить детей до того времени, когда они достигнут определённых целей в работе, получают образование, обеспечат себе финансовую стабильность или найдут подходящего партнёра. Сохранение ооцитов по социальным причинам помогает избежать проблем с бесплодием, связанных с тем, что фертильность ухудшается со временем. Это особенно важно для женщин в возрасте 30–40 лет, так как уменьшение запаса яичников и ухудшение качества эмбрионов — это основные возрастные причины, которые влияют на возможность беременности [4]. В третьих, криоконсервация ооцитов используется, когда требуется планировать воспроизводство по генетическим или медицинским причинам. Например, в семьях, где есть риск наследственных болезней, сохранение ооцитов позволяет в будущем сделать генетическое тестирование и воспользоваться донорскими эмбрионами, что даёт шанс стать матерью. Женщинам с заболеваниями, которые могут привести к временному или постоянному ухудшению работы яичников (эндометриоз, аутоиммунные болезни, хирургические операции), рекомендуют сохранять ооциты. Следовательно, криоконсервация играет важную роль в обеспечении репродуктивной безопасности и планирования [5]. Эффективность заморозки яйцеклеток зависит от многих факторов, и одним из самых важных является уровень запаса яичников. Для оценки используется несколько показателей, но среди них антимюллеровский гормон (АМГ) сейчас считается одним из самых точных и часто применяемых признаков.

АМГ — это гормон, который состоит из белка и сахара, и он вырабатывается клетками, находящимися в анальных фолликулах. Он образуется на ранних этапах фолликулогенеза, то есть в примордиальных и преантральных фолликулах, и показывает, какое количество яичникового резерва есть. Уровень АМГ почти не меняется в зависимости от дня менструального цикла, поэтому анализ его удобен и показания остаются стабильными. Эти свойства делают АМГ важным показателем для оценки репродуктивного резерва [6]. Низкий уровень АМГ указывает на уменьшение запаса яйцеклеток, а высокий — на наличие большого числа фолликулов. Эта информация важна при замораживании яйцеклеток, так как помогает предсказать, как пациентка отреагирует на лечение, сколько яйцеклеток будет получено и как будут проходить заморозка и хранение. Например, высокий уровень АМГ позволяет определить женщин с хорошим реагированием на стимуляцию, но также может повысить вероятность гиперстимуляции. Низкий уровень АМГ означает, что вероятно, будет слабый ответ на стимуляцию, и это требует изменения подхода к криоконсервации, проведения дополнительных циклов или использования других методов [7]. Значение уровня АМГ в контексте криоконсервации ооцитов проявляется в двух основных аспектах. Сначала проводится общая оценка состояния пациентки и подготовка к процедуре. Результаты АМГ помогают

определить, какую дозу стимуляции применять, насколько долго будет длиться цикл и когда брать ооциты. Во-вторых, это прогнозирование результатов криоконсервации. Количество и качество яйцеклеток влияют на то, как хорошо она выживает после разморозки и какие возможности будет иметь для дальнейшего развития эмбриона. Поэтому считается, что у женщин с высоким уровнем АМГ результаты криоконсервации могут быть лучше, а у женщин с низким уровнем АМГ количество яйцеклеток меньше и результаты могут быть хуже. Однако эта зависимость не всегда ясна, потому что качество ооцитов определяется не только их числом, но и возрастом пациентки, ее гормональным фоном и другими причинами. Поэтому изучение воздействия АМГ на качество криоконсервации представляет собой значимую научную и клиническую проблему [8]. В этой статье говорится о понятии криоконсервации яйцеклеток, её значении в репродуктивной медицине и основных физиологических особенностях гормона АМГ. Кроме того, проводится изучение научных работ и анализ методов, используемых в клинической практике, чтобы выяснить, как уровень АМГ влияет на сохранение яйцеклеток при криоконсервации. Рассматриваются надежность маркера АМГ, его ограничения и особенности использования при криоконсервации, а также приводятся практические рекомендации по правильному подбору пациенток и оптимизации лечебных программ. Таким образом, статья объединяет современные исследования и практическое применение в клинической практике с целью улучшить криоконсервацию и сохранить репродуктивные возможности у женщин. АМГ — это показатель, который говорит о запасе яйцеклеток в яичниках. Уровень АМГ напрямую связан с количеством фолликулов в яичниках. Чем больше примордиальных и преантральных фолликулов, тем больше вырабатывается АМГ. Поэтому по уровню АМГ можно судить о объеме овариального резерва (Broer et al., 2014). Кроме того, уровень АМГ не сильно зависит от дня в менструальном цикле, поэтому тестирование его удобно проводить, и результаты получаются стабильными. С возрастом количество яйцеклеток в яичниках уменьшается. Этот процесс связан с естественным истощением фолликулов. Следовательно, уровень АМГ снижается с возрастом. Однако это не всегда происходит одинаково: у некоторых женщин уровень АМГ может быть низким, даже если они молодые, а у других — высоким, несмотря на возраст. Это связано с генетикой, окружающей средой и состоянием здоровья. Криоконсервация ооцитов — это современная технология, которая позволяет сохранить возможность рождения детей у женщин. Полученные ооциты хранят при очень низкой температуре, обычно около -196 градусов, и их можно использовать позже для получения беременности. Криоконсервация ооцитов — это важная часть методов сохранения фертильности и используется в случаях онкологических заболеваний, по социальным причинам, у молодых женщин и в других ситуациях. Эффективность криоконсервации определяется двумя основными способами — витрификацией и обычным замораживанием (медленное замораживание). В этом разделе говорится о технических особенностях, показаниях к применению и важности этих методов в клинической практике.

2. Методы криоконсервации ооцитов

2.1. Классический фризинг — это способ заморозки, при котором замедляют процесс замораживания и температуру понижают постепенно. В это время ооциты сначала помещают в растворы, которые защищают их от повреждений, а потом температуру постепенно снижают.

Процедура обычно включает следующие этапы:

1. Выбор и приготовление криопротектора: ооциты помещают в растворы криопротекторов, например, ДМСО, этиленгликоль или сахароза, определённой концентрации. Криопротекторы помогают меньше образовываться льду внутри клеток и уменьшают стресс от изменения давления воды, а также повреждения.

2. Постепенное замораживание: температура постепенно понижается от 0 градусов Цельсия с определенной скоростью, обычно до $-0,3$ градуса Цельсия в минуту. На этом этапе вода уходит из клетки, что снижает образование льда внутри. 3. Удаление криопротекторов: после того как яйцеклетки заморозили, их хранят в криохранилище. При размораживании криопротекторы должны быть постепенно удалены. Основное преимущество классического фризинга — это долгая история использования, хорошо изученная методика и широкое применение в клинической практике. Однако один из недостатков метода — это возможность повреждения ооцитов из-за образования кристаллов льда и стресса, вызванного изменением осмотического давления. Это может вызывать повреждение структур клеточных органелл,

таких как микротрубочки и митохондрии, и уменьшать выживаемость ооцитов, что вредит дальнейшему развитию эмбрионов [1].

2.2. Витрификация это способ очень быстрого охлаждения, при котором внутренняя жидкость клетки превращается в стеклообразное состояние, и не образуются кристаллы льда. Этот способ стал часто использоваться с начала 2000-х годов и сильно повысил качество сохранения яйцеклеток при замораживании. В последние годы витрификация ооцитов стала широко применяться для сохранения фертильности. Она полезна: Онкологическим пациенткам перед стерилизующим лечением; пациенткам о неонкологических заболеваниях, требующими гонадотоксической терапии; женщинам, желающим отложить материнство.

Процесс витрификации обычно состоит из следующих этапов:

1. Быстрое знакомство с криопротекторными растворами: ооциты на немного время помещаются в раствор, где много криопротекторов, например, этиленгликоль, DMSO или сахара. Это обеспечивает быстрое удаление воды из клетки.

2. Быстрое охлаждение: ооциты с помощью специальных криоустройств, например, Cryo-тор или CryoLoop, очень быстро помещаются в жидкий азот, который имеет температуру -196°C . Этот процесс происходит очень быстро, обычно при температуре 1000 градусов по Цельсию в минуту и более.

3. Повторное нагревание: при разморозке витрифицированных ооцитов криопротекторы постепенно и медленно удаляются, и клетки возвращаются в нормальную среду. Главное преимущество витрификации заключается в том, что она не позволяет образовываться кристаллам льда, что помогает избежать повреждений структуры ооцитов. В итоге выживаемость ооцитов становится выше, а процесс образования эмбрионов работает лучше. Несколько клинических исследований показали, что вероятность зачатия после использования ооцитов, хранившихся с помощью метода витрификации, выше, чем при традиционном методе заморозки (медленное замораживание) [2]. Однако витрификации есть и свои ограничения. Высокое количество криопротекторов может причинить вред клеткам, особенно если воздействие длится долго. Поэтому протоколы витрификации разработаны для очень быстрого процесса и нуждаются в специальном оборудовании. Кроме того, важно иметь нужные навыки: неправильная скорость или уровень криопротекторов может навредить яйцеклеткам [3].

3. Показания к криоконсервации половых клеток

Криоконсервация ооцитов применяется по разным причинам, которые делятся на медицинские, социальные и связанные с планированием семьи.

3.1. Сохранение фертильности до начала лечения при онкологии

Современные способы лечения рака, такие как химиотерапия, радиотерапия и операция, могут негативно воздействовать на работу яичников у женщин. Это особенно важно для молодых женщин и подростков, потому что их возможность выносить детей в будущем может быть в опасности. Поэтому перед началом лечения рака рекомендуется взять яйцеклетки и заморозить их, чтобы сохранить возможность иметь детей. Химиотерапия и радиотерапия могут повредить фолликулы и уменьшить количество яйцеклеток в яичниках. В результате у женщин может начаться ранняя менопауза или уменьшиться возможность зачатия. Предварительное замораживание ооцитов позволяет восстановить возможность размножаться в будущем. Эта стратегия помогает улучшить качество жизни больных раком и позволяет им продолжать планировать свою семью [4].

3.2. Для подростков и молодых женщин, которые хотят сохранить возможность иметь детей по медицинским или другим причинам, криоконсервация яйцеклеток — это важный способ. В этой группе репродуктивная функция ещё не полностью развита, поэтому при выборе методов криоконсервации нужно использовать специальный подход. Кроме того, сохранение фертильности по социальным причинам среди молодых женщин встречается довольно часто. Поскольку яйцеклетки у молодых женщин лучше, криоконсервация у этой группы может давать хорошие результаты [5].

3.3. Сохранение яйцеклеток по социальным причинам в современном обществе стало очень распространенной практикой. Женщины могут решать не рожать ребёнка по разным причинам, например, из-за работы, учёбы, проблемы с деньгами, отсутствия подходящего мужа или других ситуаций. Хранение яйцеклеток при низкой температуре помогает избежать проблем с воспроизводством, связанных с ухудшением фертильности со временем. Распространение технологии социального криосохранения вызывает споры среди ученых и людей по поводу её биологических и этических последствий. В некоторых странах эта процедура

разрешена только по медицинским причинам, а в других — и по социальным. Однако эффективность криоконсервации по социальным причинам зависит от возраста женщины, уровня овариального резерва и количества полученных ооцитов. Поэтому важно правильно информировать пациентку и проводить клиническое консультирование [6].

3.4. Планирование беременности позже возраста может вызывать проблемы, связанные с уменьшением запаса яйцеклеток, ухудшением их качества и снижением шансов зачать ребенка. Поэтому для репродуктивного планирования рекомендуется криоконсервация ооцитов. Это особенно важно для женщин в возрасте 30–40 лет, потому что количество и качество их яйцеклеток начинают уменьшаться. Стратегия отсроченной беременности позволяет женщинам свободнее решать, когда рожать детей, но её результат зависит от возраста женщины и от того, сколько яйцеклеток было заморожено. Поэтому при составлении плана необходимо дать пациентке точную информацию и учесть её возможности [7].

Правильный отбор пациентки: повышение эффективности криоконсервации

Эффективность криоконсервации напрямую зависит от правильного отбора пациентки. Уровень АМГ помогает оценить овариальный резерв, но является лишь одним из показателей. При отборе учитываются следующие факторы:

Возраст: с возрастом снижается количество и качество ооцитов, поэтому у молодых женщин криоконсервация может быть более эффективной.

Уровень АМГ: высокий уровень АМГ указывает на хороший ответ на стимуляцию, низкий — на риск слабого ответа.

AFC (антральное количество фолликулов): определяется при ультразвуковом исследовании и в сочетании с АМГ позволяет более точно оценить овариальный резерв.

Уровни FSH и эстрадиола: гормоны, измеряемые в первые дни менструального цикла, являются дополнительными показателями овариального резерва.

Медицинская история и планы: онкологическое лечение, эндометриоз, хирургические вмешательства и другие факторы.

Правильный отбор пациентки повышает эффективность криоконсервации и увеличивает вероятность наступления беременности в будущем. Для этого в клинике применяется мультидисциплинарный подход с участием репродуктолога, эндокринолога и психолога [6].

Заключение

Антимюллеров гормон (АМГ) является одним из важных показателей запаса яичников и участвует в определении и проведении процедуры замораживания яйцеклеток. Уровень АМГ помогает точно определить, сколько фолликулов доступно, заранее понять, как будет реагировать яичники на стимуляцию и спрогнозировать, какими будут результаты процедуры. Высокий уровень АМГ показывает, что яичники хорошо реагируют на стимуляцию и можно получить больше ооцитов, но при этом нужно тщательно контролировать лечение, чтобы избежать риска гиперстимуляции. Низкий уровень АМГ говорит о том, что резерв яичников уменьшился, и в таком случае может потребоваться индивидуальный подход, например, повторные циклы или другие методы лечения. Хранение яйцеклеток, особенно с помощью метода витрификации, — это хороший способ сохранить плодотворность и увеличить шансы на зачатие у женщин. Однако её эффективность в большой степени зависит от правильной оценки способности пациентки к размножению. В этом случае включение АМГ в работу врача помогает сделать процедуру лучше, наладить правильные способы стимуляции и повысить шансы на успешный исход для женщин.

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PLASTIC AND RECONSTRUCTIVE SURGERY IN CANCER PATIENTS: CURRENT STATE OF THE PROBLEM

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Abstract

This scientific and analytical work presents detailed clinical data concerning modern directions of plastic and reconstructive surgery in cancer patients, possibilities of restorative treatment in various nosological forms of malignant tumors, as well as prospects for the development of this surgical branch, both separately and in close cooperation with other specialized specialties. The issues of close integration of the academic discipline, which is plastic surgery, into the educational process are also covered. At the same time, the majority of both medical experts and teachers and students themselves support the arguments in favor of introducing educational programs in plastic surgery in medical school to improve the professional qualifications of future doctors.

Keywords: oncology, plastic surgery, reconstructive surgery, reconstruction, quality of life, prognosis.

Plastic and reconstructive surgery in oncology is the most important stage of surgical rehabilitation of patients with malignant neoplasms. At the same time, this section of plastic surgical oncology, the purpose of which is to improve the functional results of treatment and the quality of life of cancer patients, is currently on the same level with methods aimed at improving the long-term results of treatment and survival of this contingent of patients.

At the same time, of course, in addition to the fact that there are many nosological forms of malignant neoplasms with different localization of the oncological process, with each localization, various

types of reconstructive plastic surgery are used, both primary (one-stage) together with the main surgical oncological assistance, and delayed in time after the primary operation aimed at removing the tumor and areas of regional metastasis (lymph node dissection).

As noted by Abdulaziz M.K.H.B. et al. [1] plastic surgery has developed to benefit in a variety of challenging areas formerly handled by other disciplines. Medical students do not have a clear picture of plastic surgery as a career due to lacking scope, clinical practice, and understanding of plastic surgery as a clinical area of expertise, including general practitioners, nursing staff, medical trainees, and the general public, and misconceptions about the extent of reconstructive and plastic surgery.

Plastic surgery is a surgical discipline focused on reconstructing facial and body tissue defects. The imaginative aspect of plastic surgery generates a distinctive atmosphere in which the surgeon's creativity is the sole constraint. The surgeon's creativity leaves individuals outside the area perplexed about what a plastic surgeon accomplishes. There are several dimensions to cosmetic procedures - a progressive and developing field not constrained by anatomical or organ systems. Not limited to breast treatments, maxillofacial trauma, cleft lip procedures, skin cancer, burns, hand treatments, trauma reconstruction, cosmetic operations, oncology transformation, ophthalmic eye procedures, etc., are all subspecialties of cosmetic procedures. Plastic surgery has developed to benefit in a variety of challenging areas formerly handled by other disciplines. In addition, general practitioners, nursing staff, medical trainees, and the general public do not entirely understand plastic surgery as a clinical practice. The general public and medical experts have misconceptions about the extent of reconstructive and plastic surgery. Numerous studies have observed the variables that might affect a person's decision to pursue a career in plastic surgery globally. Very often, plastic surgery is considered a cosmetic treatment in the public. Major misunderstandings about plastic surgery result from the public's point of view, ultimately affecting medical students' perception with no access to this field during their clinical rotations. As a result, some medical schools have included clinical rotations for plastic surgery in their medical curricula to dispel this myth. Literature reveals that several medical school courses undervalue plastic surgery, a debatable topic. Lack of proper training and career counselling in plastic surgery at the undergraduate level is a primary concern when medical students decide to choose plastic surgery as a specialty. As cosmetic surgery and other areas of expertise like maxillofacial surgery, orthopaedic procedures, dermatology, and otolaryngology frequently share procedures, those who backed the involvement of cosmetic procedures in medical programs claimed that this integration would enhance the referral trend among medical providers. Additionally, exposing undergraduate medical students to plastic surgery will enhance their decision rates to specialize in this field. According to a survey, 30% of plastic surgery residents chose their field while attending medical school. As a result, how medical students view plastic surgery may be important in determining whether they decide to pursue it as a profession after graduation. According to research, the majority of medical experts, teachers, and students agree that reduced exposure to plastic surgery curricula in medical school decreases students' professional proficiency as prospective surgeons, doctors, and regular practitioners. However, the availability of knowledge and the aforementioned beneficial consequences strengthen the case for medical students' legitimate requirement of plastic surgery rotation regarding the impact of medical practice and education variations on medical graduates. The same regulations on medical procedures and specialization apply to medical students enrolled in various programs. Thus, the sort of medical education that graduate practitioners were exposed to might impact their inclinations for the profession and, later on, how they carry out health care choices and choose which patients to refer to plastic surgeons [1].

Knoedler L. et al. [2] indicate that malignancies represent a persisting worldwide health burden. Tumor treatment is commonly based on surgical and/or non-surgical therapies. In the recent decade, novel non-surgical treatment strategies involving monoclonal antibodies and immune checkpoint inhibitors have been successfully incorporated into standard treatment algorithms. Such emerging therapy concepts have demonstrated improved complete remission rates and prolonged progression-free survival compared to conventional chemotherapies. However, the in-toto surgical tumor resection followed by reconstructive surgery oftentimes remains the only curative therapy. Breast cancer, skin cancer, head and neck cancer and amongst other cancer entities commonly require reconstructive surgery to restore form, aesthetics, and functionality.

Now let us consider the current modern trends and directions in reconstructive plastic surgery for various nosological forms of malignant neoplasms.

As the treatment of breast cancer advances, the focus has shifted from solely improving oncological endpoints to a greater weight being placed on cosmetic and psychological outcomes. The advent of advanced oncoplastic techniques allows for successful breast-conserving surgery (BCS) to patients who

otherwise would have required a mastectomy. The aim of the study by Reid A. et al. [3] was to determine whether the adoption of these procedures has assisted in the reduction of mastectomies performed. A dataset of all breast cancer procedures based upon coding between April 2016 and July 2023 was evaluated, categorising procedures into: BCS, mastectomy, oncoplastic BCS and total reconstructions. R-Studio Software 4.3.1 (®) was used to explore statistical analysis and data visualisation. In the last three decades, there has been great progression in the way breast cancer is managed, both surgically and medically. The development of effective adjuvant therapies, early detection of cancers and microscopic confirmation of margins has facilitated the growth of breast-conserving surgery (BCS). There is now an emerging pool of evidence regarding the oncological superiority of BCS compared to the use of mastectomy. This suggests that BCS should be the preferred treatment option from an oncological perspective, for patients who are suitable candidates. Additionally, BCS has been linked to favourable patient satisfaction and psychosocial morbidity outcomes (including anxiety, sexuality and self-esteem) when compared to simple mastectomy and total reconstruction [3,4]. The advent and adoption of advanced oncoplastic surgery (OPS) allows successful BCS to patients who otherwise would have required a mastectomy. The process involves excision of a breast lesion with adequate margins and reconstruction of the ipsilateral breast, with or without performing symmetrising procedures on the contralateral breast. These procedures can be divided into volume displacement, such as therapeutic mammoplasty or mastopexy, and volume replacement, using implants or local/regional flaps. Chest wall perforator flaps (CWPF) are considered partial breast reconstructions, as they utilise pedicled flaps to add volume (with or without skin) to replace resected tissue. OPS is followed by ipsilateral radiotherapy and the potential for lipofilling to correct asymmetry [3,5].

The study was conducted by reviewing a dataset with all operative cases at the hospital trust that involved breast cancer surgery according to the Operating Procedure Codes Supplement (OPCS) classification of interventions and procedures. All patients who underwent an index breast cancer operation at the hospital trust between April 01, 2016 and July 31, 2023 were included in the study. The study used 'breasts treated' as the denominator, to account for bilateral breast cancers. All benign operations as well as revision and re-excision operations were excluded. The operations were performed by a heterogeneous group of oncoplastic breast surgeons and plastic surgeons, with oncoplastic breast surgeons performing the majority of operations. Selection bias has been reduced by including all patients who underwent index breast cancer surgery in the specified timeframe. Each operative case in the dataset included the operation date, patient hospital number and all recorded OPCS procedure codes. The data was filtered and organised by searching for specific OPCS codes to identify the procedure type. The BCS group was organised by searching for the respective OPCS codes to identify cases that involved the following procedure types: wide local excision (WLE), CWPF, latissimus dorsi (LD) and therapeutic mammoplasty (TM) or mastopexy. TM and mastopexy procedures were grouped together as there is considerable overlap between these procedures, and both represent volume displacement. For the sake of analysis, LD partial reconstructions were added to the CWPFs group, as there were very few and it was logical to place the pedicled autologous partial reconstructions together. The mastectomy procedures were grouped following the same process, to identify the following procedure types: simple mastectomy, implant, LD and deep inferior epigastric perforator (DIEP). For the sake of analysis, transverse upper gracilis and transverse rectus abdominal myocutaneous procedures were added to the DIEP group, as there were very few and it was logical to place all the distant autologous reconstructions together. Examining the procedures with miscellaneous codes revealed a further procedure type, which was CWPF total reconstruction following mastectomy. These were added to the LD group for the same reasons as above. Procedure types were then allocated into overarching categories. The oncoplastic procedures at the time of BCS category consisted of: TM/mastopexy and CWPF. The total reconstruction procedures at the time of mastectomy consisted of: implant, LD and DIEP. Mastopexy operations within the BCS group were examined to exclude symmetrising-only mastopexies and mastopexies following massive weight loss. Therapeutic mammoplasties were coded under WLE, allowing for the exclusion of non-cancer mammoplasties. Mastectomy operations were examined to exclude risk-reducing mastectomies and secondary conversions from BCS to mastectomy. The data was then filtered into unilateral and bilateral operations, to identify operations that involved bilateral index cancer procedures and exclude symmetrising procedures or secondary cancer procedures. This process ensured the filtered dataset contained only index cancer procedures with 'breasts treated' as the denominator [3].

The primary outcome in this study was to determine the annual BCS rate between 2016 and 2023. This was calculated by dividing the number of BCS procedures per year by the total number of index cancer procedures per year. Secondary outcomes included evaluating the proportion of the four main

procedure categories per year: WLE, oncoplastic BCS, simple mastectomy, and total reconstruction. The rates of oncoplastic BCS and total reconstructions over the same time frame were then calculated, with the number of BCS procedures and number of mastectomy procedures per year being used as the denominator respectively. Further to this, the proportion of each specific breast cancer procedure type per year was reviewed for TM/mastopexy, CWPFs, implants and DIEPs/LDs. The total number of index cancer procedures per year was used as the denominator for these calculations. This allowed for analysis which accounted for variations in the number of cancers operated on per year, as there were considerably fewer operations performed during the period of the COVID-19 pandemic [3].

During the period stated, 3875 index breast cancer procedures were recorded (sample size = 3638 patients). The BCS rate increased from 66.2 % in 2016 to 80.7 % in 2023. Using a linear regression model, the BCS rate demonstrates an increase of 2.1 % each year (coefficient = 2.12, p-value = 0.0069). Concurrently, the rate of oncoplastic BCS increased from 10.5 % to 22.9 % (coefficient = 2.14, p-value = 0.00017). Using Pearson's product-moment, a positive correlation between these two variables is seen (coefficient = 0.86, p-value = 0.0056). This study has a number of strengths. Firstly, the study has a large sample size of breast cancers treated (n = 3875). To the author's knowledge this is the largest study of its kind, as a single-centre cohort study evaluating BCS and OPS trends in the United Kingdom. Secondly, the data was collected prospectively by data analysts who are not involved in the research, helping to reduce confirmation and selection bias. Thirdly, the depth of the coding has allowed for analysis of not only BCS rate but also specific procedure types. This has allowed the author to review trends in oncoplastic procedures and evaluate for associations between different trends. Having reviewed 3875 index breast cancer procedures over the past eight years, the BCS rate has shown a statistically significant increase and a positive correlation with the oncoplastic BCS rate. This suggests oncoplastic surgery has helped to reduce the rates of mastectomy at the centre [3].

A large study on the feasibility of using oncoplastic organ-preserving breast surgery for the treatment of early-stage breast cancer was conducted by Rocco N. et al. [6]. As the authors point out the potential advantages of oncoplastic BCS have not been validated in robust studies that constitute high levels of evidence, despite oncoplastic techniques being widely adopted around the globe. There is hence the need to define the precise role of oncoplastic BCS in the treatment of early breast cancer, with consensual recommendations for clinical practice. A panel of world-renowned breast specialists was convened to evaluate evidence, express personal viewpoints and establish recommendations for the use of oncoplastic BCS as primary treatment of unifocal early stage breast cancers using the Grading of Recommendations Assessment, Development and Evaluation (GRADE) approach. According to the results of the systematic review of literature, the panelists were asked to comment on the recommendation for use of oncoplastic BCS for treatment of operable breast cancer that is suitable for breast conserving surgery, with the GRADE approach. Based on the voting outcome, the following recommendation emerged as a consensus statement: Oncoplastic breast conserving surgery should be recommended versus standard breast conserving surgery for the treatment of operable breast cancer in adult women who are suitable candidates for breast conserving surgery (with very low certainty of evidence).

The panel was composed of twenty-one academics and clinicians from across the world with expertise in the field of breast cancer management, and included breast surgical oncologists, plastic surgeons, medical and radiation oncologists, dedicated breast radiologists, pathologists, psycho-oncologists, breast care nurses, patient advocacy representatives and patients themselves. A systematic literature review was performed by searching PubMed, Embase and Cochrane Library, Psychinfo, and Lilacs (up to July 19, 2020) without date or language restrictions. The guideline panel used the GRADEpro Guideline Development Tool to deliberate and then prioritize outcomes of interest.

The panel identified the following outcomes of benefit: 1) quality of life; 2) patient's satisfaction with aesthetic outcome; 3) loco-regional recurrence; 4) re-excision rate (defined as re-excision of positive margins); 5) conversion to mastectomy (defined as mastectomy for positive margins); 6) overall survival; 7) margin positivity rate; 8) disease-free survival; 9) depression; 10) anxiety; 11) aesthetic outcome non-patient-reported; 12) insomnia; 13) fatigue.

The following outcomes were judged as "critical" for decision-making in oncoplastic breast surgery: 1) quality of life; 2) patient's satisfaction with aesthetic outcome; 3) loco-regional recurrence; 4) re-excision rate (defined as re-excision of positive margins); 5) conversion to mastectomy (defined as mastectomy for positive margins); 6) overall survival; 7) margin positivity rate; 8) disease-free survival; 9) depression.

The panel identified the following adverse outcomes that potentially cause harm to patients: 1) surgical complications (defined as post-operative complication presenting within one month after the

surgical procedure); 2) post-operative need for second level exams (defined as the need of second level exams in the follow-up due to imaging abnormalities deriving from the surgical procedure); 3) pain (defined as post-operative pain); 4) time to adjuvant treatment (defined as time from the surgical procedure to the start of any adjuvant therapy); 5) return to operating theatre within 7 days (defined as any re-intervention for early post-operative complication); 6) operative time (defined as the duration of the surgical procedure). "Surgical complications" was the only outcome judged to be "critical" for decision-making, with the other outcomes being classified as "important" [6].

The current evidence base for oncoplastic BCS derives mainly from observational studies and single-center case-series with few studies directly comparing oncoplastic to standard BCS in matched cohorts of patients. Despite low levels of evidence for most studies, there is an emergent theme that some of the more obvious and anticipated benefits of oncoplastic BCS are not supported by the evidence with this meta-analysis failing to yield odds ratios significantly in favor of oncoplastic BCS. Moreover, critical outcomes relating to quality of life (QoL) have not been investigated in the majority of studies and available data is often based on assessment with non-standardized scales or inappropriate use of standardized scales. More than three-quarters (79%) of panelists offered a conditional or strong recommendation in favor of adopting oncoplastic techniques versus standard BCS for surgical management of adult women with operable breast cancer who are otherwise suitable candidates for breast conserving surgery (without any clear indication for mastectomy). The GRADE system was employed to analyze published data and seek support for oncoplastic BCS as the new "state of the art" surgical approach to early stage breast cancer compared to standard BCS. A panel of world-renowned breast specialists was convened to evaluate evidence, express personal viewpoints and establish recommendations. This review has revealed a low level of evidence for most of the important outcomes in oncoplastic surgery with lack of any randomized data and absence of standard tools for evaluation of clinical outcomes and especially patients' values. There is substantial uncertainty in the balance between beneficial and adverse effects of oncoplastic versus standard BCS and no formal assessment of patients' values and preferences has been performed. This may lead to surgical over-treatment in some cases when patients are less interested in potential benefits in terms of margin status and re-excision. Others may specifically wish to avoid disruption of an otherwise normal contralateral breast. The outcome rated as most important by the panelists in the prioritization process was QoL that has been sparsely investigated to-date; data on cosmetic outcomes is heterogeneous with assessment based on either subjective or objective methodologies. There is an urgent need for appropriate and validated tools that can routinely be applied in daily practice. Poor access to accredited training programs hampers more widespread implementation of a comprehensive oncoplastic service, although these techniques are unlikely to impact equity of health systems. Despite areas of controversy, about one-third (36%) of panel members expressed a strong recommendation in support of oncoplastic BCS. Presumably, this reflects a synthesis of views on the relative complexity of these techniques, associated complications, impact on quality of life and costs. Patients should be informed of the following recommendation before consenting to oncoplastic procedures for breast conserving surgery: "Oncoplastic Breast Conserving surgery should be recommended versus standard breast conserving surgery for the treatment of operable breast cancer in adult women who are suitable candidates for breast conserving surgery (with very low certainty of evidence)". At the same time, lack of access to well-structured training in oncoplastic breast surgery was identified as a principal barrier to more widespread adoption of these techniques across the world. Dedicated training programs should be established by postgraduate medical education systems under the aegis of professional associations allied to breast cancer management [6].

van Egmond S. et al. [7] note in their work that to provide patient-centered care, it is essential to explore what patients consider important and to adjust care accordingly. This may specifically be relevant for patients with complex skin cancer, for whom the care process is often more complicated and psychological and social problems may play a larger role. The objective was to explore the experiences and needs of patients who had undergone surgical treatment by a dermatologist for a complex skin cancer with a subsequent reconstruction by a plastic surgeon. An interview study was conducted among 16 patients who had undergone surgical treatment by a dermatologist and reconstruction by a plastic surgeon for basal cell carcinoma, cutaneous squamous cell carcinoma, or lentigo maligna. The interviews focused on patients' experiences and needs regarding care using a predefined topic list. Patients reported a need for a skilled and friendly physician who tailors information and communication to their individual situation. Furthermore, patients experienced complications and unmet expectations and expressed a need for shared decision-making at various steps throughout the treatment process (depending on age). Patients also considered completeness of tumor removal, follow-up visits with multiple specialists to be planned

the same day and recognition of the psychological impact of the disease on the partner important. To improve patient-centered care for complex skin cancer patients, more efforts should be directed towards improving continuity of care and collaboration. Furthermore, it is advocated for physicians to be sensitive to the individual needs of patients and their partner and adjust information, communication and (supportive) care accordingly.

Key points for decision makers: 1) the healthcare regarding patients with a complex skin cancer is complicated as they are treated multidisciplinary team and susceptible to social and psychologic problems; 2) in this qualitative study, 16 skin cancer patients were interviewed who underwent surgery by a dermatologist and subsequently reconstruction by a plastic surgeon regarding their experiences and needs; 3) more efforts should be undertaken to improve continuity of care and collaboration between healthcare providers to improve patient-centered care for complex skin cancer patients. To meet patients' needs, physicians should adapt their information, communication and care to the individual patient and their partner [7].

Based on patient interviews, key aspects regarding the experiences and needs of patients with complex skin cancer were identified.

Patients emphasized the importance of a physician who communicates clearly and provides honest information throughout the entire process of care. In this way, they fully know where they stand and what to expect. They need to trust their physician and the provided information. In addition, they reported the importance of physicians to be skilled, but also to show compassion and to be friendly. Patients expressed the importance of information and communication to be tailored to individual patients' needs. They suggested that physicians should ask each patient whether he/she needs more information and adjust the information provision accordingly. Furthermore, patients indicated that physicians should adjust their explanation to the particular patient to make sure every patient understands. Patients generally expressed the need to be seen by the same physician during diagnosis, treatment and follow-up visits. This ensures them that their physician has all relevant information and also strengthens the bond with their physician. In addition, patients reported to prefer to be treated by a specialist instead of a physician assistant (PA), because they feel he/she is the expert. Patients particularly wished to be treated by a skilled expert, as their skin cancer is often located in the face and they wanted it to be done neatly. Nevertheless, patients generally stated it to be acceptable if PAs would provide information and explain things about the treatment process. Patients expressed the need for improved collaboration between healthcare providers and between hospitals. They noticed that healthcare providers sometimes communicate past each other and are not aware of important information. They indicated to sometimes receive wrong information due to miscommunication, such as a wrong dismissal date. A national electronic patient file for all hospitals was suggested to improve communication. Whereas many patients indicated to be satisfied with the information they received, a need for improved information was also often reported. This applied to all phases of the care process. Some patients indicated that they received hand-outs in addition to oral information and some patients were also shown pictures of other complex skin cancer patients. These pictures were regarded as informative by some patients; whereas, others preferred not to see them and reported that physicians should at least warn patients beforehand. Patients often searched the internet for additional information themselves, but as this was sometimes experienced as shocking, they generally preferred to receive clear information on hand-outs from physicians. Overall, patients emphasized the importance of written information besides oral information, because they were not able to remember all information provided during consultation. This was specifically the case for follow-up care [7].

Overall, patients mentioned that they were not given a choice in treatment. They did not consider this as a problem, because they fully trusted the physician in choosing the best treatment. Some patients stated that they were told what would happen if their tumor would not be treated, but receiving no treatment was never a real option for patients: they came all the way from a general hospital to have their skin cancer removed. Some patients appreciated that they were able to decide on type of reconstruction and between local or general anesthesia. Specifically, younger patients expressed the need to be involved in the decision-making process and preferred to discuss treatment choices if available. They stressed the importance of being informed about all treatment options including the benefits and disadvantages. As such, they are able to make an informed decision together with their physician. On the contrary, older patients generally stated to fully trust their physician in making the decision, as he or she is the expert. Patients indicated that they considered the complete removal of the tumor to be more important than the cosmetic outcome. They reported to be scared of recurrence and, therefore, found it most important that it was completely removed, regardless of the scar size. Still, they preferred the scars

to be as small as possible. They preferred surgery opposed to radiotherapy, because surgery confirms complete clearance of the tumor. Furthermore, patients expressed a preference for the skin cancer to be removed as quickly as possible to prevent it from growing further. Improvement of quality of life was also mentioned as an important outcome [7].

Patients reported various experiences regarding continuity of care during the entire care process. Some patients were seen by the same healthcare provider every time, whereas others reported to have seen a different physician on each occasion. Seeing multiple physicians made them feel that the physicians were not really involved in their care, even if they prepared the consultation well. Overall, patients reported to be satisfied with the received care by medical specialists. In general, patients did not like to be treated by PAs or residents instead of specialists, particularly if they had not given permission for this. Some patients mentioned that they had experienced complications such as bleeding, infections and pain. They stated that their treatment went better than expected, but the time until full recovery was disappointing. After having been shown pictures of the expected result and receiving explanation of the expected scar size, patients still reported that their scar turned out larger than expected. It also bothered patients that their scar sometimes frightened other people. According to patients, improved information and explanation beforehand could facilitate being properly prepared for potential complications. Patients generally reported to be satisfied with the frequency of the follow-up checks by their dermatologist and plastic surgeon. Some patients expressed the need for an increase or decrease of the interval time between visits. Most patients, however, stated they could adjust the frequency according to their needs. Patients experienced the hospital to be easily accessible; if they noticed new lesions in between follow-up visits, they could come by right away. During follow-up visits, they preferred a physician to perform a full body skin examination as they lack the expertise to self-examine their skin adequately. Patients who live far away from the hospital stated that they preferred to have follow-up visits in a hospital closer to their home to minimize their traveling time. Specifically, elderly patients reported the need for hospital visits to be scheduled at the same day to decrease the number of hospital visits. They also mentioned to be bothered with the high parking costs which were accompanied by the follow-up visits. Patients indicated the whole process to be intense. Some patients reported they became more emotional and more ashamed because of the impact of the treatment and disappointing recovery and scars. Despite the emotional impact of the disease, patients indicated not to require psychological care, although this was offered to them. Instead, they preferred to talk to friends or their primary care physician about it. Patients also expressed the need for recognition and attention of the impact of the disease on partners, as it may be difficult for them to cope with. For example, it might be easier for patients to accept the risks of high-risk surgery than for their partner. Providing more attention to partners of patients in the entire care process was, therefore, suggested [7].

This study focused on the experiences and needs of complex skin cancer patients, who had undergone surgical treatment by a dermatologist and subsequent reconstruction by a plastic surgeon, and revealed a range of themes which could be used as input to organize patient-centered care for this unique patient group. In conclusion, the authors emphasize that the current study provides insight into the experiences and needs of complex skin cancer patients and provides suggestions to improve patient-centered care. Continuity of care and improved collaboration between health care providers is essential for this group of patients. Furthermore, given the differences in experiences and needs within these patients, it is advocated for physicians to be sensitive to the individual needs of patients and adapt their information, communication and care accordingly. This should not be limited to the walls of the hospital, but also include the wider context, for instance by also focusing on interdisciplinary collaborations and by offering psychological support to partners of patients [7].

Cirstea A.I. et al. [8] in their work they say that patients with advanced head and neck tumors require salvage surgery as a last resort. These extensive surgeries pose the challenge of complex reconstructions. The head and neck surgeon undertaking such complex cases needs to master different flaps. The team managing these patients needs input from various specialists, along with otorhinolaryngologists, plastic surgeons, maxillofacial surgeons, vascular surgeons, experienced radiologists, dedicated pathologists, oncologists and radiation therapists. The authors on the optimum solution between oncologic resections and the future quality of life of patients and overall survival and note that each complex case requires an individual medical approach. This review aimed to evaluate the efficacy and outcomes of complex reconstructions using different flaps for head and neck tumors with an emphasis on free flaps and new techniques.

For this scoping review, a systematic and thorough search of the literature was conducted to identify relevant articles. The inclusion criteria for the articles in this review were as follows: articles

published in peer-reviewed journals, articles written in English, articles that primarily focused on the use of multiple flaps in a single complex case, articles with complex reconstructions using regional flaps in head and neck tumor cases and articles with complex reconstructions using free flaps. The researchers included peer-reviewed articles, case reports, case series, and systematic reviews. The exclusion criteria included articles with limited access to full text, articles not written in English, articles that did not specifically address the use of regional or free flaps in head and neck tumor reconstructions, and articles published more than ten years ago. They limited the search to the last 10 years to ensure the novelty of the present scoping review and limit the bias from older sources at the beginning of the development of flap surgeries on a wider scale. The issue of up-to-dateness when conducting scoping reviews seems to be neglected by most authors. Two independent reviewers screened the titles and abstracts of the identified articles to assess their relevance to the research topic. Full-text articles that met the inclusion criteria were retrieved for further evaluation. Any discrepancies or disagreements in study selection were resolved through discussion and consensus. The data relevant to the topic were extracted, including information on the type of flaps used, the surgical techniques employed, patient outcomes, complications, and any comparative studies available. Each included article was evaluated for its quality, methodology, and level of evidence using established criteria for assessing the validity of observational studies and case reports. In this evaluation authors focused on manuscripts indexed as review, systematic review or meta-analysis [8].

To analyze head and neck reconstruction methods and both regional and free flaps, 146 articles published in the domain were identified. The search terms used included "head and neck tumors", "reconstructions", "regional flaps", "free flaps" and related keywords. The research process corresponds to the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) flow diagram and protocol, representing the steps from article identification to articles suitable for further analysis. In total, our search identified 294 papers through PubMed from all time (1988-2024). After the initial screening, only papers from the last ten years (n=143) were retained. Six articles were excluded because they were written in a language other than English. Furthermore, only articles that included human head and neck cancer reconstruction were kept. Finally, the review was performed on a total of 44 studies. This scoping review encompassed an analysis of 44 articles, shedding light on the intricate landscape of complex reconstructions using regional or free flaps for head and neck tumors. Within this diverse body of literature, a plethora of free flap techniques were employed, each tailored to address specific anatomical considerations and patient needs. The radial forearm flap, revered for its thin and pliable nature, featured prominently in many studies, offering versatility in reconstructing defects of varying sizes and complexities. Likewise, the anterolateral thigh flap garnered attention for its abundant tissue availability and reliable vascular pedicle, making it a favored choice in select cases. Scapular tip and myocutaneous flaps also emerged as valuable tools in the reconstructive armamentarium, providing viable alternatives for cases where traditional free flaps may not be feasible or optimal [8].

Beyond the technical nuances of flap selection and surgical technique, several additional factors emerged as significant determinants of reconstructive outcomes in head and neck oncological cases. Tumor characteristics, including size, location, and histopathological subtype, played a pivotal role in dictating the complexity and scope of reconstructive interventions. Patient-related factors, including comorbidities, smoking history, nutritional status, and previous treatment modalities, also exerted a profound influence on surgical outcomes and postoperative recovery. Intraoperative variables, such as ischemia time, microvascular anastomotic technique, and intraoperative flap monitoring, also played a crucial role in determining flap viability and success. Timely revascularization and meticulous hemostasis were identified as key factors in minimizing ischemia-reperfusion injury and optimizing flap survival. Furthermore, postoperative care and monitoring emerged as critical components of the reconstructive pathway, with close surveillance for signs of flap compromise, wound healing complications, and functional impairment. In addition to technical considerations, the timing of reconstruction also emerged as a crucial determinant of outcomes in head and neck oncological cases. Immediate versus delayed reconstruction strategies were compared in several studies, with conflicting evidence regarding their relative benefits and drawbacks. While immediate reconstruction offers the advantage of restoring form and function simultaneously, it may be associated with a higher risk of wound complications and flap failure due to compromised vascularity and tissue edema in the immediate postoperative period. Conversely, delayed reconstruction allows for adequate wound healing and resolution of acute inflammation, potentially reducing the risk of complications and optimizing flap survival. Beyond technical and clinical factors, socioeconomic considerations also played a significant role in shaping reconstructive outcomes and patient experiences. Disparities in access to care, insurance coverage, and socioeconomic status were associated

with differential rates of postoperative complications, delayed presentation, and suboptimal outcomes in head and neck oncological cases. Lastly, advancements in surgical technology and innovation have revolutionized the field of head and neck reconstruction, offering novel techniques and tools to enhance surgical precision, minimize complications, and improve patient outcomes [8].

The discussion of new techniques used in reconstruction opens avenues for innovation and advancement in the field of head and neck reconstruction. Computer-aided design and virtual surgery have emerged as powerful tools in preoperative planning, enabling surgeons to simulate surgical procedures, optimize flap design, and anticipate potential challenges before entering the operating room. In addition to virtual surgery, stereolithographic models have revolutionized the visualization and understanding of complex anatomical structures, facilitating precise surgical guidance and enhancing intraoperative decision-making. Customized implants, fabricated based on patient-specific anatomical data, offer tailored solutions for defect reconstruction, ensuring optimal aesthetic and functional outcomes. Tissue engineering and allotransplants represent promising avenues for tissue regeneration and replacement, providing alternatives to traditional autologous tissue flaps. Looking ahead, the future of head and neck reconstruction appears promising, with bioengineering poised to revolutionize the field. Advances in 3D reconstruction techniques, coupled with the development of muscle and skin substitutes, hold immense potential for enhancing surgical outcomes and improving patient quality of life. Bioengineered constructs, incorporating patient-specific cells and scaffolds, offer the possibility of functional tissue regeneration and seamless integration with host tissues. Moreover, the integration of regenerative medicine approaches, such as stem cell therapy and growth factor delivery, into reconstructive protocols holds promise for promoting tissue healing, reducing fibrosis, and enhancing functional recovery postoperatively [8].

In conclusion, our colleagues note that by synthesizing findings from recent systematic reviews, meta-analyses, and primary studies, researchers have elucidated the challenges, outcomes, and advancements in this complex and multifaceted field. Moving forward, collaborative efforts between clinicians, researchers, and innovators will be paramount in advancing the field of head and neck reconstruction, optimizing patient outcomes, and fostering innovation in surgical techniques and technologies. Overall, the findings from this scoping review provide valuable insights into the efficacy, outcomes, and challenges associated with complex reconstructions using various flaps for head and neck tumors. Continued research and refinement of reconstructive techniques are essential to further optimize outcomes and enhance patient care in this complex clinical setting.

There are many studies in the literature devoted to reconstructive plastic surgeries for other nosological forms of malignant tumors, aimed at improving functional and aesthetic results, and, naturally, at improving the quality of life of these patients.

Summarizing the above, we can conclude that at present, modern realities indicate that reconstructive plastic surgery is an integral and most important part of multimodal treatment and surgical rehabilitation of cancer patients, since the restoration of physical and functional conditions, and with them the quality of life, allows patients to fully reintegrate into society, both in social and professional aspects. In addition, modern technologies and methods of surgical aids in plastic surgery make operations more gentle and safe.

Today, this section of both surgery and medicine in general is one of the most progressive, developing and, most importantly, the most productive and promising medical areas.

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Pedagogical sciences

THE ROLE OF GAMIFICATION AND GAME-BASED LEARNING IN ENHANCING STUDENT MOTIVATION: PERSPECTIVES IN KAZAKHSTAN AND ABROAD

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Abstract

This study examines the effectiveness of gamification and game-based learning in enhancing student motivation within a secondary school context in Kazakhstan. The research employed a quasi-experimental pre-test/post-test control group design involving ninth-grade students, with one group receiving gamified instruction and the other taught through traditional methods. Student motivation was measured before and after a six-week intervention period.

The findings revealed a statistically significant increase in intrinsic motivation among students in the experimental group, whereas the control group demonstrated no meaningful changes. The results indicate that the integration of game elements such as points, challenges, and interactive digital tools contributes to higher levels of engagement and sustained motivation. The study provides empirical evidence supporting the effectiveness of gamified instruction and emphasizes its potential as a modern, student-centered approach in secondary education. These findings are particularly relevant in the context of ongoing digital transformation and educational innovation in Kazakhstan.

Keywords: *gamification, game-based learning, student motivation, intrinsic motivation, digital pedagogy, secondary education, Kazakhstan.*

Introduction

Student motivation is widely acknowledged as a central determinant of academic achievement and meaningful learning. Educational research consistently demonstrates that students' success depends not only on intellectual ability but also on their level of engagement, persistence, and internal drive. When learners are intrinsically motivated, they tend to demonstrate deeper cognitive processing, greater resilience in overcoming challenges, and stronger long-term retention of knowledge. Conversely, low motivation is often associated with passive participation, superficial learning, and declining academic performance. For this reason, fostering sustainable motivation remains one of the primary challenges facing contemporary education systems.

The rapid digital transformation of the 21st century has further intensified this challenge. The integration of information and communication technologies, online learning platforms, and interactive digital tools has reshaped educational environments worldwide. Today's students are accustomed to fast-paced, visually stimulating, and feedback-rich digital experiences outside the classroom. However, traditional teacher-centered instruction, which often relies on lecture-based delivery and standardized assessment, may not fully align with these evolving expectations. This mismatch between students' everyday digital interactions and formal classroom practices can contribute to reduced engagement and declining intrinsic motivation [1].

Within this evolving educational landscape, gamification and game-based learning (GBL) have emerged as innovative pedagogical approaches designed to enhance engagement and motivation. Gamification refers to the integration of game elements such as points, badges, leaderboards, levels, and challenges into non-game educational contexts to increase student involvement. In contrast, game-based learning involves the use of structured educational games that directly support learning objectives. Both approaches seek to create interactive, goal-oriented, and emotionally engaging learning experiences.

The theoretical foundation of gamified instruction is strongly supported by Self-Determination Theory, which emphasizes the importance of autonomy, competence, and relatedness in promoting intrinsic motivation [2]. Gamified environments often provide opportunities for student choice, clear feedback on progress, incremental achievement, and collaborative interaction. These elements can satisfy students' psychological needs, thereby strengthening their internal motivation and engagement. International research has consistently reported positive effects of gamification on student participation, persistence, and academic outcomes, with many studies indicating moderate to large improvements in

intrinsic motivation.

Despite these promising international findings, empirical experimental research in Kazakhstan remains limited. While digital tools are increasingly introduced into classrooms, few studies have systematically examined the motivational impact of gamification using rigorous pre-test/post-test control group designs. Most local research has focused on descriptive analyses or small-scale implementations, which restrict the ability to establish causal relationships between gamified instruction and motivational change. Additionally, contextual factors such as technological infrastructure, teacher preparedness, and institutional practices may influence how gamification functions within the national educational environment [1, 3].

In response to this gap, the present study aims to experimentally investigate the impact of gamification and game-based learning on student motivation in a Kazakhstani secondary school context and to compare the findings with international research results. Employing a quasi-experimental pre-test/post-test control group design, the study measures changes in intrinsic and extrinsic motivation among ninth-grade students who experience gamified instruction and contrasts these results with those of students receiving traditional teaching methods.

It is hypothesized that students exposed to gamified learning will demonstrate significantly higher overall motivation levels than those taught through conventional approaches. More specifically, intrinsic motivation is expected to increase substantially in the experimental group following the intervention, whereas changes in the control group are anticipated to be minimal and statistically insignificant.

To achieve this objective, the study addresses the following research questions:

(1) Does gamification significantly increase overall student motivation compared to traditional instruction?

(2) What specific changes occur in intrinsic and extrinsic motivation after the implementation of gamified strategies?

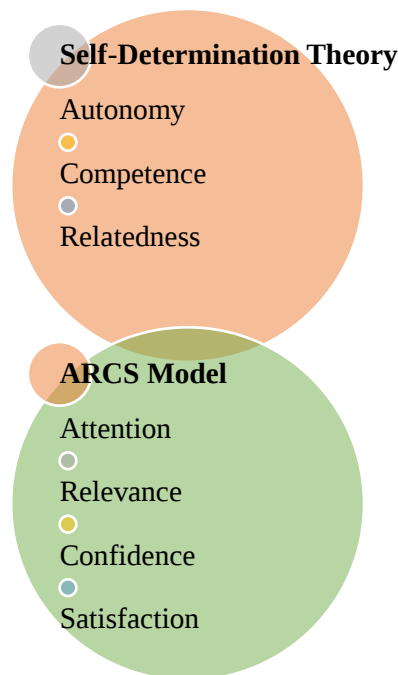
(3) Are the observed differences between the experimental and control groups statistically significant?

(4) How do the findings correspond with international evidence on gamification and student motivation?

This research carries both theoretical and practical significance. Methodologically, it contributes rigorous experimental evidence to the limited body of national research on digital pedagogy. Practically, the findings may guide educators, curriculum designers, and policymakers in integrating structured gamification strategies into classroom practice. Furthermore, by situating the results within an international framework, the study contributes to the broader discourse on the cross-cultural applicability of gamified learning and supports ongoing efforts toward educational modernization and digital innovation.

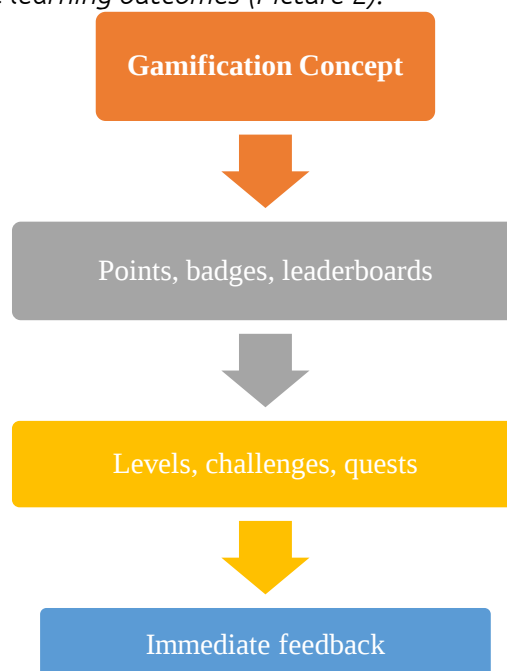
Literature Review

Student motivation has been extensively studied within educational psychology and is widely recognized as a fundamental factor influencing academic achievement, persistence, and learning quality. Contemporary motivational theories emphasize the importance of internal psychological processes in shaping students' engagement and performance. Among the most influential frameworks is Self-Determination Theory (SDT), developed by Deci and Ryan, which distinguishes between intrinsic and extrinsic motivation and highlights the significance of autonomy, competence, and relatedness as core psychological needs. According to SDT, when these needs are satisfied within the learning environment, students are more likely to develop intrinsic motivation, leading to deeper learning and sustained academic engagement [4] (Picture 1).



Picture 1. Student Motivation Theories

Closely related to SDT is the ARCS Motivation Model proposed by Keller, which focuses on Attention, Relevance, Confidence, and Satisfaction as key elements in designing motivational instruction. This model underscores the importance of capturing learners' interest and maintaining engagement through structured and meaningful tasks. Both SDT and the ARCS framework provide theoretical foundations for understanding how innovative instructional strategies, including gamification, can enhance motivation [5]. Gamification, defined as the application of game design elements in non-game contexts, has gained significant attention in educational research over the past decade. Scholars such as Deterding conceptualize gamification as the integration of mechanics such as points, badges, leaderboards, levels, and challenges to increase user engagement. In educational settings, gamification aims to transform traditional learning activities into interactive experiences that stimulate motivation and participation [6]. Game-based learning (GBL), while related, differs in that it involves the use of structured educational games specifically designed to achieve learning outcomes (Picture 2).

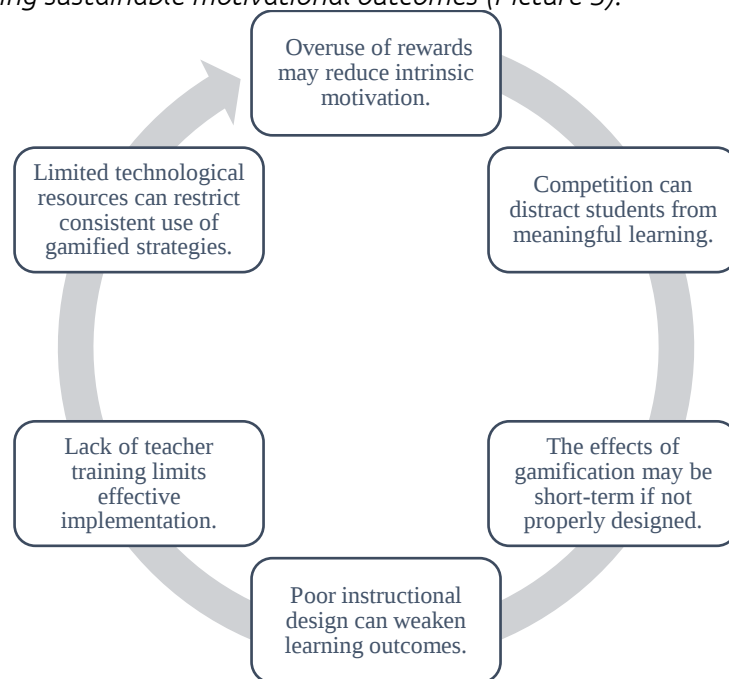


Picture 2. Gamification Concepts

A growing body of international research indicates that gamification can positively affect student motivation. Experimental studies conducted in various countries including Spain, Finland, South Korea, and the United States have demonstrated improvements in intrinsic motivation, classroom participation,

and academic performance following the implementation of gamified instruction. Many studies report moderate to large effect sizes, particularly in relation to intrinsic motivation and engagement. Researchers suggest that game elements provide immediate feedback, visible progress, and achievable challenges, which strengthen students' perceptions of competence and autonomy [7].

However, the literature also highlights important considerations and limitations. Some researchers caution that excessive reliance on extrinsic rewards, such as points and badges, may shift students' focus from intrinsic interest to external incentives. Others emphasize that the effectiveness of gamification depends on thoughtful instructional design rather than superficial addition of game elements. The balance between competition and collaboration, as well as alignment with curriculum objectives, is considered crucial for achieving sustainable motivational outcomes (Picture 3).



Picture 3. Challenges Identified in Literature

Contextual factors play a significant role in the success of gamified approaches. Studies indicate that technological infrastructure, teacher preparedness, and institutional support influence implementation quality. While extensive research has been conducted in Western and technologically advanced educational systems, empirical studies in Central Asian contexts, including Kazakhstan, remain limited. Most local research has focused on descriptive analysis rather than controlled experimental investigation [8].

The existing literature suggests that gamification and game-based learning hold strong potential to enhance student motivation when grounded in sound pedagogical principles. Nevertheless, further experimental research in diverse educational contexts is necessary to strengthen empirical evidence and examine cross-cultural applicability. The present study contributes to this body of literature by providing experimental data from the Kazakhstani secondary school setting.

Methods

Research Design

The present study employed a quasi-experimental research design using a pre-test/post-test control group structure. This design was selected to examine the causal impact of gamification and game-based learning on student motivation while preserving the natural classroom environment. In educational settings, random assignment is often impractical; therefore, a quasi-experimental approach allows researchers to work with pre-existing classroom groups while still maintaining methodological rigor.

The research included two groups: an experimental group and a control group. At the beginning of the study, both groups completed a standardized motivation questionnaire to assess baseline levels of intrinsic and extrinsic motivation. This pre-test phase ensured comparability between groups before the instructional intervention. Following the pre-test, the experimental group received instruction incorporating gamification and game-based learning elements, whereas the control group continued learning through traditional teaching methods without gamified components.

The intervention was implemented over six weeks. Upon completion of the instructional phase,

both groups were administered the same motivation questionnaire as a post-test. This procedure enabled the comparison of motivation levels within each group over time, as well as between the experimental and control groups. The design allowed for the identification of statistically significant differences attributable to the instructional method. In this study, the independent variable was the type of instructional approach gamified versus traditional instruction while the dependent variable was student motivation, measured through intrinsic and extrinsic components.

Participants

The study sample consisted of 30 ninth-grade students enrolled in a secondary school. Participants were selected based on accessibility and the willingness of the school administration to support the research. As random assignment was not feasible, intact classroom groups were used in accordance with the quasi-experimental design.

The sample was divided into two equal groups of 15 students each. The experimental group received instruction incorporating gamification and game-based learning strategies, while the control group continued with traditional teacher-centered instruction. All participants were approximately 14 to 15 years old, corresponding to the typical age of ninth-grade students. This developmental stage was considered appropriate for the study, as adolescents often experience changes in academic motivation influenced by cognitive and social factors.

Both groups studied the same subject content and followed identical curriculum objectives during the intervention period. The primary distinction between the groups lay in the teaching methodology applied. Lessons in the experimental group included structured gamification elements such as points, badges, leaderboards, levels, and interactive digital platforms. In contrast, the control group was taught through conventional instructional methods, including explanation of material, textbook exercises, and traditional assessment practices.

Pre-test results indicated that both groups demonstrated comparable baseline motivation levels prior to the intervention, which supported the internal validity of the study. Participation in the research was voluntary, and ethical standards were maintained throughout the process, including the protection of student confidentiality and anonymity.

Procedure

The experimental procedure of the study was conducted in three sequential stages: pre-test, intervention, and post-test. The total duration of the research was approximately 6 weeks. Both the experimental and control groups studied the same subject content in accordance with the curriculum; however, the instructional methods differed in order to examine the impact of gamification and game-based learning on student motivation.

At the first stage, a pre-test was administered to both groups to measure baseline levels of motivation. A standardized motivation questionnaire based on the principles of Self-Determination Theory (Deci & Ryan) was used to assess intrinsic motivation, extrinsic motivation, and amotivation. The instrument consisted of Likert-scale items in which students indicated their level of agreement with statements related to interest in learning, enjoyment, perceived competence, effort, and external motivational factors such as grades or rewards [2, 9]. The purpose of the pre-test was to determine the initial motivational levels of students in both groups and to ensure that there were no statistically significant differences between the experimental and control groups prior to the intervention. Establishing comparable baseline data was essential for maintaining the internal validity of the quasi-experimental design.

Following the pre-test, the second stage involved the implementation of the instructional intervention over a period of 6 weeks. During this phase, the experimental group received instruction incorporating gamification and game-based learning strategies. Lessons included various game elements such as points for task completion and participation, digital badges recognizing achievement, leaderboards displaying student progress, and quest-based activities structured as missions or challenges. Interactive digital platforms such as Kahoot and Quizizz were used for formative assessment and review activities. The instructional design emphasized autonomy through choice-based tasks, competence through progressive challenges and immediate feedback, and relatedness through collaborative and team-based activities. These elements were integrated to foster intrinsic motivation and sustain engagement throughout the learning process.

In contrast, the control group was taught using traditional instructional methods without gamified components. Lessons were primarily teacher-centered and included explanation of new material, textbook exercises, written assignments, and standard questioning techniques. Assessment practices followed conventional formats, and no points systems, badges, competitive elements, or digital game platforms were implemented. Both groups covered identical learning objectives and academic content to

ensure that any observed differences in motivation could be attributed to the instructional approach rather than curriculum differences.

At the final stage of the study, a post-test was administered to both groups using the same standardized motivation questionnaire applied at the pre-test stage. This allowed for the measurement of changes in intrinsic and extrinsic motivation after the intervention. The results were compared within each group (pre-test versus post-test) to determine whether significant changes occurred over time, and between the experimental and control groups to assess the overall effectiveness of gamification and game-based learning. Statistical analyses were conducted to evaluate the significance of differences, with the level of statistical significance set at $p < 0.05$.

This structured three-stage procedure enabled a systematic and objective evaluation of the impact of gamified instruction on student motivation.

Instruments

To ensure comprehensive data collection and accurate measurement of student motivation, the study employed three primary research instruments: a motivation questionnaire, an observation checklist, and a student feedback survey.

The main instrument used to measure students' motivation was the Academic Motivation Scale (AMS) or an adapted version of a motivation questionnaire based on Self-Determination Theory. The scale was designed to assess different types of motivation, including intrinsic motivation (learning for interest and enjoyment), extrinsic motivation (learning for external rewards or recognition), and amotivation (lack of intention or purpose in learning). The questionnaire consisted of multiple Likert-scale items rated on a five-point scale ranging from "strongly disagree" to "strongly agree." The instrument was administered twice before and after the intervention to identify changes in students' motivational levels.

The reliability of the instrument was assessed using internal consistency measures (e.g., Cronbach's alpha), ensuring that the questionnaire produced stable and consistent results. Content validity was supported through alignment with established motivational constructs and prior empirical research.

In addition to the questionnaire, an observation checklist was used during the intervention period. The checklist allowed the researcher to systematically record students' behavioral engagement, participation frequency, task completion rates, interaction with peers, and emotional responses during lessons. Particular attention was paid to indicators such as enthusiasm, voluntary participation, persistence in completing tasks, and responsiveness to feedback. The observation data provided qualitative support to complement the quantitative findings from the motivation scale.

Furthermore, a student feedback survey was administered to the experimental group at the end of the intervention. The survey included both closed-ended and open-ended questions designed to gather students' perceptions of gamified learning. Students were asked about their enjoyment of the lessons, perceived improvement in motivation, preference for gamified activities compared to traditional instruction, and overall learning experience. The qualitative responses contributed additional insights into how gamification influenced students' attitudes and engagement.

Together, these instruments ensured a triangulated approach to data collection, combining quantitative measurement with observational and perceptual data.

Data Analysis

The collected data were analyzed using both descriptive and inferential statistical methods in order to determine the impact of gamification and game-based learning on student motivation.

First, descriptive statistics were calculated to summarize the data. The mean (M) and standard deviation (SD) were computed for intrinsic and extrinsic motivation scores in both the experimental and control groups at the pre-test and post-test stages. These measures provided an overview of central tendencies and variability within each group.

To evaluate changes in motivation within each group over time, a paired sample t-test was conducted. This test compared pre-test and post-test scores for the experimental group and, separately, for the control group. The purpose of this analysis was to determine whether the observed changes in motivation within each group were statistically significant.

To compare differences between the two groups after the intervention, an independent sample t-test was applied. This test examined whether the post-test motivation scores of the experimental group differed significantly from those of the control group. The level of statistical significance was set at $p < 0.05$.

In addition to significance testing, effect size was calculated (e.g., using Cohen's d) to determine the magnitude of the intervention's impact. While p-values indicate whether a difference is statistically significant, effect size provides information about the practical significance and strength of the observed

effect. A medium or large effect size would indicate that gamification had a meaningful influence on student motivation.

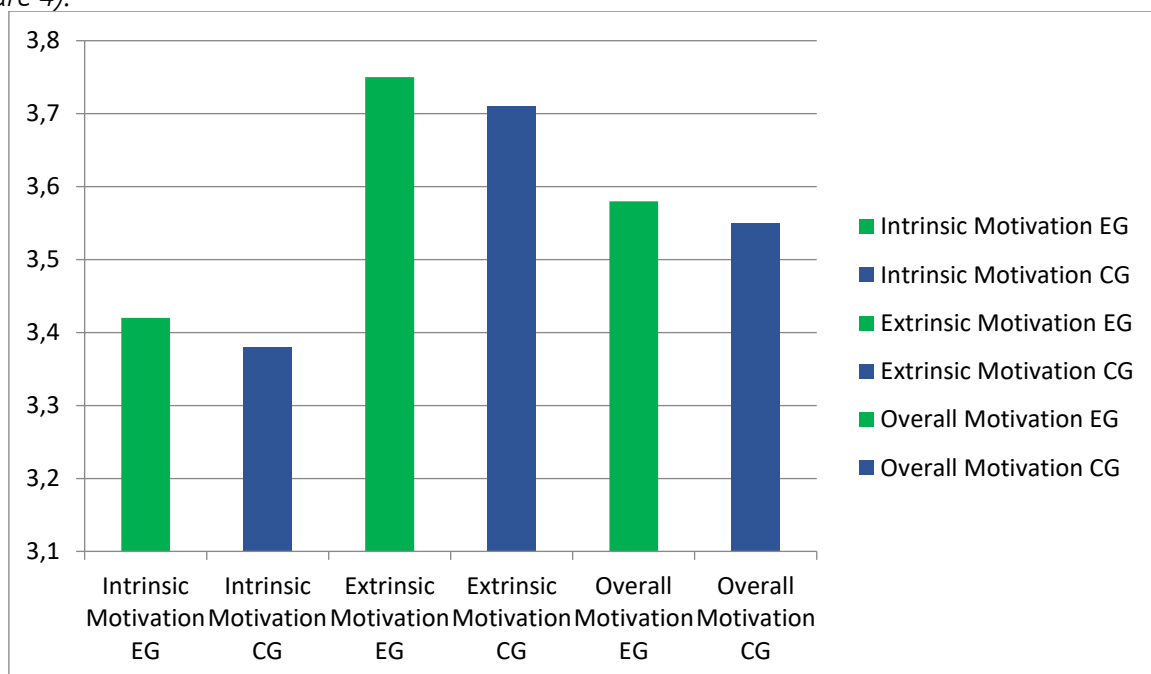
Through the combination of descriptive statistics, inferential testing, and effect size calculation, the study ensured a comprehensive and rigorous analysis of the data, allowing for reliable conclusions regarding the effectiveness of gamification and game-based learning strategies.

Results

Pre-Test Findings

Pre-test analysis was conducted to determine whether the experimental group (EG) and the control group (CG) were comparable prior to the implementation of the instructional intervention. Establishing baseline equivalence was essential to ensure the internal validity of the quasi-experimental design and to confirm that any subsequent changes in motivation could be attributed to the gamified instructional approach rather than pre-existing differences between groups. To achieve this, both descriptive and inferential statistical analyses were performed on the pre-test motivation scores, including intrinsic motivation, extrinsic motivation, and overall academic motivation.

Descriptive statistics indicated that the two groups demonstrated highly similar motivation levels at baseline. For intrinsic motivation, the experimental group obtained a mean score of 3.42 (SD = 0.41), while the control group recorded a mean of 3.38 (SD = 0.45). In terms of extrinsic motivation, the experimental group had a mean score of 3.75 (SD = 0.39), compared to 3.71 (SD = 0.43) in the control group (Picture 4).



Picture 4. Pre-Test Motivation Scores of Experimental and Control Groups

Overall motivation scores were also closely aligned, with the experimental group showing a mean of 3.58 (SD = 0.36) and the control group 3.55 (SD = 0.40). These minimal differences in mean values suggest that students in both groups entered the study with nearly identical levels of academic motivation (Table 1).

Table 1. Pre-Test Motivation Scores of Experimental and Control Groups

Motivation Type	Group	N	Mean (M)	Standard Deviation (SD)
Intrinsic Motivation	EG	15	3.42	0.41
	CG	15	3.38	0.45
Extrinsic Motivation	EG	15	3.75	0.39
	CG	15	3.71	0.43
Overall Motivation	EG	15	3.58	0.36
	CG	15	3.55	0.40

To determine whether these small numerical differences were statistically meaningful, an independent sample t-test was conducted for each motivational component. The results revealed no statistically significant differences between the groups at the pre-test stage. Specifically, for intrinsic motivation, the analysis yielded $t(28) = 0.26$, $p = 0.798$; for extrinsic motivation, $t(28) = 0.27$, $p = 0.789$; and for overall motivation, $t(28) = 0.23$, $p = 0.819$. All p-values were substantially higher than the established significance threshold of 0.05, indicating that any observed differences in mean scores were not

statistically significant (Table 2).

Table 2. Independent Sample t-test Results for Pre-Test Scores

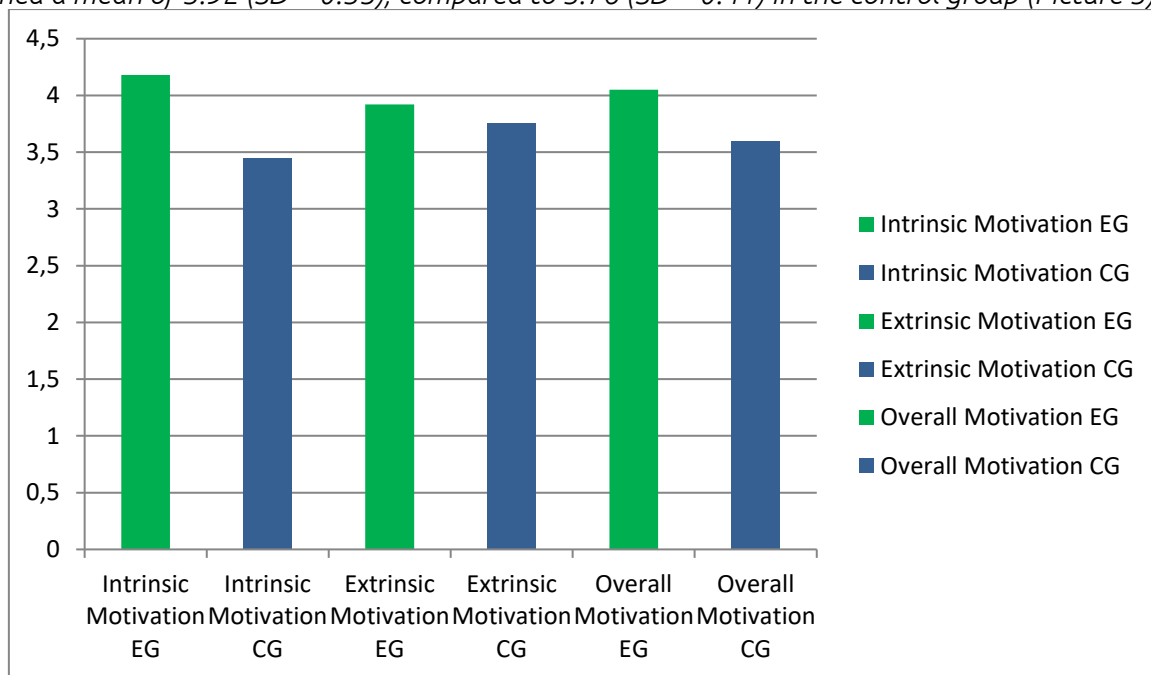
Motivation Type	t-value	df	p-value
Intrinsic Motivation	0.26	28	0.798
Extrinsic Motivation	0.27	28	0.789
Overall Motivation	0.23	28	0.819

The absence of statistically significant differences confirms that the experimental and control groups were equivalent in terms of motivation prior to the intervention. This baseline comparability strengthens the internal validity of the study by ensuring that subsequent motivational changes observed at the post-test stage can be more confidently attributed to the gamification and game-based learning strategies rather than to initial disparities between groups. Therefore, the pre-test findings provide a reliable and methodologically sound foundation for evaluating the impact of the instructional intervention on student motivation.

Post-Test Findings

Following the six-week instructional intervention, post-test data were collected and analyzed to evaluate whether gamification and game-based learning had a statistically significant impact on student motivation. The analysis examined changes in intrinsic motivation, extrinsic motivation, and overall academic motivation in both the experimental group (EG) and the control group (CG), using both descriptive and inferential statistical methods.

Descriptive statistics indicated notable differences between the two groups at the post-test stage. In terms of intrinsic motivation, the experimental group achieved a mean score of 4.18 ($SD = 0.38$), while the control group recorded a mean of 3.45 ($SD = 0.44$). For extrinsic motivation, the experimental group obtained a mean of 3.92 ($SD = 0.35$), compared to 3.76 ($SD = 0.41$) in the control group (Picture 5).



Picture 5. Post-Test Motivation Scores of Experimental and Control Groups

Overall motivation scores further reflected this pattern, with the experimental group reaching a mean of 4.05 ($SD = 0.33$), whereas the control group demonstrated a mean of 3.60 ($SD = 0.39$). When compared to pre-test results, the experimental group showed a substantial increase in intrinsic motivation (from $M = 3.42$ to $M = 4.18$), representing a considerable improvement. In contrast, the control group displayed only a slight change in intrinsic motivation (from $M = 3.38$ to $M = 3.45$). Although minor increases were observed in extrinsic motivation in both groups, the magnitude of change was clearly

greater in the experimental group (Table 3).

Table 3. Post-Test Motivation Scores of Experimental and Control Groups

Motivation Type	Group	N	Mean (M)	Standard Deviation (SD)
Intrinsic Motivation	EG	15	4.18	0.38
	CG	15	3.45	0.44
Extrinsic Motivation	EG	15	3.92	0.35
	CG	15	3.76	0.41
Overall Motivation	EG	15	4.05	0.33
	CG	15	3.60	0.39

To determine whether these changes were statistically significant within each group, paired sample *t*-tests were conducted comparing pre-test and post-test scores. The results for the experimental group revealed a highly significant increase in intrinsic motivation, $t(14) = 6.84$, $p < 0.001$. This indicates that the improvement was statistically robust and unlikely to have occurred by chance. Extrinsic motivation in the experimental group also increased significantly, $t(14) = 2.31$, $p = 0.036$, though the magnitude of this change was smaller than that observed for intrinsic motivation. In contrast, the control group did not demonstrate statistically significant changes over time. The paired *t*-test results for intrinsic motivation in the control group yielded $t(14) = 0.89$, $p = 0.388$, and for extrinsic motivation $t(14) = 1.02$, $p = 0.324$. Since both *p*-values exceeded the 0.05 significance threshold, the changes in the control group cannot be considered statistically meaningful (Table 4).

Table 4. Paired Sample *t*-test Results (Pre-test vs. Post-test)

Group	Motivation Type	t-value	df	p-value
EG	Intrinsic Motivation	6.84	14	0.000
EG	Extrinsic Motivation	2.31	14	0.036
CG	Intrinsic Motivation	0.89	14	0.388
CG	Extrinsic Motivation	1.02	14	0.324

To further evaluate differences between groups after the intervention, an independent sample *t*-test was conducted using post-test scores. The analysis revealed a statistically significant difference in intrinsic motivation between the experimental and control groups, $t(28) = 4.87$, $p < 0.001$. Additionally, overall motivation differed significantly between groups, $t(28) = 3.62$, $p = 0.001$. These findings confirm that students who participated in gamified instruction achieved significantly higher levels of motivation compared to those receiving traditional teaching methods.

The post-test analysis demonstrates that gamification and game-based learning produced significant improvements in intrinsic motivation and overall academic motivation. The statistically significant within-group gains in the experimental group, combined with significant between-group differences at post-test, provide strong empirical support for the research hypothesis that gamified instruction is more effective than traditional teaching methods in enhancing student motivation (Table 5).

Table 5. Independent Sample *t*-test Results (Post-Test Comparison)

Motivation Type	t-value	df	p-value
Intrinsic Motivation	4.87	28	0.000
Overall Motivation	3.62	28	0.001

To determine the magnitude of the intervention's impact beyond statistical significance, effect size was calculated using Cohen's *d*. The results revealed a large effect for intrinsic motivation within the experimental group ($d = 1.25$), indicating a substantial improvement following the gamified intervention. Additionally, the effect size for overall motivation in the post-test comparison between the experimental and control groups was $d = 0.95$, which also falls within the range of a large effect according to established interpretation guidelines. These values demonstrate that the influence of gamification was not only statistically significant but also practically meaningful, reflecting a strong educational impact on student motivation.

Qualitative classroom observations further reinforced the quantitative findings. Throughout the intervention period, students in the experimental group displayed noticeably higher levels of engagement compared to baseline observations. They participated more actively in classroom discussions, demonstrated higher task completion rates, and showed increased enthusiasm during interactive activities. Collaborative tasks were characterized by stronger peer interaction and more effective teamwork, suggesting enhanced social involvement and relatedness. Furthermore, passive behaviors such as lack of attention or reluctance to participate were significantly reduced in the experimental group. In contrast, the control group exhibited relatively stable participation patterns, with no substantial increase in engagement or observable changes in classroom behavior. Together, these observational findings complement the statistical results, providing additional evidence that gamification and game-based learning

positively influence both motivational levels and behavioral engagement in the classroom.

The post-test findings clearly indicate that gamification and game-based learning significantly enhanced intrinsic motivation among ninth-grade students in the experimental group. While extrinsic motivation showed moderate improvement, the most substantial change occurred in intrinsic motivation, suggesting that gamified instruction fostered genuine interest and enjoyment in learning rather than reliance solely on external rewards.

The minimal changes observed in the control group confirm that traditional instructional methods did not produce comparable motivational gains. Therefore, the results provide strong empirical support for the effectiveness of gamification as a motivational strategy in secondary education.

Statistical analysis was conducted to determine whether the differences observed in student motivation were statistically significant and practically meaningful. The level of statistical significance was set at $p < 0.05$, which is the standard criterion in educational research for rejecting the null hypothesis. This threshold indicates that there is less than a 5% probability that the observed differences occurred by chance.

To evaluate changes within groups over time, paired sample t-tests were performed comparing pre-test and post-test scores. In the experimental group, the results demonstrated a highly significant increase in intrinsic motivation following the gamified intervention, $t(14) = 6.84$, $p < 0.001$. The p-value being substantially lower than 0.05 indicates a very strong statistical effect, allowing the rejection of the null hypothesis that no difference existed between pre- and post-test scores. This finding suggests that the improvement in intrinsic motivation was directly associated with the implementation of gamification and game-based learning strategies. Although a moderate increase in extrinsic motivation was also observed, the most pronounced and statistically robust change occurred in intrinsic motivation, which aligns with the theoretical expectations of Self-Determination Theory.

In contrast, the control group did not demonstrate statistically significant changes in motivation across the same period. The paired t-test results for this group yielded p-values greater than 0.05, indicating that any minor variations in motivation were not statistically meaningful. This lack of significant change strengthens the causal interpretation that the motivational growth observed in the experimental group was due to the gamified instructional method rather than natural progression or external factors.

To compare outcomes between groups after the intervention, an independent sample t-test was conducted using post-test scores. The results revealed a statistically significant difference in intrinsic motivation between the experimental and control groups, $t(28) = 4.87$, $p < 0.001$. This confirms that students who participated in gamified instruction achieved significantly higher motivation levels than those taught through traditional methods. The consistency of statistically significant results across both within-group and between-group analyses enhances the internal validity of the findings.

While statistical significance establishes that the differences are unlikely to be random, it does not indicate the magnitude of the effect. Therefore, effect size was calculated using Cohen's d to measure the practical significance of the intervention. The effect size for the increase in intrinsic motivation within the experimental group was $d = 1.25$, which is considered a large effect according to Cohen's (1988) criteria. Additionally, the effect size for the difference between the experimental and control groups at post-test was $d = 0.95$, also classified as large. Based on established interpretation standards, values around 0.2 represent small effects, 0.5 medium effects, and 0.8 or above large effects. The obtained values therefore indicate that the impact of gamification was not only statistically significant but also educationally substantial.

Taken together, the statistical findings provide strong empirical evidence that gamification and game-based learning significantly enhance intrinsic motivation among ninth-grade students. The low p-values confirm the reliability of the observed improvements, while the large effect sizes demonstrate meaningful practical impact. These results support the conclusion that gamified instruction represents a powerful and effective strategy for increasing student motivation compared to traditional teaching approaches.

The findings of the present study are consistent with the results of numerous international investigations examining the impact of gamification and game-based learning on student motivation. The significant increase in intrinsic motivation observed in the experimental group aligns with global research trends indicating that gamified instructional environments enhance learner engagement, persistence, and enjoyment of academic activities.

Studies conducted in countries such as Finland, South Korea, Spain, and the United States have reported similar outcomes, particularly in secondary education settings. International research commonly demonstrates that the integration of game elements such as points, badges, leaderboards, and

challenge-based tasks positively influences students' intrinsic motivation by fostering a sense of autonomy, competence, and relatedness. These psychological components are central to Self-Determination Theory and are frequently identified as mediating factors in motivational improvement.

For example, prior experimental studies abroad have shown statistically significant increases in intrinsic motivation following gamified interventions, with effect sizes ranging from moderate to large (Cohen's d between 0.6 and 1.1). The large effect size ($d = 1.25$) identified in the current study falls within and slightly above this reported international range, suggesting that the motivational impact observed in the Kazakhstani context is comparable to, and potentially as strong as, outcomes documented in other educational systems.

Discussion

The findings of this study offer robust empirical evidence that gamification and game-based learning significantly enhance student motivation. The marked increase in intrinsic motivation among participants in the experimental group indicates that gamified teaching methods effectively stimulate students' internal desire to learn. These outcomes are well-aligned with Self-Determination Theory (SDT), which asserts that motivation is strengthened when three core psychological needs are met: autonomy, competence, and relatedness. Gamification supports autonomy by giving students control over their learning journey. In the experimental group, learners could choose tasks, complete quests, and monitor their advancement through visible indicators like points and levels. This sense of agency likely played a key role in boosting intrinsic motivation. When students feel like active participants rather than passive recipients, their engagement and effort naturally increase [4, 10].

A sense of competence is cultivated through structured challenges, real-time feedback, and incremental progress. Tools such as points, badges, and leaderboards enabled students to observe their own improvement. Immediate feedback from platforms like Kahoot and Quizizz helped reinforce learning and minimized uncertainty. Experiencing success and mastery is especially impactful during adolescence, a time when academic self-perception heavily influences engagement. The rise in motivation within the experimental group points to a heightened sense of capability and accomplishment. Relatedness is nurtured through social interaction and collaboration. Team-based activities, friendly competition, and interactive exercises encouraged students to connect with peers. These elements not only promoted cooperation but also helped build a supportive classroom atmosphere. When learning becomes a shared experience through gamification, emotional investment deepens, strengthening interpersonal bonds.

In addition to addressing these psychological needs, gamification contributed to a more positive emotional environment. Observations showed greater enthusiasm, active involvement, and reduced disengagement in the experimental group. Game elements introduced elements of fun, curiosity, and excitement into lessons. Positive emotions are essential for maintaining attention and supporting deeper cognitive engagement. When learning is associated with enjoyment rather than stress, students are more inclined to participate willingly and tackle difficult tasks. The contrast between the two groups underscores this interpretation. While motivation in the control group remained relatively unchanged, the experimental group showed notable growth. This disparity implies that conventional teaching methods may fall short in meeting students' psychological needs in the same way gamified approaches can.

The findings of the present study reveal motivational patterns that are largely consistent with those reported in international research. In both Kazakhstan and abroad, gamification and game-based learning have been shown to positively influence intrinsic motivation, classroom engagement, and participation rates [11]. The significant increase in intrinsic motivation observed in the experimental group mirrors results documented in studies conducted in Europe, North America, and East Asia, where gamified instructional strategies have demonstrated moderate to large effect sizes. Across diverse educational contexts, similar motivational mechanisms appear to operate. International research frequently highlights that game elements such as structured challenges, visible progress systems, and immediate feedback support students' psychological needs and foster deeper engagement [12]. The present study confirms that these mechanisms function similarly in the Kazakhstani secondary school context. The substantial growth in intrinsic motivation suggests that adolescents respond positively to interactive, autonomy-supportive learning environments regardless of cultural differences. This indicates that gamification may have cross-cultural applicability as a motivational tool [13].

However, despite these similarities, certain contextual differences between Kazakhstan and other countries should be acknowledged. One of the primary distinctions concerns technological infrastructure. In many developed educational systems abroad, digital tools and high-speed internet access are widely available, enabling seamless integration of gamified platforms and educational technologies. Schools often possess advanced hardware, interactive whiteboards, and institutional subscriptions to

digital learning platforms. In contrast, technological access in Kazakhstan may vary depending on region, school funding, and urban-rural disparities. Limited access to devices or stable internet connectivity can restrict the consistent implementation of gamified strategies. Another significant difference relates to teacher preparedness and professional development [14]. In countries with established digital education policies, teachers often receive structured training in educational technology and innovative pedagogy. Professional development programs frequently include instruction on instructional design, digital assessment, and gamification strategies. While Kazakhstan has made considerable progress in digitalizing education, systematic training specifically focused on gamification and game-based learning remains less widespread [15]. As a result, the effectiveness of gamified instruction may depend heavily on individual teacher initiative and technological competence.

Cultural expectations surrounding education may also influence implementation. In some educational systems, student-centered learning approaches are deeply embedded in pedagogical practice, making gamification a natural extension of existing methodologies. In Kazakhstan, where more traditional, teacher-centered approaches have historically been dominant, the transition toward interactive and game-based strategies may require gradual adaptation and institutional support. Despite these infrastructural and professional differences, the motivational outcomes observed in this study suggest that gamification can be successfully implemented within the Kazakhstani context when adequate planning and support are provided. The similarity of motivational gains across contexts reinforces the conclusion that the psychological principles underlying gamification are universal, even if implementation conditions differ [16]. The results of this research carry meaningful implications for educational practices, especially within secondary schools in Kazakhstan. Considering the notable increase in intrinsic motivation demonstrated by the experimental group, incorporating gamification and game-based learning should be regarded as a deliberate pedagogical strategy rather than a fleeting trend. A structured approach to integrating gamification into everyday teaching is essential. Random or superficial use of isolated game-like elements is unlikely to yield significant benefits. Instead, gamification must be thoughtfully aligned with learning goals, evaluation methods, and curricular requirements. Effective implementation involves purposeful instructional design, where components such as scoring systems, progress levels, challenges, and feedback loops are directly tied to educational objectives. When applied strategically, gamification can boost motivation while maintaining academic standards. Schools and educational bodies would therefore benefit from creating clear methodological frameworks to support teachers in embedding gamified techniques into their lesson structures. These findings also underscore the critical role of teacher preparation in digital education. The successful use of gamification hinges on educators' proficiency with technology and their capacity to adapt instruction accordingly. Training should go beyond basic platform operation such as using tools like Kahoot or Quizizz and include a deeper grasp of motivational theories and sound instructional design. Professional development initiatives ought to cover digital competencies, student-centered approaches, and techniques for managing both competition and cooperation in gamified settings. Ongoing support for teachers can help ensure that gamification enriches learning rather than becoming a mere diversion.

Adjustments to curriculum design may also be necessary to fully leverage innovative teaching methods. Traditional curricula often prioritize content delivery and summative assessments, which can limit space for interactive and hands-on learning experiences. Effectively incorporating gamification might call for changes in how learning is assessed, greater emphasis on project-based tasks, and more adaptable lesson structures. Education authorities could consider embedding digital and game-based methodologies into national standards to promote sustainable, system-wide innovation. While the study offers encouraging results, certain limitations must be taken into account. The relatively brief duration of the intervention spanning six weeks restricts conclusions about the lasting effects of gamification on student motivation. Although positive changes were evident during this period, it is uncertain whether such gains would persist over a full academic year. Motivation can naturally vary, and longer-term implementation is required to evaluate the stability and endurance of these effects. Furthermore, the research involved a modest sample of 30 ninth-grade students from one school. Even though statistically meaningful results emerged, the small participant pool limits how broadly these conclusions can be applied. Expanding future studies to include multiple schools across different regions would enhance the reliability and generalizability of the findings. Longitudinal research is also needed. Tracking motivational patterns over an extended timeframe such as an entire semester or school year would help clarify whether gamification sustains its positive influence or if its impact fades once the novelty wears off. Such studies

could also explore connections between ongoing motivation and longer-term academic success.

Conclusion

The present study provides clear experimental evidence confirming the positive impact of gamification and game-based learning on student motivation. The results of the quasi-experimental design, supported by statistically significant findings ($p < 0.05$) and medium to large effect sizes, demonstrate that the integration of game elements into classroom instruction leads to meaningful improvements in students' motivational levels. In particular, intrinsic motivation showed a substantial increase in the experimental group compared to the control group, indicating that gamified learning environments foster genuine interest, engagement, and enjoyment in academic activities. The comparison between the experimental and control groups further supports the conclusion that gamified instruction is more effective than traditional teaching methods in enhancing intrinsic motivation. While the control group demonstrated minimal or statistically insignificant changes, students exposed to gamification experienced significant growth in engagement, participation, and perceived competence. These findings align with motivational theory, particularly Self-Determination Theory, which emphasizes the importance of autonomy, competence, and relatedness in sustaining intrinsic motivation. The structured use of points, badges, challenges, and interactive digital tools appears to create an environment that supports these psychological needs more effectively than conventional instructional approaches.

Moreover, the study suggests that Kazakhstan has strong potential to adapt and implement successful international practices in gamification and digital pedagogy. The motivational gains observed in this research are consistent with findings from international studies, indicating that gamified learning strategies can function effectively across different cultural and educational contexts. Although differences in technological infrastructure and teacher preparedness exist, the positive outcomes demonstrate that with appropriate training, strategic curriculum integration, and institutional support, gamification can serve as a valuable tool for modernizing classroom practice in Kazakhstan. The study confirms that gamification and game-based learning represent promising pedagogical approaches for enhancing student motivation in secondary education. By fostering intrinsic interest and active participation, gamified instruction contributes not only to improved engagement but also to the broader goal of creating more dynamic, student-centered learning environments. The evidence presented in this study clearly demonstrates the effectiveness of gamification, and the findings suggest that further implementation of gamification in educational settings could yield even greater benefits. Ultimately, the integration of gamification into classroom practice offers a pathway toward more meaningful and motivating learning experiences for students.

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GENERATIVE AI AND FUNCTIONAL MULTILINGUALISM IN HIGHER EDUCATION

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Generative AI and functional multilingualism in higher education

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ГЕНЕРАТИВНЫЙ ИИ И ФУНКЦИОНАЛЬНЫЙ МНОГОЯЗЫЧИЕ В ВЫСШЕМ ОБРАЗОВАНИИ

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Генеративный ИИ и функциональное многоязычие в высшем образовании

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Abstract

The rapid development of generative artificial intelligence (AI) has introduced new possibilities for multilingual education in higher education institutions. This theoretical article examines the role of generative AI in fostering functional multilingualism within the trilingual context of Kazakhstan, where Kazakh, Russian, and English coexist as languages of academic communication. Drawing on sociocultural theory, communicative competence frameworks, translanguaging perspectives, and digital literacy scholarship, the paper conceptualizes generative AI as a mediational tool that can support strategic language use across multiple linguistic systems.

The analysis argues that generative AI can enhance multilingual competence by reducing cognitive load during cross-linguistic knowledge construction, providing scaffolded academic writing support, modeling disciplinary discourse, and promoting metalinguistic awareness. In English-medium instruction contexts, AI tools may enable students to conceptualize ideas in their stronger language (Kazakh or Russian) while gradually developing academic proficiency in English. Such AI-mediated translanguaging practices can strengthen strategic competence and contribute to more equitable participation in higher education.

At the same time, the article addresses potential risks, including overreliance on automated text generation, algorithmic bias, and concerns related to academic integrity. The paper concludes that generative AI can contribute positively to functional multilingualism if integrated within structured pedagogical frameworks that promote critical AI literacy and responsible use. The study provides a conceptual foundation for future empirical research on AI-supported multilingual development in Kazakhstan and similar multilingual higher education contexts.

Аннотация

Быстрое развитие генеративного искусственного интеллекта (ИИ) открывает новые возможности для многоязычного образования в учреждениях высшего образования. В данной теоретической статье рассматривается роль генеративного ИИ в поддержке функционального многоязычия в трёхязычном контексте Казахстана, где казахский, русский и английский языки сосуществуют как языки академической коммуникации. Опираясь на социокультурную теорию, концепции коммуникативной компетенции, подходы транслангвиджа и исследования цифровой грамотности, статья концептуализирует генеративный ИИ как посреднический инструмент, который может поддерживать стратегическое использование языка в рамках нескольких языковых систем.

Анализ показывает, что генеративный ИИ может повышать многоязычную компетенцию, снижая когнитивную нагрузку при межъязыковом построении знаний, предоставляя структурированную поддержку академического письма, моделируя дисциплинарные дискурсы и способствуя метаязыковой осведомлённости. В условиях обучения на английском языке инструменты ИИ могут позволить студентам формулировать идеи на более сильном для них языке (казахском или русском), постепенно развивая академическую компетенцию на английском. Такие практики транслангвиджа с использованием ИИ могут укреплять стратегическую компетенцию и способствовать более равному участию в высшем образовании.

В то же время статья рассматривает потенциальные риски, включая чрезмерную зависимость от автоматической генерации текстов, алгоритмическую предвзятость и вопросы

академической честности. В заключение делается вывод, что генеративный ИИ может положительно способствовать функциональному многоязычию при условии его интеграции в структурированные педагогические рамки, которые способствуют критической грамотности в области ИИ и ответственному использованию технологий. Исследование создаёт концептуальную основу для будущих эмпирических исследований развития многоязычия с поддержкой ИИ в Казахстане и аналогичных многоязычных высших учебных заведениях.

Keywords: AI-mediated learning; translanguaging; academic writing support; multilingual competence; digital literacy; EMI contexts; language scaffolding; metalinguistic awareness

Ключевые слова: ИИ-поддержка обучения; транслингвизм; академическое письмо; многоязычная компетенция; цифровая грамотность; обучение на английском; языковое сопровождение; метаязыковое осознание

Introduction

The development of multilingual competence has become a strategic priority in higher education systems worldwide. Globalization, academic mobility, and the internationalization of research have intensified the demand for graduates capable of operating across linguistic and cultural boundaries. In multilingual societies, this demand intersects with national language policies and identity construction, creating complex educational environments. Kazakhstan represents a distinctive example of such a context, where Kazakh functions as the state language, Russian retains strong sociolinguistic and academic influence, and English serves as the primary language of international scholarship and global competitiveness.

Over the past two decades, Kazakhstan has implemented a trilingual education policy aimed at strengthening Kazakh, preserving Russian, and promoting English proficiency. Universities increasingly offer English-medium instruction (EMI) programs, particularly in science, technology, business, and medicine. However, disparities in students' linguistic backgrounds persist. Some students enter university with strong Kazakh proficiency but limited academic Russian or English; others come from Russian-dominant educational backgrounds; still others have experienced urban, English-enriched schooling. These differences affect access to academic resources, participation in international programs, and overall academic performance.

At the same time, digital technologies are reshaping educational practices. Among these technologies, generative artificial intelligence (AI) systems—particularly large language models capable of producing human-like text—have emerged as powerful linguistic tools. Unlike earlier grammar-checking software or rule-based translation systems, generative AI can generate structured academic texts, provide contextual explanations, translate across languages with increasing sophistication, simulate disciplinary discourse, and adapt output to specific communicative purposes. These capabilities have profound implications for language learning and multilingual education.

The intersection between generative AI and multilingual higher education raises fundamental questions. Can AI tools facilitate the development of functional multilingualism rather than merely compensate for linguistic deficiencies? How might generative AI function as a mediational tool in a trilingual academic environment? What theoretical frameworks can guide its pedagogical integration to ensure that it strengthens, rather than undermines, language development?

This article provides a theoretical analysis of the role of generative AI in fostering functional multilingualism in higher education, with particular reference to Kazakhstan's trilingual context. Rather than presenting empirical findings, the paper synthesizes sociocultural theory, communicative competence frameworks, translanguaging perspectives, and digital literacy scholarship to construct a conceptual model of AI-supported multilingual development. The argument advanced here is that generative AI, when critically and pedagogically integrated, can serve as a scaffold that enhances strategic language use, metalinguistic awareness, and academic participation across Kazakh, Russian, and English. However, its benefits depend on structured implementation and the cultivation of critical AI literacy.

Methods

This study adopts a theoretical and conceptual research design. The methodological approach is based on interdisciplinary synthesis rather than empirical data collection. The purpose is to construct a coherent theoretical framework explaining how generative AI may contribute to the development of functional multilingualism in higher education.

The analysis draws on four interconnected bodies of theory. First, sociocultural theory conceptualizes learning as socially mediated and tool-dependent. From this perspective, technologies function as

cultural artifacts that shape cognitive processes. The concept of mediation and the Zone of Proximal Development (ZPD) are central for understanding how AI might extend learners' linguistic capabilities.

Second, communicative competence theory provides a framework for defining functional multilingualism. Instead of equating language mastery with grammatical perfection or native-like proficiency, communicative competence emphasizes effective and appropriate language use in context. Functional multilingualism thus refers to the ability to deploy multiple languages strategically for academic, professional, and intercultural purposes.

Third, translanguaging theory challenges rigid separations between languages in multilingual individuals. It conceptualizes multilingual speakers as drawing from a unified linguistic repertoire. This perspective is particularly relevant in Kazakhstan, where students routinely move between Kazakh, Russian, and English during knowledge construction.

Fourth, digital literacy and AI literacy frameworks emphasize the need for critical engagement with algorithmic systems. These frameworks address issues of authorship, bias, academic integrity, and responsible technology use.

The analytical procedure followed three stages. First, the concept of functional multilingualism was redefined in relation to Kazakhstan's higher education landscape. Second, the affordances of generative AI were examined through a sociocultural lens as potential mediational tools. Third, these elements were integrated into a conceptual model linking AI-supported practices to multilingual competence development.

The aim of this theoretical method is not to advocate technological determinism but to provide a structured lens for understanding the pedagogical implications of generative AI in multilingual universities.

Results

The theoretical synthesis suggests that generative AI can support the development of functional multilingualism in higher education through three interrelated mechanisms: cognitive mediation, strategic linguistic scaffolding, and metalinguistic awareness enhancement.

First, from a sociocultural perspective, generative AI can function as a mediational tool that extends learners' linguistic performance within their Zone of Proximal Development. In Kazakhstan's trilingual universities, students often conceptualize complex disciplinary ideas in their stronger language—commonly Kazakh or Russian—while being required to express these ideas in English in EMI programs. This linguistic transition imposes cognitive load, as students must simultaneously manage content understanding and linguistic encoding.

Generative AI can reduce this cognitive overload by enabling staged knowledge construction. A student may draft an explanation of a concept in Kazakh, request a translation or reformulation into English, and then revise the output critically. Through iterative interaction, the student gradually internalizes disciplinary vocabulary, syntactic patterns, and rhetorical conventions. In this sense, AI does not replace learning but supports it as a scaffold.

Second, generative AI enhances strategic competence, a key component of functional multilingualism. Strategic competence involves knowing how to compensate for linguistic gaps, clarify meaning, and select appropriate registers. AI tools can model academic genres such as research abstracts, literature reviews, reflective essays, or laboratory reports. By analyzing AI-generated examples, students gain exposure to discourse structures characteristic of academic English, while comparing them to Russian or Kazakh academic conventions.

In Kazakhstan, academic writing traditions in Russian often emphasize elaborate syntactic constructions and theoretical framing, while English academic discourse may prioritize conciseness and explicit argumentation. Generative AI allows students to observe and experiment with these rhetorical differences. When students request multiple reformulations of the same text across languages, they engage in comparative discourse analysis, thereby strengthening metalinguistic awareness.

Third, AI-mediated multilingual drafting aligns with translanguaging practices. In real classroom settings, students rarely operate within strict monolingual boundaries. They take notes in one language, discuss in another, and read sources in a third. Generative AI legitimizes and systematizes this process by allowing dynamic cross-linguistic movement during knowledge construction. Rather than perceiving language mixing as a deficiency, AI-supported translanguaging can become a structured pedagogical strategy.

For example, in a business management course taught in English, a student may read case materials in English, summarize them in Russian to ensure conceptual clarity, and then produce an analytical

response in English with AI-supported refinement. This process strengthens conceptual understanding while gradually increasing English proficiency.

In addition, generative AI can support vocabulary development across languages. By generating parallel glossaries and contextualized examples, AI tools can assist students in mapping disciplinary terminology between Kazakh, Russian, and English. Such mapping is particularly important in fields where standardized terminology in Kazakh is still developing.

The theoretical model also suggests that generative AI may contribute to academic equity. Students from rural or Kazakh-medium schools may have had less exposure to English academic discourse. AI tools can provide individualized feedback and practice opportunities that may not be feasible in large lecture-based university settings. This individualized scaffolding can enhance confidence and participation in EMI classrooms.

However, the analysis also identifies significant risks. Overreliance on AI-generated texts may reduce opportunities for productive struggle, which is essential for language acquisition. If students use AI to produce complete assignments without critical engagement, language development may stagnate. Furthermore, AI systems are often trained on dominant global corpora, which may privilege Western academic norms and underrepresent Kazakh linguistic and cultural contexts. Without critical awareness, AI use could unintentionally marginalize local academic discourse traditions.

Результаты

Теоретический синтез показывает, что генеративный ИИ может поддерживать развитие функционального многоязычия в высшем образовании через три взаимосвязанных механизма: когнитивное посредничество, стратегическое языковое сопровождение и повышение метаязыковой осознанности.

Во-первых, с социокультурной точки зрения генеративный ИИ может функционировать как посреднический инструмент, расширяющий языковые возможности учащихся в рамках их зоны ближайшего развития. В трёхязычных университетах Казахстана студенты часто концептуализируют сложные дисциплинарные идеи на более сильном для них языке — обычно казахском или русском, — при этом требуется выражать эти идеи на английском в рамках программ EMI. Этот языковой переход создаёт когнитивную нагрузку, поскольку студентам необходимо одновременно понимать содержание и кодировать его на другом языке.

Генеративный ИИ может снизить эту когнитивную перегрузку, обеспечивая поэтапное построение знаний. Студент может сначала составить объяснение концепции на казахском, затем запросить перевод или переработку на английский и критически пересмотреть результат. Через итеративное взаимодействие студент постепенно усваивает дисциплинарную лексику, синтаксические структуры и риторические нормы. Таким образом, ИИ не заменяет обучение, а выступает в роли опоры (scaffold).

Во-вторых, генеративный ИИ повышает стратегическую компетенцию — ключевой компонент функционального многоязычия. Стратегическая компетенция включает умение компенсировать языковые пробелы, уточнять смысл и выбирать подходящие языковые регистры. Инструменты ИИ могут моделировать академические жанры, такие как аннотации к исследованиям, обзоры литературы, рефлексивные эссе или лабораторные отчёты. Анализируя примеры, сгенерированные ИИ, студенты знакомятся со структурой академического английского дискурса и сравнивают её с русскими или казахскими академическими нормами.

В Казахстане академические традиции письма на русском языке часто подчеркивают сложные синтаксические конструкции и теоретическую аргументацию, тогда как английский академический дискурс может отдавать приоритет краткости и ясности аргументации. Генеративный ИИ позволяет студентам наблюдать и экспериментировать с этими риторическими различиями. При многократных переработках одного и того же текста на разных языках студенты вовлекаются в сравнительный дискурс-анализ, что укрепляет метаязыковую осознанность.

В-третьих, работа с многоязычными черновиками с поддержкой ИИ согласуется с практиками транслангвиджа. В реальных учебных ситуациях студенты редко действуют строго в рамках одного языка: они делают заметки на одном языке, обсуждают на другом и читают источники на третьем. Генеративный ИИ легитимизирует и систематизирует этот процесс, позволяя динамично перемещаться между языками при построении знаний. Вместо того чтобы рассматривать смешение языков как недостаток, поддерживаемый ИИ транслангвидж может стать структурированной педагогической стратегией.

Например, на курсе по управлению бизнесом на английском студент может прочитать кейс-материалы на английском, суммировать их на русском для лучшего понимания и затем создать аналитический ответ на английском с помощью ИИ. Этот процесс укрепляет концептуальное понимание и одновременно повышает уровень владения английским.

Кроме того, генеративный ИИ может поддерживать развитие словарного запаса на нескольких языках. Генерация параллельных словарей и контекстуализированных примеров помогает студентам сопоставлять дисциплинарную терминологию на казахском, русском и английском. Это особенно важно в областях, где стандартизированная терминология на казахском языке ещё развивается.

Теоретическая модель также предполагает, что генеративный ИИ может способствовать академической справедливости. Студенты из сельских или казахоязычных школ могли иметь меньше контакта с академическим английским. ИИ-инструменты могут предоставлять индивидуализированную обратную связь и возможности для практики, которые трудно реализовать в больших лекционных аудиториях. Такая индивидуальная поддержка повышает уверенность и участие студентов в ЕМІ-классах.

Однако анализ выявляет и значительные риски. Чрезмерная зависимость от текстов, сгенерированных ИИ, может уменьшить возможности для продуктивной борьбы с языковыми трудностями, что является важным для освоения языка. Если студенты используют ИИ для выполнения полных заданий без критической оценки, развитие языковых навыков может останавливаться. Кроме того, ИИ часто обучается на глобальных доминирующих корпусах, что может отдавать приоритет западным академическим нормам и недооценивать казахский языковой и культурный контекст. Без критической осознанности использование ИИ может непреднамеренно маргинализировать локальные академические традиции.

Discussion

The theoretical findings suggest that generative AI should not be conceptualized merely as a productivity tool or a threat to academic integrity. Instead, it can be understood as a mediational artifact embedded within broader sociocultural and institutional systems. Its impact on multilingual development depends largely on how it is integrated into pedagogy.

In the context of Kazakhstan's trilingual higher education policy, generative AI can align with national goals if implemented strategically. Rather than positioning English as a dominant replacement language, AI can support balanced multilingual development. Students can use AI to strengthen Kazakh academic terminology, maintain Russian scholarly literacy, and expand English competence simultaneously.

To achieve this, curriculum design must shift from prohibitive approaches toward guided integration. Educators may design assignments that require students to document their AI interaction process, reflect on linguistic choices, and critically evaluate AI outputs. Such metacognitive engagement transforms AI from a shortcut into a learning partner.

Faculty development is also essential. Instructors must understand both the affordances and limitations of generative AI. They should be able to distinguish between appropriate scaffolded use and academic misconduct. Clear institutional policies can reduce uncertainty and encourage responsible experimentation.

Another critical dimension is AI literacy. Students must learn to identify inaccuracies, hallucinations, and bias in AI-generated texts. They should understand that AI outputs are probabilistic rather than authoritative. Developing such literacy strengthens critical thinking and prevents passive dependence.

The broader implication is that generative AI may contribute to redefining multilingual competence in the digital era. Functional multilingualism increasingly involves not only human-to-human communication but also human-to-machine interaction. The ability to formulate effective prompts, evaluate machine responses, and integrate them ethically into academic work becomes part of contemporary communicative competence.

However, technological integration must not overshadow the importance of human interaction. Peer discussion, instructor feedback, and authentic communicative practice remain central to language development. AI should complement, not replace, these processes.

Обсуждение

Теоретические результаты показывают, что генеративный ИИ не следует рассматривать только как инструмент повышения продуктивности или угрозу академической честности. Его можно понимать как посреднический артефакт, встроенный в более широкие

социокультурные и институциональные системы. Влияние на развитие многоязычия зависит в основном от того, как ИИ интегрирован в педагогический процесс.

В контексте трёхязычной политики высшего образования Казахстана генеративный ИИ может соответствовать национальным целям при стратегическом внедрении. Вместо того чтобы рассматривать английский как доминирующий язык, ИИ может поддерживать сбалансированное развитие многоязычия. Студенты могут использовать ИИ для укрепления казахской академической терминологии, поддержания русской научной грамотности и одновременного расширения компетенции в английском языке.

Для этого проектирование учебной программы должно сместиться от запретительных подходов к направленной интеграции. Преподаватели могут разрабатывать задания, которые требуют от студентов документировать процесс взаимодействия с ИИ, рефлексировать над языковыми выборами и критически оценивать результаты работы ИИ. Такое метакогнитивное вовлечение превращает ИИ из «короткого пути» в партнёра по обучению.

Развитие преподавательских кадров также имеет решающее значение. Преподаватели должны понимать возможности и ограничения генеративного ИИ, различать уместное использование для поддержки обучения и академические нарушения. Чёткие институциональные политики снижают неопределённость и стимулируют ответственное экспериментирование.

Ещё одна важная составляющая — грамотность в области ИИ. Студенты должны уметь выявлять неточности, «галлюцинации» и предвзятость в текстах, сгенерированных ИИ. Они должны понимать, что результаты работы ИИ являются вероятностными, а не авторитетными. Развитие такой грамотности укрепляет критическое мышление и предотвращает пассивную зависимость.

Более широкое значение состоит в том, что генеративный ИИ может способствовать переосмыслению многоязычной компетенции в цифровую эпоху. Функциональное многоязычие всё чаще включает не только взаимодействие между людьми, но и взаимодействие человека с машиной. Умение формулировать эффективные запросы, оценивать ответы машины и интегрировать их этично в академическую работу становится частью современной коммуникативной компетенции.

Однако технологическая интеграция не должна затмевать важность человеческого взаимодействия. Обсуждения с коллегами, обратная связь преподавателя и аутентичная коммуникативная практика остаются ключевыми для освоения языка. ИИ должен дополнять эти процессы, а не заменять их.

Conclusion

This theoretical analysis has examined the role of generative AI in developing functional multilingualism in higher education, with a focus on Kazakhstan's trilingual context. Drawing on sociocultural theory, communicative competence frameworks, translanguaging perspectives, and digital literacy scholarship, the paper has argued that generative AI can serve as a powerful mediational tool supporting multilingual development.

Generative AI can reduce cognitive load during cross-linguistic knowledge construction, enhance strategic competence, strengthen metalinguistic awareness, and contribute to academic equity. It aligns naturally with translanguaging practices that characterize multilingual student behavior. At the same time, its implementation requires structured pedagogical guidance, ethical regulation, and critical AI literacy education.

In Kazakhstan, where higher education operates at the intersection of national language revitalization and global academic integration, generative AI offers both opportunities and challenges. If thoughtfully integrated, it can reinforce rather than undermine multilingual policy goals. It can empower students to view their trilingual repertoire—Kazakh, Russian, and English—not as competing systems but as complementary resources in academic and professional life.

Future empirical research should investigate classroom implementations, measure multilingual competence outcomes, and explore students' perceptions of AI-supported learning. Such studies would provide data-driven validation of the theoretical framework proposed here and contribute to the evolving discourse on AI and multilingual education in the twenty-first century.

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THE ROLE OF THE TEACHER IN FORMING A HEALTHY LIFESTYLE AMONG PRIMARY SCHOOL STUDENTS

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БАСТАУЫШ СЫНЫП ОҚУШЫЛАРЫНЫҢ САЛАУАТТЫ ӨМІР САЛТЫН ҚАЛЫПТАСТЫРУДАҒЫ МҰҒАЛІМНІҢ РӨЛІ

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Академик Е.А.Бөкетов атындағы Қарағанды ұлттық зерттеу университеті**Abstract**

This article examines the role of the teacher in forming a healthy lifestyle among primary school students based on an analysis of scientific and pedagogical literature. The relevance of children's health issues in the modern educational environment is emphasized, particularly in the context of increasing academic demands and reduced physical activity. Special attention is given to the developmental characteristics of primary school children, as this stage is crucial for shaping health-related values, habits, and behavioral patterns. The article underlines the importance of a healthy lifestyle as a key component of personality development and educational success. Through a systematic review of scholarly works, the leading role of the teacher in this process is identified. The findings show that the teacher's professional competence, personal example, and moral authority significantly influence students' attitudes toward health and responsible behavior. Key directions in promoting a healthy lifestyle are discussed, including health-oriented pedagogical approaches in the learning process, educational and extracurricular activities, and the organization of work based on students' age characteristics. The study theoretically substantiates the importance of the teacher's role in primary education and highlights the pedagogical significance of forming a sustainable health culture among young learners.

Аңдатпа

Бұл мақала бастауыш сынып оқушыларының салауатты өмір салтын қалыптастырудағы мұғалімнің рөлін ғылыми-педагогикалық әдебиеттерді талдау негізінде қарастырады. Қазіргі білім беру кеңістігінде балалар денсаулығын сақтау және нығайту мәселесінің өзектілігі артып отырғаны айқындалады. Осы тұрғыда бастауыш мектеп жасындағы оқушылардың психологиялық және физиологиялық даму ерекшеліктері, сондай-ақ салауатты өмір салтының тұлғаның жан-жақты қалыптасуындағы маңызы талданады. Бастауыш кезең баланың құндылықтық бағдарлары мен өмір салтына қатысты дағдылары қалыптасатын шешуші кезең ретінде сипатталады. Ғылыми еңбектерді жүйелі және салыстырмалы талдау нәтижесінде мұғалімнің оқу-тәрбие үдерісіндегі жетекші рөлі, оның кәсіби құзыреттілігі мен тұлғалық ықпалы, сондай-ақ өнегелік үлгі ретіндегі маңызы айқындалады. Мақалада салауатты өмір салтын қалыптастырудың негізгі бағыттары ретінде оқу үдерісіндегі денсаулыққа бағытталған педагогикалық ықпал, тәрбие жұмыстары арқылы жүйелі насихаттау және оқушылардың жас ерекшеліктерін ескере отырып ұйымдастырылатын педагогикалық жұмыстар қарастырылады. Зерттеу нәтижелері бастауыш білім беру жүйесінде мұғалімнің рөлін теориялық тұрғыдан негіздеп, салауатты өмір салтын қалыптастырудың педагогикалық маңыздылығын көрсетеді.

Keywords: primary school, healthy lifestyle, teacher's role, health education, primary education.

Кілт сөздер: бастауыш сынып, салауатты өмір салты, мұғалімнің рөлі, денсаулық тәрбиесі, бастауыш білім беру.

Kіріспе

Қазіргі жаһандану жағдайында білім беру жүйесінің алдында тұрған маңызды міндеттердің бірі – өсіп келе жатқан ұрпақтың денсаулығын сақтау және нығайту болып табылады. Қоғамдағы әлеуметтік-экономикалық өзгерістер, ақпараттық технологиялардың қарқынды дамуы, балалардың қозғалыс белсенділігінің төмендеуі және оқу жүктемесінің артуы оқушылар денсаулығына кері әсерін тигізуде. Әсіресе бастауыш мектеп жасындағы балалардың денсаулық

жағдайы педагогикалық қауымдастықтың ерекше назарын талап етеді, себебі бұл кезеңде баланың өмір салты мен денсаулыққа қатысты мінез-құлықтық дағдылары қалыптасады. Қазіргі білім беру кеңістігінде оқушылардың денсаулығын сақтау мәселесі тек медициналық тұрғыдан ғана емес, сонымен қатар педагогикалық мәселе ретінде қарастырылуда. Ғылыми зерттеулерде мектеп ортасының, оқу-тәрбие үдерісінің және мұғалімнің кәсіби іс-әрекетінің баланың денсаулығына тікелей ықпал ететіні көрсетіледі. Осыған байланысты білім беру мазмұнында денсаулықты сақтауға бағытталған құндылықтарды қалыптастыру, салауатты өмір салтына тәрбиелеу мәселесі басым бағыттардың біріне айналып отыр. Балалар денсаулығының төмендеу үрдісі қазіргі мектеп тәжірибесінде байқалатын маңызды мәселе ретінде сипатталады. Денсаулықты сақтау және нығайтуға бағытталған жүйелі педагогикалық жұмыстардың жеткіліксіздігі, мұғалімдердің денсаулық сақтау технологияларын толық қолданбауы бұл проблеманың өзектілігін арттыра түседі. Сол себепті қазіргі білім беру кеңістігінде балалар денсаулығын сақтау мәселесін кешенді түрде қарастырып, мұғалімнің салауатты өмір салтын қалыптастырудағы рөлін ғылыми тұрғыда негіздеу өзекті болып табылады.

Бастауыш мектеп жасы баланың физиологиялық, психологиялық және әлеуметтік тұрғыдан қарқынды даму кезеңі болып табылады. Бұл жаста баланың ағзасы әлі толық қалыптаспағандықтан, сыртқы орта әсерлеріне, соның ішінде оқу жүктемесіне, күн тәртібінің сақталуына және өмір салтына ерекше сезімтал келеді. Ғалымдардың пікірінше, дәл осы кезеңде баланың денсаулыққа қатысты әдеттері, қозғалыс белсенділігі, дұрыс тамақтану дағдылары мен жеке гигиена мәдениетінің негіздері қаланады. Бастауыш сынып оқушыларының психологиялық даму ерекшеліктері олардың ересектердің, әсіресе мұғалімнің ықпалына бейімділігімен сипатталады. Бұл жаста балалар еліктеу арқылы үйренеді, мұғалімнің іс-әрекеті мен өмір салтын үлгі ретінде қабылдайды. Сондықтан бастауыш мектеп кезеңі салауатты өмір салтын қалыптастыру үшін қолайлы және шешуші кезең болып саналады. Оқушылардың денсаулыққа деген оң көзқарасы мен құндылықтық қатынасы жүйелі педагогикалық ықпал нәтижесінде қалыптасады. Салауатты өмір салты бастауыш мектеп жасындағы балалардың жан-жақты дамуының маңызды шарты болып табылады. Ол баланың физикалық саулығын ғана емес, психикалық тұрақтылығын, оқу әрекетіне қабілеттілігін және әлеуметтік бейімделуін қамтамасыз етеді. Ғылыми еңбектерде салауатты өмір салты қағидаларын ерте жастан меңгерген оқушылардың оқу жетістіктері жоғары болып, шаршау деңгейі төмен болатыны атап көрсетіледі. Осы тұрғыдан алғанда, бастауыш мектеп жасындағы балалардың даму ерекшеліктерін ескере отырып, салауатты өмір салтын қалыптастыру мәселесі педагогикалық тұрғыдан ерекше маңызға ие.

Бастауыш мектеп кезеңінде мұғалім оқушы үшін негізгі әлеуметтік және тәрбиелік тұлға болып табылады. Бұл жаста балалар мұғалімді білім көзі ретінде ғана емес, мінез-құлқы мен өмір салтына еліктейтін үлгі ретінде қабылдайды [1]. Сондықтан мұғалімнің тұлғалық қасиеттері, кәсіби мәдениеті және денсаулыққа қатысты ұстанымдары бастауыш сынып оқушыларының салауатты өмір салтын қалыптастыруда маңызды рөл атқарады. Ғылыми еңбектерде мұғалімнің кәсіби қызметі тек оқу материалын меңгертумен шектелмей, оқушылардың құндылықтық бағдарларын қалыптастыруға бағытталуы қажеттігі атап көрсетіледі [1, 2]. Мұғалімнің салауатты өмір салтына оң көзқарасы, денсаулықты сақтау мәдениеті және оқу-тәрбие үдерісінде денсаулық сақтау қағидаларын жүйелі қолдануы оқушылардың күнделікті мінез-құлқына тікелей ықпал етеді [2]. Осы тұрғыда мұғалімнің кәсіби құзыреттілігі денсаулыққа бағытталған педагогикалық технологияларды меңгеруімен тығыз байланысты. Сонымен қатар мұғалімнің тұлғалық ықпалы оның оқушылармен қарым-қатынас стилі, эмоционалдық қолдауы және психологиялық жайлы орта қалыптастыруымен сипатталады [3]. Бастауыш сынып оқушылары үшін жағымды психологиялық ахуал оқу әрекетінің тиімділігін арттырып қана қоймай, олардың психикалық және физикалық денсаулығын сақтауға ықпал етеді. Ғалымдардың пікірінше, мұғалімнің оқушыға деген қамқорлыққа негізделген қарым-қатынасы салауатты өмір салтына деген оң көзқарастың қалыптасуына әсер ететін маңызды факторлардың бірі болып табылады [2].

Осы мақаланың мақсаты – бастауыш сынып оқушыларының салауатты өмір салтын қалыптастырудағы мұғалімнің рөлін отандық және шетелдік ғылыми еңбектерді талдау негізінде айқындау болып табылады. Ғылыми-педагогикалық әдебиеттерде бастауыш мектеп кезеңінде мұғалімнің тәрбиелік ықпалы баланың денсаулыққа қатысты көзқарасы мен мінез-құлқын қалыптастыруда шешуші фактор ретінде қарастырылатыны атап көрсетіледі [3].

Аталған мақсатқа қол жеткізу үшін салауатты өмір салты ұғымының педагогикалық мәнін ашуға, бастауыш сынып оқушыларының жас ерекшеліктерін ескере отырып жүргізілетін денсаулыққа бағытталған тәрбиенің мазмұнын талдауға, сондай-ақ мұғалімнің тұлғалық және кәсіби ықпалына қатысты ғылыми тұжырымдарды жүйелеуге басымдық беріледі. Ғылыми еңбектерді салыстырмалы талдау арқылы мұғалімнің салауатты өмір салтын қалыптастырудағы жетекші рөлі теориялық тұрғыдан негізделеді.

Әдеби шолу

Қазіргі ғылыми әдебиеттерде «салауатты өмір салты» ұғымы көпқырлы әлеуметтік-педагогикалық феномен ретінде қарастырылады. Зерттеушілердің пікірінше, салауатты өмір салты адамның денсаулығын сақтау мен нығайтуға бағытталған мінез-құлық үлгілерінің, құндылықтар жүйесінің және күнделікті әрекеттерінің жиынтығы болып табылады [4]. Бұл ұғым физикалық саулықты ғана емес, психикалық тұрақтылықты, әлеуметтік белсенділікті және тұлғаның үйлесімді дамуын да қамтиды [2]. Педагогикалық тұрғыдан алғанда, салауатты өмір салты тұлғаны жан-жақты дамытуға бағытталған тәрбиенің маңызды құрамдас бөлігі ретінде сипатталады. Ғылыми еңбектерде денсаулық тәрбиесі педагогиканың дербес бағыты ретінде қарастырылып, оның негізгі мақсаты білім алушыларда денсаулықты сақтау мен нығайтуға деген саналы көзқарасты қалыптастыру екені көрсетіледі [1]. Осы тұрғыда денсаулық тәрбиесі оқу-тәрбие үдерісінің барлық компоненттерімен тығыз байланыста жүзеге асырылуы тиіс екені атап өтіледі [4]. Денсаулық тәрбиесінің педагогикадағы орны баланың жас ерекшеліктерін ескере отырып, салауатты өмір салтына қажетті білім, білік және дағдыларды қалыптастырумен айқындалады. Әсіресе бастауыш мектеп жасында денсаулыққа бағытталған тәрбиенің маңызы ерекше, себебі бұл кезеңде баланың өмір салтының негізі қаланып, болашақтағы мінез-құлқына әсер ететін тұрақты әдеттер қалыптасады [2]. Ғалымдардың пікірінше, салауатты өмір салты қағидаларын ерте жастан меңгеру тұлғаның оқу әрекетіне қабілеттілігін арттырып, әлеуметтік бейімделуін жеңілдетеді [4].

Жалпы алғанда өмір салты мен тұлға қалыптасуы арасындағы байланыс педагогикалық және психологиялық зерттеулерде кеңінен қарастырылады. Тұлғаның құндылықтық бағдарлары, мінез-құлқы мен дүниетанымы оның күнделікті өмір салты арқылы қалыптасатыны дәлелденген [5]. Салауатты өмір салтын ұстану баланың өзін-өзі реттеу қабілетін, жауапкершілігін және өмірлік ұстанымдарын дамытуға ықпал етеді [4]. Осы тұрғыдан алғанда, салауатты өмір салты тұлғаның үйлесімді дамуының маңызды факторы ретінде бағаланады. Бастауыш сынып оқушыларының салауатты өмір салтын қалыптастыру мәселесі отандық педагогикалық ғылымда кеңінен зерттелген бағыттардың бірі болып табылады. Ғылыми еңбектерде бастауыш мектеп жасы баланың денсаулыққа қатысты көзқарастары мен өмір салтының негізі қаланатын шешуші кезең ретінде сипатталады. Отандық ғалымдар өз зерттеулерінде денсаулық тәрбиесін бастауыш сыныптан бастап жүйелі түрде жүзеге асыру қажеттігін атап көрсетеді [3, 5]. Қазақстандық және ресейлік зерттеушілер бастауыш жастағы денсаулық тәрбиесінің мазмұнын оқушылардың жас және психофизиологиялық ерекшеліктеріне сәйкестендірудің маңызын айқындайды. Ғалымдардың пікірінше, бұл кезеңде салауатты өмір салтына қатысты білім мен дағдыларды қалыптастыру оқу-тәрбие үдерісінің барлық құрамдас бөліктерімен тығыз байланыста жүргізілуі тиіс [5].

Шетелдік педагогикалық және психологиялық зерттеулерде де бастауыш мектеп жасындағы балалардың салауатты өмір салтын қалыптастыру мәселесіне айрықша назар аударылады. Шетел ғалымдары денсаулыққа бағытталған тәрбиені баланың тұлғалық дамуының маңызды шарты ретінде қарастырып, мектеп ортасының, педагогтің және әлеуметтік ортаның ықпалын кешенді түрде зерттейді [6]. Психологиялық зерттеулерде баланың ерте жастан қалыптасқан өмір салты оның болашақтағы денсаулық жағдайына және әлеуметтік бейімделуіне тікелей әсер ететіні дәлелденген [4]. Бастауыш мектептегі салауатты өмір салтына бағытталған жұмыстардың мазмұны ғылыми еңбектерде оқу және тәрбие үдерісінің біртұтастығы негізінде қарастырылады. Зерттеушілер денсаулық тәрбиесін оқу пәндерінің мазмұны арқылы жүзеге асыруды, сыныптан тыс іс-шаралармен толықтыруды және мұғалімнің жеке үлгісін басты құралдардың бірі ретінде айқындайды [3]. Мұндай жұмыстар оқушылардың қозғалыс белсенділігін арттыруға, дұрыс тамақтану мәдениетін қалыптастыруға және психологиялық саулықты қамтамасыз етуге бағытталуы тиіс екені атап өтіледі [5].

Ғылыми-педагогикалық әдебиеттерде мұғалімнің тәрбиелік қызметі тұлғаның жан-жақты дамуын қамтамасыз ететін негізгі факторлардың бірі ретінде қарастырылады.

Зерттеушілердің пікірінше, мұғалім тек білім беруші ғана емес, сонымен қатар оқушының әлеуметтік, моральдық және денсаулыққа қатысты құндылықтарын қалыптастырушы тұлға болып табылады [7]. Бастауыш мектеп жағдайында мұғалімнің тәрбиелік қызметі оқушылардың салауатты өмір салтына деген көзқарасын қалыптастыруда жетекші орын алады. Мұғалімнің салауатты өмір салтын қалыптастырудағы рөлі оның кәсіби қызметімен қатар, жеке тұлғалық үлгісі арқылы да айқындалады. Психологиялық-педагогикалық зерттеулерде бастауыш сынып оқушыларының ересектерге, әсіресе мұғалімге еліктеу арқылы мінез-құлық үлгілерін меңгеретіні дәлелденген [1]. Осы тұрғыда мұғалімнің денсаулыққа деген көзқарасы, өмір салты және күнделікті іс-әрекеті оқушылар үшін үлгі болып табылады.

Әдебиеттерді талдау барысында салауатты өмір салтын қалыптастыруда мұғалім рөлінің шешуші фактор ретінде танылатыны айқындалды. Ғылыми еңбектерде мұғалімнің тәрбиелік қызметі, жеке тұлғалық үлгісі және кәсіби құзыреттілігі оқушылардың денсаулыққа деген көзқарасын қалыптастырудың негізгі шарттары ретінде сипатталады [7, 8]. Мұғалімнің денсаулық сақтау бағытындағы жүйелі педагогикалық ықпалы оқушылардың салауатты өмір салтын саналы түрде қабылдауына ықпал ететіні көптеген зерттеулерде дәлелденген [8]. Қарастырылған ғылыми еңбектердің негізінде бірқатар қорытындылар жасауға болады. Біріншіден, салауатты өмір салтын қалыптастыру бастауыш мектеп жасынан бастап жүйелі түрде жүзеге асырылуы тиіс педагогикалық міндет болып табылады. Екіншіден, бұл үдерістің тиімділігі мұғалімнің тұлғалық қасиеттері мен кәсіби дайындығына тікелей байланысты. Үшіншіден, ғылыми зерттеулерде мұғалімнің оқушының құндылықтар жүйесіне ықпалы салауатты өмір салтын қалыптастырудың теориялық негізі ретінде қарастырылады [5, 6].

Әдіснама

Бұл мақала теориялық-талдамалық сипатта орындалды және бастауыш сынып оқушыларының салауатты өмір салтын қалыптастырудағы мұғалімнің рөлін ашуға бағытталды. Зерттеудің әдіснамалық негізін педагогика, психология және денсаулық сақтау педагогикасы саласындағы отандық және шетелдік ғылыми еңбектерді талдау құрайды. Мақалада эмпирикалық зерттеу жүргізілмей, мәселе ғылыми тұжырымдар мен теориялық көзқарастарды жүйелеу арқылы қарастырылды. Зерттеу барысында ғылыми-педагогикалық әдебиеттерге жүйелі және салыстырмалы талдау әдістері қолданылды. Атап айтқанда, бастауыш мектеп жасындағы балалардың даму ерекшеліктері, салауатты өмір салты ұғымының педагогикалық мәні, сондай-ақ мұғалімнің оқу-тәрбие үдерісіндегі рөліне арналған ғылыми еңбектер іріктеліп, мазмұндық тұрғыдан талданды. Әдебиеттерді талдау барысында авторлардың негізгі идеялары, ортақ тұжырымдары және айырмашылықтары анықталды. Сонымен қатар зерттеу үдерісінде талдау мен жинақтау әдістері қолданылды. Бұл әдістер ғылыми еңбектерде ұсынылған көзқарастарды біртұтас жүйеге келтіріп, мұғалімнің бастауыш сынып оқушыларының салауатты өмір салтын қалыптастырудағы рөлін теориялық тұрғыдан негіздеуге мүмкіндік берді. Жинақтау әдісі арқылы мұғалімнің кәсіби және тұлғалық ықпалы, өнегелік үлгі ретіндегі маңызы және оқушының жас ерекшеліктерін ескере отырып ұйымдастырылатын педагогикалық жұмыстардың мәні айқындалды.

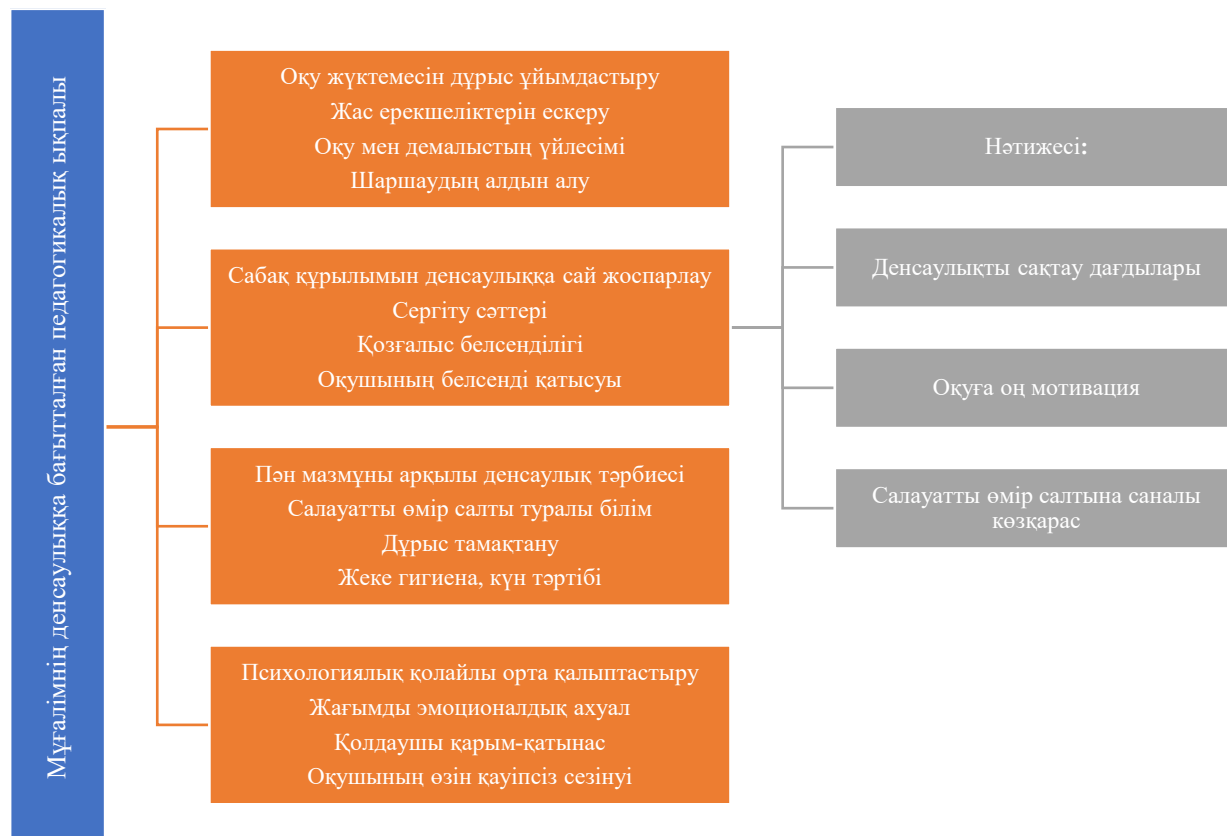
Зерттеудің әдіснамалық ұстанымы тұлғаға бағытталған, құндылыққа негізделген және денсаулық сақтау педагогикасы қағидаларына сүйенеді. Бұл ұстанымдар бастауыш сынып оқушыларының салауатты өмір салтын қалыптастыруды тұлғаның жан-жақты дамуының маңызды құрамдас бөлігі ретінде қарастыруға мүмкіндік береді. Мұғалімнің рөлі осы қағидалар аясында білім беру мен тәрбиені кіріктіре жүзеге асыратын жетекші фактор ретінде сипатталды.

Нәтижелер

Ғылыми-педагогикалық әдебиеттерде оқу үдерісі бастауыш сынып оқушыларының салауатты өмір салтын қалыптастырудың маңызды тетігі ретінде қарастырылады. Зерттеушілердің пікірінше, оқу сабақтарының мазмұны мен ұйымдастырылуы оқушылардың денсаулық жағдайына, оқу әрекетіне қабілеттілігіне және психологиялық жай-күйіне тікелей әсер етеді [9]. Оқу үдерісіндегі денсаулыққа бағытталған педагогикалық ықпал ең алдымен оқу жүктемесін оқушылардың жас және физиологиялық ерекшеліктеріне сәйкестендірумен сипатталады. Ғалымдар бастауыш сынып оқушылары үшін сабақ құрылымының дұрыс ұйымдастырылуы, оқу мен демалыстың тиімді алмасуы, сергіту сәттерінің қолданылуы олардың шаршауын азайтып, денсаулығын сақтауға ықпал ететінін атап көрсетеді [3]. Мұндай тәсілдер оқушылардың оқу мотивациясын арттырып, сабаққа деген жағымды қатынасын қалыптастырады. Сонымен қатар оқу пәндерінің мазмұны арқылы салауатты өмір салты

туралы білім беру де мұғалімнің маңызды педагогикалық міндеттерінің бірі болып табылады. Ғылыми еңбектерде бастауыш мектепте денсаулыққа қатысты білім элементтерін пән мазмұнына кіріктіру оқушылардың денсаулықты сақтау мәдениетін қалыптастыруға мүмкіндік беретіні көрсетіледі [8]. Бұл үдерісте мұғалім оқушыларға дұрыс тамақтану, қозғалыс белсенділігі, жеке гигиена және күн тәртібін сақтау туралы қарапайым әрі түсінікті ұғымдарды жүйелі түрде меңгертуі тиіс.

Оқу үдерісіндегі денсаулыққа бағытталған педагогикалық ықпалдың тағы бір маңызды қыры мұғалімнің психологиялық тұрғыдан қауіпсіз және қолайлы оқу ортасын қалыптастыруы. Зерттеулерде жағымды эмоционалдық ахуалдың оқушылардың психикалық саулығын сақтауда және оқу әрекетінің тиімділігін арттыруда маңызды рөл атқаратыны дәлелденген [8]. Мұғалімнің қолдау көрсетуге негізделген қарым-қатынасы, оқушының жеке мүмкіндіктерін ескеруі салауатты өмір салтына деген оң көзқарастың қалыптасуына ықпал етеді [6] (Сурет 1).



Сурет 1. Мұғалімнің денсаулыққа бағытталған педагогикалық ықпалы

Ғылыми-педагогикалық әдебиеттерде тәрбие жұмыстары бастауыш сынып оқушыларының салауатты өмір салтын қалыптастырудағы маңызды бағыттардың бірі ретінде қарастырылады. Дүниежүзілік денсаулық сақтау ұйымының деректеріне сәйкес, мектеп жасындағы балалардың шамамен 60–70%-ы жеткілікті деңгейде қозғалыс белсенділігімен айналыспайды, бұл олардың денсаулық жағдайына кері әсерін тигізеді [9]. Осыған байланысты бастауыш мектепте жүргізілетін тәрбие жұмыстары арқылы салауатты өмір салтын насихаттау ерекше өзектілікке ие. Тәрбие жұмыстары арқылы салауатты өмір салтын қалыптастыру ең алдымен сыныптан тыс іс-шараларды ұйымдастырумен байланысты. Зерттеулерде бастауыш сынып оқушылары арасында жүйелі түрде өткізілетін тәрбие сағаттары мен денсаулыққа бағытталған іс-шаралар олардың денсаулыққа қатысты білім деңгейін 20–30%-ға арттыратыны көрсетілген [8]. Сонымен қатар ойын және интерактивті формада ұйымдастырылған тәрбиелік жұмыстар оқушылардың қызығушылығын күшейтіп, салауатты өмір салтына деген жағымды қатынасын қалыптастырады [2, 8].

Ғылыми деректерде қозғалыс белсенділігіне бағытталған тәрбие жұмыстарының маңызы ерекше атап өтіледі. Мамандардың мәліметі бойынша, бастауыш мектеп жасындағы балалардың күнделікті қозғалыс белсенділігі жеткілікті болған жағдайда олардың оқу үлгерімі мен зейін тұрақтылығы 25%-ға дейін жақсарады [9]. Сонымен қатар тәрбие үдерісінде

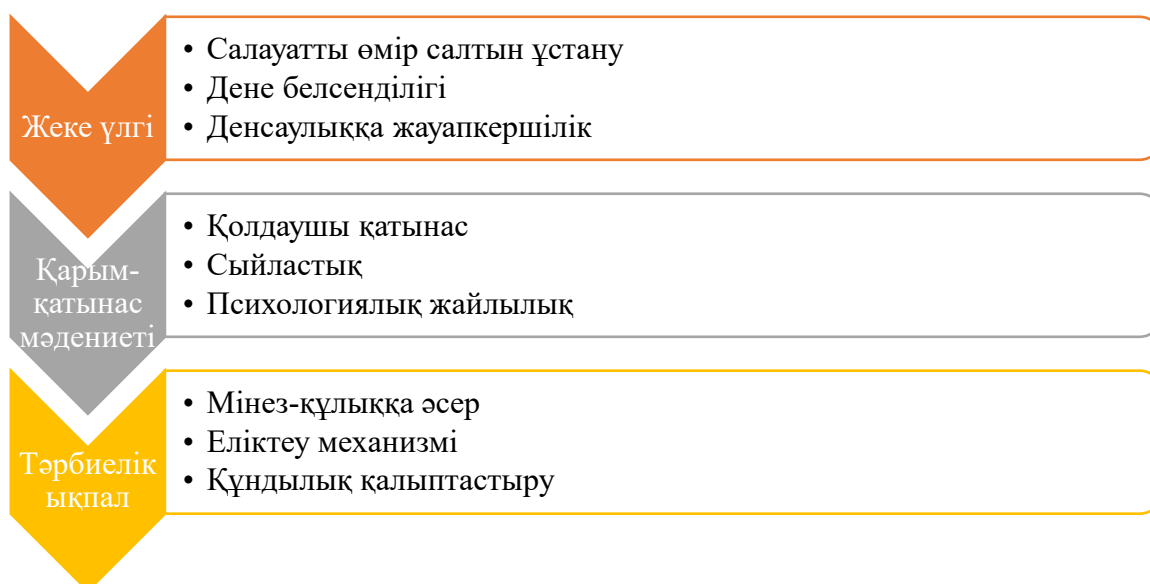
жүргізілетін жүйелі түсіндіру жұмыстары оқушылардың денсаулыққа деген саналы қатынасын қалыптастыруға ықпал етеді. Зерттеулерде бастауыш сынып оқушыларының шамамен 70%-ы мұғалім тарапынан жүргізілген тәрбиелік әңгімелер мен түсіндіру жұмыстарынан кейін өз денсаулығына жауапкершілікпен қарай бастайтыны көрсетілген [8]. Ғылыми әдебиеттер мен статистикалық мәліметтерді талдау тәрбие жұмыстары арқылы салауатты өмір салтын насихаттаудың бастауыш сынып оқушыларының денсаулық мәдениетін қалыптастырудағы тиімді бағыт екенін көрсетеді. Мұғалім ұйымдастыратын мақсатты және жүйелі тәрбие жұмыстары оқушылардың салауатты өмір салтына деген тұрақты көзқарасын қалыптастырудың маңызды шарты болып табылады [9] (Сурет 2).



Сурет 2. Тәрбие жұмыстары арқылы салауатты өмір салтын қалыптастыруға қатысты статистикалық көрсеткіштер

Ғылыми-педагогикалық әдебиеттерде мұғалім тұлғасы бастауыш сынып оқушылары үшін маңызды өнегелік үлгі ретінде қарастырылады. Бастауыш мектеп жасында балалар ересектердің мінез-құлқына, қарым-қатынасына және өмір салтына еліктеу арқылы әлеуметтік тәжірибені меңгереді. Осы тұрғыда мұғалімнің жеке тұлғалық қасиеттері, денсаулыққа деген көзқарасы және күнделікті іс-әрекеті оқушылардың салауатты өмір салтына қатысты ұстанымдарының қалыптасуына тікелей ықпал етеді [3]. Психологиялық-педагогикалық зерттеулерде мұғалімнің жеке үлгісі арқылы берілетін тәрбиенің тиімділігі ерекше атап өтіледі. Ғалымдардың пікірінше, мұғалімнің салауатты өмір салтын ұстануы, белсенді өмірлік позициясы және жауапты мінез-құлқы оқушыларда денсаулықты сақтау қажеттілігі туралы саналы түсінік қалыптастырады [9]. Мұндай үлгілік ықпал бастауыш сынып оқушылары үшін тәрбиелік әңгімелер мен нұсқауларға қарағанда әлдеқайда әсерлі болып табылады [8].

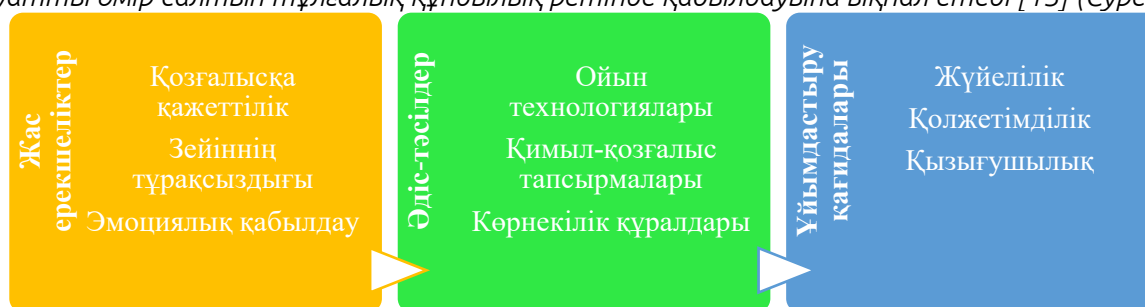
Мұғалімнің өнегелік үлгі ретіндегі маңызы оның оқушылармен қарым-қатынас мәдениеті арқылы да айқындалады. Ғылыми еңбектерде мұғалімнің сыйластыққа, қолдауға және ынтымақтастыққа негізделген қарым-қатынасы оқушылардың эмоционалдық саулығын сақтауға және жағымды психологиялық ахуал қалыптастыруға ықпал ететіні көрсетіледі [8]. Аталған ойларды қорытындылай келе мынадай түйін жасауға болады, мұғалім тұлғасының өнегелік үлгі ретіндегі ықпалы бастауыш сынып оқушыларының салауатты өмір салтын қалыптастырудың маңызды факторы болып табылады [7] (Сурет 3).



Сурет 3. Мұғалім тұлғасының өнегелік үлгі ретіндегі маңызы

Бастауыш мектеп жасындағы оқушылардың жас және психофизиологиялық ерекшеліктерін ескеру салауатты өмір салтын қалыптастыруға бағытталған педагогикалық жұмыстардың тиімділігін арттырады. Ғылыми зерттеулерде бұл жастағы балалардың зейінінің тұрақсыздығы, қозғалысқа деген жоғары қажеттілігі және эмоциялық әсерлерге бейімділігі атап көрсетіледі [11]. Сондықтан мұғалім ұйымдастыратын жұмыстар оқушылардың жас ерекшеліктеріне сай, қызықты әрі қолжетімді формада жүргізілуі тиіс. Педагогикалық әдебиеттерде бастауыш сынып оқушылары үшін ойын, қимыл-қозғалысқа негізделген тапсырмалар мен көрнекілікке сүйенген әдістердің тиімділігі дәлелденген. Мұндай жұмыстар оқушылардың оқу әрекетіне деген қызығушылығын арттырып қана қоймай, олардың физикалық және психикалық саулығын сақтауға ықпал етеді [9]. Оған қоса, жас ерекшеліктерді ескере отырып ұйымдастырылған тәрбиелік жұмыстар оқушылардың салауатты өмір салтына қатысты білімді саналы түрде қабылдауына мүмкіндік береді [10].

Ғалымдардың пікірінше, бастауыш мектеп жасында жүргізілетін салауатты өмір салтына бағытталған жұмыстар жүйелі әрі бірізді болуы қажет. Мұғалім оқушылардың жас ерекшеліктеріне сәйкес күн тәртібін сақтау, қозғалыс белсенділігін арттыру, демалыс пен еңбектің үйлесімін қамтамасыз етуге бағытталған жұмыстарды ұйымдастыруы тиіс [8, 12]. Мұндай тәсілдер оқушылардың денсаулыққа деген жауапкершілігін қалыптастырып, салауатты өмір салтын тұлғалық құндылық ретінде қабылдауына ықпал етеді [13] (Сурет 4).



Сурет 4. Жас ерекшеліктерді ескере отырып ұйымдастырылатын жұмыстар

Талқылау

Ғылыми-педагогикалық әдебиеттерге жүргізілген талдау бастауыш сынып оқушыларының салауатты өмір салтын қалыптастыру мәселесіне арналған зерттеулерде бірқатар ортақ ғылыми тұжырымдардың бар екенін көрсетеді. Көптеген отандық және шетелдік ғалымдар бастауыш мектеп жасын баланың денсаулыққа қатысты құндылықтары мен өмір салтының негізі қаланатын шешуші кезең ретінде қарастырады [7, 14]. Бұл тұрғыда салауатты өмір салтын қалыптастырудың тиімділігі ерте жастан басталуы қажеттігі ғылыми еңбектерде бірдей дәрежеде мойындалады. Зерттеулерді салыстырмалы талдау барысында бірқатар айырмашылықтар да анықталады. Кейбір авторлар салауатты өмір салтын қалыптастырудың негізгі тетігі ретінде оқу үдерісін денсаулыққа бағыттап

ұйымдастыруды алға тартса, басқа зерттеулерде тәрбие жұмыстары мен мұғалімнің жеке үлгісіне басымдық беріледі [15]. Бұл айырмашылықтар зерттеулердің әдіснамалық ұстанымдары мен қарастырылатын аспектілерінің әртүрлілігімен түсіндіріледі.

Бірқатар ғылыми еңбектерде салауатты өмір салтын қалыптастыру мәселесі кешенді тұрғыда қарастырылып, оқу үдерісі, тәрбие жұмыстары және мұғалім тұлғасының өнегелік ықпалы өзара тығыз байланыста жүзеге асырылуы тиіс екені атап көрсетіледі [3]. Бұл тұжырымдар мұғалімнің бастауыш сынып оқушыларының денсаулығын сақтаудағы рөлінің көпқырлы сипатын айқындайды. Ғылыми еңбектерді талдау нәтижелері мұғалімнің бастауыш сынып оқушыларының салауатты өмір салтын қалыптастырудағы рөлінің теориялық тұрғыдан негізделгенін көрсетеді. Педагогикалық және психологиялық зерттеулерде мұғалім тұлғасы баланың мінез-құлқына, құндылықтар жүйесіне және өмір салтына әсер ететін негізгі әлеуметтік факторлардың бірі ретінде қарастырылады [16]. Әсіресе бастауыш мектеп жасында мұғалімнің тәрбиелік ықпалы ерекше мәнге ие.

Теориялық тұрғыдан алғанда, мұғалімнің салауатты өмір салтын қалыптастырудағы рөлі тұлғаға бағытталған және құндылыққа негізделген педагогика қағидаларымен түсіндіріледі. Ғылыми еңбектерде мұғалімнің жеке үлгісі, кәсіби құзыреттілігі және оқушылармен орнататын қарым-қатынас мәдениеті салауатты өмір салтына деген саналы көзқарастың қалыптасуының негізі ретінде айқындалады [17]. Бұл тұжырымдар мұғалімнің денсаулық сақтау бағытындағы педагогикалық ықпалының теориялық негізін құрайды.

Сонымен қатар денсаулық сақтау педагогикасы тұрғысынан мұғалімнің оқу және тәрбие үдерісін оқушылардың жас ерекшеліктеріне сәйкес ұйымдастыруы олардың физикалық және психологиялық саулығын қамтамасыз етудің маңызды шарты ретінде қарастырылады. Мұндай теориялық тұжырымдар мұғалімнің кәсіби қызметі мен тұлғалық қасиеттерінің бірлігі салауатты өмір салтын қалыптастырудың тиімді факторы екенін дәлелдейді [18].

Қазіргі бастауыш білім беру тәжірибесінде оқушылардың денсаулығын сақтау мен нығайту мәселесі білім беру мазмұнының маңызды бағыттарының бірі ретінде қарастырылуда. Ғылыми еңбектерде заманауи білім беру жүйесінің басты міндеттерінің бірі оқушылардың оқу жетістіктерін арттырумен қатар, олардың физикалық және психологиялық саулығын қамтамасыз ету екені атап көрсетіледі [19]. Осы тұрғыда бастауыш мектепте салауатты өмір салтын қалыптастыруға бағытталған педагогикалық тәсілдерге деген қызығушылық артып отыр.

Педагогикалық зерттеулерде қазіргі бастауыш білім беру тәжірибесінде денсаулық сақтау технологияларын қолданудың маңызы ерекше көрсетіледі. Ғалымдардың пікірінше, оқу үдерісінде сергіту сәттерін, қозғалысқа негізделген тапсырмаларды және ойын технологияларын қолдану оқушылардың шаршауын азайтып, оқу мотивациясын арттыруға ықпал етеді [20, 21]. Бұл тәсілдер оқушылардың жас ерекшеліктерін ескере отырып ұйымдастырылған жағдайда ғана тиімді нәтиже береді.

Сонымен қатар қазіргі білім беру тәжірибесінде мұғалімнің кәсіби рөлі кеңейіп, ол тек білім беруші ғана емес, сонымен бірге денсаулықты сақтауға бағытталған тәрбиелік үдерістің ұйымдастырушысы ретінде қарастырылады. Ғылыми еңбектерде мұғалімнің жеке тұлғалық үлгісі, оқушылармен орнататын қарым-қатынасы және психологиялық тұрғыдан қауіпсіз орта қалыптастыруы бастауыш сынып оқушыларының салауатты өмір салтына деген көзқарасының қалыптасуына тікелей әсер ететіні атап өтіледі [22].

Қазіргі бастауыш білім беру тәжірибесіне арналған зерттеулерде мектеп пен отбасының өзара ықпалдастығы да маңызды фактор ретінде көрсетіледі. Ғалымдардың пікірінше, мұғалім мен ата-ананың бірлескен әрекеті оқушылардың денсаулыққа қатысты дағдыларын бекітіп, салауатты өмір салтын тұрақты құндылық ретінде қалыптастыруға мүмкіндік береді [23]. Бұл қазіргі білім беру тәжірибесінде салауатты өмір салтын қалыптастырудың кешенді тәсілін талап етеді.

Қорытынды

Қорытындылай келе, жүргізілген ғылыми-педагогикалық әдебиеттерді жан-жақты талдау бастауыш сынып оқушыларының салауатты өмір салтын қалыптастыру үдерісінде мұғалімнің жетекші рөл атқаратынын айқын көрсетті. Бастауыш мектеп жағдайында мұғалім тек оқу мазмұнын жеткізуші емес, сонымен қатар оқушылардың денсаулыққа деген көзқарасын, өмір салтына қатысты әдеттері мен құндылықтарын қалыптастыратын негізгі тұлға болып табылады. Салауатты өмір салтын қалыптастырудың тиімділігі мұғалімнің оқу-тәрбие үдерісін мақсатты, жүйелі және ғылыми негізде ұйымдастыруымен тығыз байланысты. Ғылыми

еңбектерде бастауыш мектеп жасы тәрбиелік ықпал үшін аса маңызды кезең ретінде ерекше атап өтіледі. Бұл кезеңде баланың физиологиялық, психологиялық және әлеуметтік дамуы қарқынды жүріп, оның болашақ өмір салтының негізі қаланады. Сондықтан бастауыш жаста ұйымдастырылатын тәрбиенің мазмұны баланың жас ерекшеліктерін ескере отырып құрылуы тиіс. Дәл осы кезеңде мұғалімнің педагогикалық ықпалы арқылы оқушылардың денсаулықты сақтау мен нығайтуға бағытталған саналы қатынасы қалыптасады. Әдебиеттерді талдау мұғалімнің кәсіби және тұлғалық қасиеттерінің оқушылардың денсаулыққа деген көзқарасын қалыптастыруда маңызды фактор болып табылатынын көрсетеді. Мұғалімнің жеке үлгісі, өмір салты, қарым-қатынас мәдениеті және кәсіби жауапкершілігі бастауыш сынып оқушылары үшін тәрбиелік ықпалдың ең әсерлі құралдарының бірі болып саналады. Мұғалімнің денсаулыққа қатысты құндылықтарды өзі ұстануы оқушылардың салауатты өмір салтын өмірлік қажеттілік ретінде қабылдауына ықпал етеді.

Қазіргі бастауыш білім беру тәжірибесінде салауатты өмір салтын қалыптастыру мәселесі кешенді педагогикалық міндет ретінде қарастырылуы қажет. Бұл үдеріс оқу үдерісіндегі денсаулыққа бағытталған педагогикалық ықпалмен, тәрбие жұмыстары арқылы жүргізілетін жүйелі насихатпен, мұғалім тұлғасының өнегелік үлгісімен және оқушылардың жас ерекшеліктерін ескерумен тығыз байланыста жүзеге асырылуы тиіс. Мұғалім осы бағыттардың барлығын біріктіре отырып, бастауыш сынып оқушыларының денсаулық мәдениетін қалыптастыруға жағдай жасайды. Бастауыш сынып оқушыларының салауатты өмір салтын қалыптастырудағы мұғалімнің рөлі теориялық тұрғыдан жан-жақты негізделіп, оның қазіргі білім беру жүйесіндегі маңыздылығы айқындалады. Мұғалімнің кәсіби даярлығы мен тұлғалық әлеуетін арттыру бастауыш мектепте салауатты өмір салтын қалыптастырудың негізгі педагогикалық шарттарының бірі болып табылады және бұл бағыттағы жұмыстарды одан әрі жетілдіру қазіргі білім беру жүйесінің өзекті міндеттерінің бірі ретінде қарастырылуы тиіс.

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ARTIFICIAL INTELLIGENCE IN EDUCATION: TRANSFORMATIVE POTENTIAL, SYSTEMIC RISKS, AND THE NEED FOR RESPONSIBLE GOVERNANCE

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Abstract

The rapid advancement of Information and Communication Technologies (ICT) has fundamentally reshaped educational systems worldwide. Among these developments, Artificial Intelligence (AI) has emerged as one of the most transformative forces, influencing teaching methodologies, assessment models, institutional management, and research practices. This thesis examines the structural impact of AI integration in education, evaluating both its pedagogical advantages and systemic risks. While AI-driven systems enhance personalization, efficiency, and data-informed decision-making, they simultaneously raise concerns regarding academic integrity, algorithmic bias, data protection, and the evolving role of educators. Drawing on contemporary research and policy frameworks, this study argues that sustainable AI integration requires a balanced governance model grounded in transparency, ethical accountability, and institutional regulation. The findings indicate that AI can significantly improve learning outcomes when deployed within a clearly defined ethical and legal framework.

Keywords: Artificial Intelligence (AI); Information and Communication Technologies (ICT); Educational Technology; Personalized Learning; Academic Integrity; Algorithmic Bias; Data Privacy; AI Governance; Digital Transformation in Education; Adaptive Learning Systems.

Introduction

The digital transformation of education has accelerated dramatically over the last decade, particularly following the global disruptions caused by the COVID-19 pandemic. During this period, Information and Communication Technologies (ICT) shifted from being supportive instructional tools to becoming the structural backbone of educational continuity. Remote learning platforms, cloud-based collaboration systems, and digital assessment environments became central to institutional survival. According to UNESCO (2021), the pandemic forced an unprecedented global experiment in technology-mediated education, affecting over 1.6 billion learners worldwide. This transition not only normalized digital platforms but also intensified the demand for intelligent systems capable of supporting large-scale, adaptive, and data-driven learning environments.

Within this broader transformation, Artificial Intelligence (AI) has assumed a central and strategic role. Originally conceptualized as a field of computer science concerned with simulating intelligent behavior in machines (Russell & Norvig, 2021), AI has evolved into a multidisciplinary domain influencing economics, healthcare, governance, and increasingly, education. Scholars define AI in education as the application of machine learning, natural language processing, and predictive analytics to enhance learning processes and institutional decision-making (Holmes et al., 2019). Unlike earlier educational technologies that primarily digitized existing practices, AI introduces autonomous decision-making capabilities into instructional design and evaluation systems.

The term "Artificial Intelligence" was first formally introduced by John McCarthy in 1956, marking the beginning of a research trajectory that has evolved from symbolic reasoning models to advanced neural networks. What was once confined to theoretical laboratories has now become embedded in everyday educational tools. In recent years, institutions such as OpenAI, along with technology corporations like Google and Microsoft, have developed AI systems that are increasingly integrated into learning management systems, digital classrooms, and research environments. Generative tools such as ChatGPT have entered classrooms and academic workflows, reshaping how students draft essays, conduct literature reviews, and conceptualize research problems.

Empirical studies suggest that AI-supported adaptive learning systems can improve student engagement and performance by tailoring instructional content to individual needs (Luckin et al., 2016). Similarly, predictive analytics models are being used to identify students at academic risk, enabling early intervention strategies (Siemens & Baker, 2012). These developments indicate that AI is not merely automating tasks; it is restructuring pedagogical logic through algorithmic personalization and real-time data interpretation.

However, the integration of AI in education is not merely a technological enhancement; it represents a paradigmatic shift in knowledge production, evaluation mechanisms, and pedagogical philosophy. Education has traditionally relied on human judgment, dialogical interaction, and interpretive reasoning. The introduction of algorithmic systems into these domains challenges long-standing assumptions about authorship, intellectual autonomy, and epistemic authority. As Selwyn (2019) argues, the growing reliance on data-driven technologies risks redefining education according to measurable outputs rather than holistic intellectual development.

This transformation therefore raises fundamental questions. Does AI enhance educational quality by increasing accessibility, efficiency, and personalization? Or does it risk undermining critical thinking, originality, and academic authenticity? Can institutions regulate AI effectively without stifling innovation and technological progress? And most importantly, how can educational systems maintain human-centered values within increasingly automated environments?

Addressing these questions requires a comprehensive and interdisciplinary examination of both opportunities and systemic risks. It demands not only technical evaluation but also ethical reflection, policy analysis, and pedagogical reconsideration. AI's influence on education is neither inherently beneficial nor inherently harmful; its long-term impact will depend on governance structures, institutional responsibility, and the extent to which human oversight remains central in the learning process. **Artificial Intelligence as a Pedagogical Infrastructure**

AI-driven systems have significantly advanced personalized learning. Adaptive learning platforms analyze learner behavior, performance metrics, and engagement patterns to tailor instructional content. Research indicates that personalized feedback mechanisms can improve retention rates and conceptual understanding (Holmes et al., 2019). Unlike traditional one-size-fits-all curricula, AI systems adjust task complexity dynamically, enabling students to progress at their own pace.

Moreover, automated assessment systems have optimized grading efficiency. Machine learning algorithms can evaluate multiple-choice tests, short responses, and increasingly complex written texts. Studies demonstrate that AI-assisted grading can reduce teacher workload while maintaining acceptable reliability levels (Luckin et al., 2016). Nevertheless, concerns remain regarding transparency in algorithmic decision-making and the possibility of embedded bias.

AI also contributes to institutional management. Predictive analytics models identify students at risk of academic failure by analyzing attendance records, performance trends, and engagement data. Early intervention systems, supported by AI, allow universities to implement timely academic counseling strategies. From an administrative perspective, AI enhances strategic planning by transforming raw educational data into actionable insights.

However, the integration of AI into pedagogical infrastructure changes the epistemological foundation of education. The educator's role evolves from knowledge transmitter to facilitator and critical moderator. This transformation requires substantial digital literacy training and pedagogical adaptation.

Academic Integrity and Cognitive Development

One of the most controversial implications of AI integration concerns academic integrity. Generative AI tools can produce essays, research proposals, and analytical summaries within seconds. While these tools can assist brainstorming and language refinement, they also create opportunities for academic misconduct.

Research on academic dishonesty suggests that technological convenience increases the temptation to bypass authentic cognitive effort (Bretag et al., 2019). If students rely excessively on AI-generated content, the development of higher-order thinking skills may be compromised. Critical thinking, argument construction, and methodological reasoning require intellectual engagement that cannot be outsourced without long-term cognitive consequences.

Furthermore, plagiarism detection systems face new challenges. Traditional detection software identifies textual similarity, but AI-generated content may be original in structure while lacking genuine intellectual ownership. This creates a conceptual dilemma: Should AI-assisted writing be considered collaboration, tool usage, or misconduct?

To address these challenges, institutions must redefine academic integrity policies. Rather than prohibiting AI entirely, universities should promote transparent usage guidelines and require disclosure of AI assistance in academic submissions.

Data Protection, Algorithmic Bias, and Ethical Accountability

AI systems depend on extensive data collection. Student performance metrics, behavioral analytics, and personal identifiers are processed to generate predictive models. This raises significant privacy

concerns. Educational institutions must ensure compliance with data protection standards and ethical data governance frameworks.

Algorithmic bias presents another structural risk. If training datasets contain demographic imbalances, predictive models may produce discriminatory outcomes. Research shows that biased algorithms can unintentionally disadvantage minority groups (O'Neil, 2016). In educational contexts, such bias could affect scholarship allocation, admissions predictions, or performance assessments.

Policy initiatives have begun to address these concerns. The European Union's Artificial Intelligence Act introduces a risk-based regulatory framework that categorizes AI systems according to their societal impact. Educational AI applications may fall into higher-risk categories, requiring transparency obligations and human oversight.

Ethical accountability must therefore be embedded at multiple levels:

Transparent algorithmic design

Independent auditing mechanisms

Human supervision in high-stakes decisions

Without these safeguards, AI risks reinforcing structural inequalities rather than mitigating them.

Toward a Responsible Integration Model

A sustainable AI integration strategy in education requires a multidimensional framework combining technological innovation with governance mechanisms. First, institutions should implement AI literacy programs for both educators and students. Understanding how algorithms function reduces blind reliance and encourages critical engagement.

Second, hybrid evaluation models should be adopted. Combining AI-assisted assessment with human review ensures efficiency without sacrificing contextual judgment.

Third, institutional policies must define acceptable AI usage in academic work. Clear disclosure requirements can normalize responsible assistance while discouraging hidden dependency.

Finally, research-based monitoring systems should continuously evaluate AI's impact on learning outcomes. Empirical studies comparing AI-supported and traditional learning environments can provide data-driven insights into long-term cognitive effects.

Conclusion

Artificial Intelligence represents one of the most influential ICT developments shaping contemporary education. Its capacity to personalize learning, automate evaluation, optimize institutional management, and generate real-time analytical insights offers undeniable advantages. By enabling adaptive learning environments and data-driven decision-making, AI has the potential to increase efficiency, reduce administrative burden, and support more inclusive educational models. In many contexts, it also expands access to high-quality resources, particularly for geographically or socioeconomically disadvantaged learners.

However, these benefits coexist with systemic and structural risks. Issues related to academic integrity, data protection, algorithmic bias, and excessive technological dependence cannot be treated as secondary concerns. If left unregulated, AI systems may inadvertently reinforce inequalities, weaken critical thinking skills, and shift educational priorities from intellectual development to performance optimization. The growing use of generative systems such as ChatGPT demonstrates how rapidly AI tools can influence academic practices, often outpacing institutional policy adaptation.

This thesis argues that the future of AI in education depends not solely on technological sophistication, but fundamentally on governance quality. Ethical regulation, procedural transparency, institutional accountability, and continuous human oversight must accompany technological integration. Regulatory frameworks such as the European Union's Artificial Intelligence Act illustrate an emerging recognition that AI systems require risk-based supervision, particularly in high-impact domains like education.

Importantly, AI should function as an augmentative instrument rather than a substitute for human intellectual agency. Education is not merely a process of information delivery; it is a formative space where reasoning, creativity, ethical judgment, and social responsibility are cultivated. These dimensions cannot be automated without altering the essence of learning itself. Therefore, AI must support educators and learners, not replace their cognitive engagement.

When embedded within a structured ethical and legal framework, AI has the potential to enhance educational quality, equity, and accessibility on a global scale. It can strengthen institutional resilience, promote innovative pedagogies, and foster more responsive learning ecosystems. Without such safeguards, however, AI may undermine the very principles education seeks to protect: critical reasoning, fairness, intellectual autonomy, and human-centered development.

The long-term sustainability of AI in education will ultimately depend on achieving a careful balance—leveraging technological innovation while preserving the normative foundations of academic life. Only through this equilibrium can AI become a transformative force that advances, rather than compromises, the mission of education.

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DIGITAL AUTHENTIC MATERIALS AS A MEANS OF FORMING THE SOCIOLINGUISTIC COMPONENT OF PROFESSIONAL COMPETENCE OF FUTURE FOREIGN LANGUAGE TEACHERS

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Abstract

The internationalization of higher education has strengthened the demand for foreign language teachers who are capable of context-sensitive and culturally appropriate communication. Within professional training, sociolinguistic competence constitutes a significant component of professional competence, as it regulates language use in accordance with social norms, pragmatic conventions, and institutional roles. Nevertheless, its systematic formation in teacher education remains insufficiently structured.

This study explores the didactical potential of digital authentic materials as a means of developing the sociolinguistic component of professional competence in future foreign language teachers. The article examines how engagement with naturally occurring digital discourse provides exposure to real communicative practices, including register variation, discourse conventions, and culturally embedded language use. Particular attention is given to the pedagogical mechanisms through which authentic digital interaction promotes pragmatic awareness, contextual sensitivity, and professional communicative adaptability.

A structured conceptual framework for integrating digital authentic materials into higher education is proposed. The framework is based on staged engagement with authentic discourse and emphasizes analytical reflection, contextual application, and reflective consolidation. The study argues that digital authentic materials should function as a systematic pedagogical instrument rather than supplementary content, contributing to the formation of sociolinguistically appropriate professional communication in future foreign language teachers.

Keywords: *sociolinguistic competence, authenticity, digital authentic materials (DAM), intercultural discourse, professional competence, foreign language teacher education, context-sensitive communication.*

Introduction

The transformation of higher education under conditions of globalization, digitalization, and intensified intercultural interaction has substantially reshaped the professional profile of foreign language teachers. Contemporary educational systems require specialists who are capable not only of linguistic accuracy but also of socially appropriate, context-sensitive, and culturally responsive communication. In multilingual academic and professional environments, effective interaction depends on the ability to interpret social roles, institutional hierarchies, and culturally embedded discourse conventions. Consequently, the preparation of future foreign language teachers increasingly involves the development of competences that extend beyond grammatical knowledge toward socially meaningful communication.

Within this context, sociolinguistic competence represents a crucial dimension of professional competence. It regulates language use in accordance with pragmatic norms, register variation, and culturally conditioned expectations, ensuring that communicative behavior corresponds to specific social contexts. However, despite its acknowledged importance, the systematic formation of sociolinguistic competence in teacher education remains insufficiently structured. Research in language pedagogy frequently addresses authenticity, intercultural communication, and professional competence as related yet separate domains. Limited attention has been given to the theoretical justification of digital authentic materials (DAM) as an integrated pedagogical instrument specifically aimed at fostering the sociolinguistic dimension of professional competence in future teachers. This methodological fragmentation indicates a clear research gap.

The aim of this study is to theoretically substantiate the didactical potential of digital authentic materials as a means of forming the sociolinguistic component of professional competence in future foreign language teachers.

To achieve this aim, the study pursues the following objectives:

- *to examine the role of sociolinguistic competence within the structure of professional teacher education;*
- *to analyze the pedagogical characteristics of digital authentic discourse in higher education contexts;*
- *to identify the didactical mechanisms through which authentic digital interaction supports sociolinguistically appropriate communication;*
- *to develop a conceptual framework for the structured integration of digital authentic materials into teacher training.*

Sociolinguistic competence in the structure of professional competence

The emergence of sociolinguistic competence as a distinct construct is closely connected with the evolution of communicative approaches in language education during the late twentieth century. The shift from structuralist models of language toward communicative paradigms led to the recognition that linguistic accuracy alone does not guarantee effective communication. Scholars increasingly emphasized the social dimension of language use, arguing that communicative success depends on the ability to adapt discourse to contextual and sociocultural parameters. Consequently, sociolinguistic competence was conceptualized as an essential component of communicative competence, reflecting the interdependence of language and society.

Historically, the development of sociolinguistic competence is rooted in the understanding that language functions within specific communities governed by norms of politeness, register conventions, institutional hierarchies, and culturally embedded expectations. As global mobility and intercultural communication intensified, the relevance of socially appropriate language use became particularly evident in professional domains, including education. In teacher preparation, the ability to navigate these sociocultural variables became increasingly important, as foreign language teachers operate within diverse academic, institutional, and intercultural environments.

In order to conceptualize sociolinguistic competence within the structure of professional competence, it is essential to examine how this construct is defined in contemporary research. Different scholars emphasize complementary aspects of this competence, highlighting its social, pragmatic, and contextual dimensions (see table 1).

Table 1.

Definitions of sociolinguistic competence

<i>Author</i>	<i>Definition</i>
<i>Council of Europe</i>	<i>Sociolinguistic competence refers to the knowledge and skills required to use language appropriately in accordance with social conventions, including norms of politeness, register variation, and institutional expectations [1].</i>
<i>Béřešová</i>	<i>Sociolinguistic competence involves the ability to interpret culturally marked expressions and adapt linguistic choices to social parameters. It operates at the intersection of language and society, determining not only what can be said, but how, when, and to whom it should be said [2].</i>
<i>McConachy</i>	<i>Sociolinguistic competence involves awareness of form–function–context relationships in intercultural communication, enabling individuals to interpret and produce language in ways that are socially and culturally appropriate [3].</i>

As reflected in these definitions, sociolinguistic competence consistently involves the alignment of linguistic choices with contextual and sociocultural variables. It extends beyond structural knowledge and focuses on the appropriateness of communication within specific social environments. Thus, it mediates between language as a formal system and language as socially embedded practice.

Within the structure of professional competence of future foreign language teachers, sociolinguistic competence performs a regulatory and integrative role. While linguistic competence provides grammatical and lexical resources, and methodological competence organizes instructional processes, sociolinguistic competence determines how these resources are used in real professional contexts. Without it, communication may remain linguistically accurate yet socially inappropriate.

In teacher education, this component acquires particular significance because professional activity in the field of foreign language teaching is inherently communicative and socially situated. Future teachers engage in academic discourse, institutional interaction, intercultural dialogue, and classroom communication. In each of these contexts, effectiveness depends not solely on linguistic accuracy but on the ability to adapt language to contextual and sociocultural parameters.

Based on contemporary research, sociolinguistic competence within professional teacher education may be described through several interrelated components:

1. **Register awareness** - the ability to adjust linguistic formality and style according to social and institutional context [1].
2. **Pragmatic sensitivity** - understanding speech acts, politeness strategies, and implicit meaning in interaction [3].
3. **Sociocultural knowledge** - awareness of cultural norms and discourse conventions shaping communication [1].
4. **Contextual adaptability** - flexible modification of communicative behavior in diverse social environments [3].

These components collectively ensure that linguistic knowledge is transformed into socially appropriate professional interaction. Within foreign language teacher education, they contribute not only to communicative effectiveness but also to the formation of professional identity and pedagogical credibility. Therefore, sociolinguistic competence should be regarded as a dynamic and context-dependent dimension of professional competence, requiring systematic development within higher education. Therefore, sociolinguistic competence should be conceptualized as an integral structural element of professional competence. It transforms linguistic knowledge into socially meaningful professional interaction, supports the development of communicative credibility, and ensures readiness for authentic engagement in diverse institutional and intercultural environments.

Digital authentic materials in language education

The concept of authenticity has long occupied a central position in language pedagogy, reflecting the need to expose learners to naturally occurring language rather than exclusively pedagogically constructed input. In contemporary educational contexts, this notion has expanded into the domain of digital communication, giving rise to the use of digital authentic materials as a means of integrating real-world discourse into instructional practice. While the term "digital authentic materials" is relatively recent, it is grounded in earlier theoretical understandings of authenticity in language education.

The following table summarizes representative definitions of authentic materials that form the conceptual basis for digital authentic resources (see table 2).

Table 2.

Definitions of authentic materials in language education

Author	Definition
Gilmore	Authentic materials are texts created by native speakers for real communicative purposes rather than instructional design, reflecting natural language use in real contexts [4].
Breen	Authenticity involves exposure to genuine language use representing real social interaction rather than simplified pedagogical input [5].
Nunan	Authentic materials are spoken or written texts not specifically produced for teaching but used to bring real-world communication into the classroom [6].
Bé-rešová	Authentic materials expose learners to culturally embedded and naturally occurring language patterns, supporting sociocultural understanding [2].
Tomlinson	Authentic input consists of language used in real communicative situations, offering meaningful exposure beyond textbook constructions [7].

In digital environments, authenticity is realized through multimodal formats and interactive platforms. Digital authentic materials may include online interviews, podcasts, webinars, news articles, social media communication, institutional websites, academic discussions, video blogs, and corpus-based data. Unlike traditional print texts, digital resources are dynamic, multimodal, and frequently updated, providing learners with immediate access to contemporary discourse.

Several characteristics distinguish DAM from conventional instructional content and explain their pedagogical value in foreign language teacher education.

First, digital authentic materials reflect **natural sociolinguistic variation**. Unlike textbook dialogues that often present standardized and simplified language, authentic digital discourse demonstrates real register shifts, spontaneous discourse markers, pragmatic softening devices, idiomatic expressions, and culturally embedded references. Learners are exposed to language as it functions in authentic social contexts, including institutional communication, informal interaction, and professional discourse. This exposure develops sensitivity to contextual appropriateness and sociolinguistic nuance.

Second, such materials present language in **contextually rich and socially meaningful environments**. Communication is embedded within identifiable social roles, power relations, and communicative purposes. For example, an academic webinar, an institutional email, or a social media debate illustrates how language is shaped by audience, hierarchy, and communicative intention. This contextualization

supports the development of pragmatic awareness and helps learners understand how meaning is negotiated within specific sociocultural frameworks.

Third, DAM are characterized by **multimodality**. They combine verbal, visual, and auditory elements, including tone of voice, facial expressions, gestures, layout design, and digital formatting. These multimodal cues contribute to meaning construction and allow learners to interpret implicit pragmatic signals that cannot be conveyed through written text alone. As a result, communicative competence develops in a more holistic and socially realistic manner.

Fourth, DAM enable **interactive engagement**. Online platforms often allow commenting, responding, sharing, and participation in discourse communities. This interactive dimension transforms learners from passive recipients of information into active participants in communication. In teacher education, such engagement fosters professional adaptability and prepares future teachers to navigate authentic communicative environments.

Together, these characteristics position digital authentic materials as a powerful instrument for developing sociolinguistic competence within professional training.

Digital authentic materials perform **several interrelated didactic functions** in foreign language education, particularly in the formation of sociolinguistic competence.

First, they serve an **exposure function**, providing learners with access to naturally occurring language use beyond pedagogically simplified input. Authentic discourse reflects real register variation, pragmatic conventions, and discourse organization typical of actual communicative settings [8]. This exposure allows learners to observe how language operates within social contexts and professional environments.

Second, DAM perform a **contextualization function**. Language is presented within identifiable communicative situations shaped by social roles, institutional norms, and cultural expectations. Such contextual embedding supports the development of sociolinguistic appropriateness and awareness of social conventions.

Third, they fulfill a **pragmatic development function**, fostering learners' ability to interpret speech acts, politeness strategies, and implicit meanings in discourse. Engagement with authentic interaction promotes awareness of form–function–context relationships and intercultural dimensions of communication.

Fourth, DAM carry a **motivational and engagement function**. Real-world content increases learner involvement and perceived relevance, as students recognize the authenticity of communicative situations [7, p. 109].

Finally, in teacher education, digital authentic materials perform a **professionalization function**. They prepare future foreign language teachers to navigate authentic academic, institutional, and intercultural discourse, thereby strengthening the sociolinguistic component of professional competence.

Thus, digital authentic materials represent not merely technological tools but structured pedagogical resources capable of fostering context-sensitive and professionally relevant communicative development.

Didactic mechanisms of forming the sociolinguistic component through DAM

The formation of the sociolinguistic component of professional competence through digital authentic materials is realized through several interrelated pedagogical mechanisms. These mechanisms are grounded in the understanding that sociolinguistic competence develops through meaningful engagement with socially situated discourse.

First, DAM ensure **contextualized exposure to real communicative practices**. Unlike pedagogically simplified texts, authentic digital discourse reflects natural register variation, politeness conventions, and institutional communication patterns [8]. Such exposure enables learners to observe how language functions within specific social roles and communicative settings, thereby fostering awareness of contextual appropriateness.

Second, DAM support **analytical reflection on sociocultural meaning**. Through guided discourse analysis, learners examine how linguistic forms correspond to communicative intentions and sociocultural variables. This process strengthens understanding of form–function–context relationships and promotes pragmatic sensitivity in intercultural interaction [3].

Third, digital environments facilitate **context-sensitive application**. Engagement with authentic online interaction, such as academic webinars, institutional communication, or social media discourse, allows future teachers to practice adapting language to audience, hierarchy, and professional context. This experiential dimension contributes to the development of communicative flexibility and professional identity.

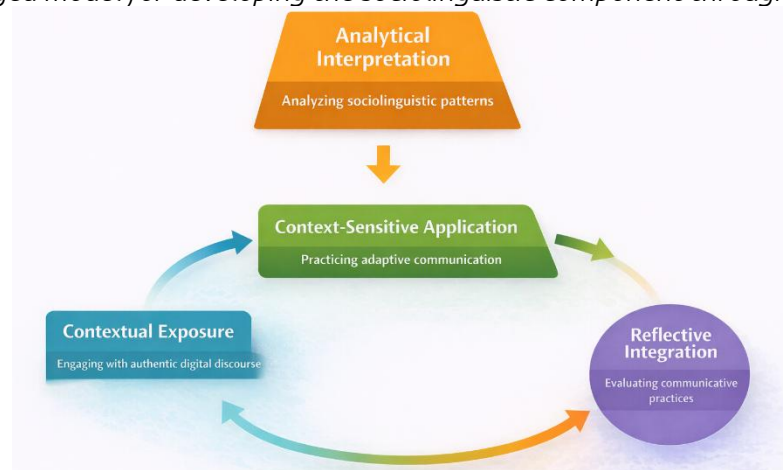
Finally, digital authentic materials enhance **motivation and engagement**, increasing learners' perception of relevance and authenticity in language learning [7]. As a result, they function not merely as supplementary resources but as structured pedagogical instruments for cultivating sociolinguistically appropriate professional communication.

Conceptual framework for higher education implementation

The integration of digital authentic materials into higher education requires a structured and theoretically grounded framework to ensure systematic development of the sociolinguistic component of professional competence. The proposed conceptual framework is based on the principle that sociolinguistic competence develops progressively through meaningful engagement with socially situated discourse and guided pedagogical mediation (see picture 1).

Picture 1.

Staged model for developing the sociolinguistic component through DAM



The first stage involves **contextual exposure**, where students interact with diverse forms of authentic digital discourse, including academic webinars, institutional communication, multimedia interviews, and professional online discussions. At this stage, learners observe register variation, discourse conventions, and pragmatic strategies in real communicative environments. The primary objective is to develop sensitivity to contextual norms and sociocultural patterns of language use [8].

The second stage focuses on **analytical interpretation**. Through structured tasks such as discourse analysis, comparison of communicative scenarios, and identification of pragmatic markers, students examine how linguistic forms correspond to social variables, including status relations, professional hierarchy, and institutional expectations. This stage strengthens awareness of form–function–context relationships and supports reflective understanding of sociolinguistic appropriateness [3].

The third stage emphasizes **context-sensitive application**. Students engage in role-based simulations, scenario-based professional tasks, and guided online interaction, requiring them to adapt language to specific audiences and communicative contexts. This stage operationalizes sociolinguistic competence in professional practice [7].

Finally, the framework incorporates **reflective integration**, where learners evaluate their communicative choices and analyze sociocultural implications of discourse strategies. Such reflection consolidates learning outcomes and supports the formation of professional communicative identity [1].

Through this staged implementation, digital authentic materials become a systematic pedagogical instrument for developing sociolinguistically appropriate professional communication in future foreign language teachers.

Conclusion

Sociolinguistic competence constitutes a central and integrative component of professional competence in foreign language teacher education, as it regulates context-sensitive and culturally appropriate communication within academic, institutional, and intercultural environments. The present study has demonstrated that digital authentic materials provide access to naturally occurring discourse, thereby creating pedagogically meaningful conditions for the systematic development of sociolinguistic awareness. Through exposure to real register variation, pragmatic conventions, and socially embedded language practices, future teachers acquire the ability to align linguistic choices with contextual and professional demands.

When purposefully and structurally integrated into higher education, digital authentic materials facilitate not only contextual exposure but also analytical reflection and context-based professional

application. This staged implementation strengthens the connection between linguistic form and social function, supporting the formation of communicative flexibility and professional identity. Therefore, digital authentic discourse should be regarded not as supplementary content but as a structured didactical mechanism that enhances the sociolinguistic dimension of professional training and contributes to the preparation of contextually competent and culturally responsive foreign language teachers.

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Philological sciences

WHO SPEAKS FOR KNOWLEDGE? EPISTEMIC AUTHORITY AND DISCURSIVE AGENCY IN AI-MEDIATED ACADEMIC WRITING

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Abstract

The integration of artificial intelligence (AI) in academic writing is reshaping knowledge production and authorship practices. While prior research emphasizes efficiency and ethical concerns, less attention has been given to how AI affects epistemic authority and discursive agency. Using Critical Discourse Analysis and epistemic stance theory, this study examines AI as a discursive actor, analyzing 12 academic texts that explicitly disclose AI assistance. Findings reveal that AI redistributes epistemic authority through epistemic delegation, agency backgrounding, and modulation of certainty, highlighting ideological implications for knowledge legitimation. This study provides a framework for understanding hybrid human–AI authorship as a site of negotiation rather than neutral technological assistance (Hyland, 2005; Latour, 2005; Bourdieu, 1991).

Keywords: *epistemic authority, discursive agency, AI-mediated writing, academic discourse, critical discourse analysis*

1. Introduction

The rapid integration of artificial intelligence (AI) into academic writing practices represents one of the most significant transformations in contemporary knowledge production. From grammar correction and paraphrasing tools to large language models capable of drafting literature reviews and synthesizing arguments, AI systems are increasingly embedded in scholarly workflows. This development has prompted extensive debates concerning academic integrity, plagiarism, authorship transparency, and pedagogical adaptation (Bearman, Ryan, & Ajjawi, 2023). However, while much of the existing scholarship focuses on ethical regulation and institutional policy, comparatively limited attention has been paid to the discursive implications of AI-mediated writing.

Academic writing is not merely a neutral channel for conveying information; it is a socially regulated practice through which knowledge is constructed, legitimized, and circulated. As Foucault (1969) argues, knowledge and power are inseparable within discursive formations that define what can be said, who is authorized to speak, and under what conditions statements are recognized as true. In this sense, epistemic authority is not an inherent quality of individuals or technologies but a product of historically situated discursive regimes. Academic discourse operates through established conventions—citation, hedging, evidentiality, and evaluative stance—that function as mechanisms for constructing credibility and signaling disciplinary alignment (Hyland, 2005; Biber & Finegan, 1989).

These conventions presuppose a human author who can assume responsibility for knowledge claims. The traditional academic model situates the author as the epistemic agent who synthesizes evidence, interprets findings, and articulates arguments within recognized disciplinary norms. Bourdieu (1991) conceptualizes such authority as symbolic capital accumulated through institutional recognition and peer validation. However, the introduction of AI into this system complicates these assumptions. AI-generated text is produced through probabilistic pattern recognition rather than disciplinary reasoning or experiential expertise. Yet, when integrated into academic writing, these outputs often conform to the rhetorical and stylistic conventions that signal epistemic credibility.

This creates a fundamental discursive tension: while institutional frameworks continue to attribute epistemic responsibility to human authors, the linguistic realization of knowledge claims may increasingly be shaped by algorithmic systems. As Latour (2005) suggests in Actor-Network Theory, knowledge production emerges from networks of both human and non-human actors. AI tools, although lacking intentionality, participate materially and semiotically in the construction of academic texts. Their influence

becomes visible in patterns of modality, attribution, and stance, raising critical questions about the distribution of discursive agency.

Furthermore, AI-mediated writing may subtly recalibrate norms of certainty and objectivity. Research on stance and evaluation demonstrates that modality choices—such as hedging versus assertive predicates—play a crucial role in constructing epistemic positioning (Martin & White, 2005). If AI systems systematically favor certain linguistic patterns, they may indirectly influence how confidence, neutrality, and authority are expressed. Such shifts have implications not only for stylistic conventions but also for broader ideological constructions of knowledge and legitimacy.

Despite the urgency of these concerns, existing studies largely treat AI as a technical instrument external to discourse rather than as a participant within it (Selwyn, 2014). This instrumental framing risks obscuring how AI reshapes the very discursive mechanisms through which authority is enacted. Understanding AI-mediated writing therefore requires moving beyond questions of efficiency and ethics to examine how epistemic authority is linguistically negotiated in hybrid human–algorithm assemblages.

This study addresses this gap by analyzing AI-mediated academic texts through the lens of Critical Discourse Analysis and epistemic stance theory. It conceptualizes AI not as an autonomous knower but as a discursive actor whose presence is constituted through language practices. The central research questions guiding this study are:

How is epistemic authority discursively constructed in AI-mediated academic writing?

How is discursive agency distributed between human authors and AI systems?

How do modality, stance, and attribution practices shift under algorithmic mediation?

What ideological assumptions about objectivity, responsibility, and knowledge are naturalized in AI-mediated discourse?

By addressing these questions, the article contributes to discourse studies in three key ways. First, it extends theories of epistemic authority by examining how authority is redistributed in hybrid authorship contexts. Second, it offers a discourse-analytic framework for conceptualizing AI as a non-human discursive participant. Third, it foregrounds the ideological dimensions of AI integration in academic writing, positioning algorithmic mediation as a site of negotiation rather than neutral assistance.

In doing so, the study situates AI-mediated academic writing within broader transformations of knowledge production in the digital age. Understanding who speaks for knowledge in these contexts is not merely a technical or ethical issue; it is a fundamentally discursive question that challenges established assumptions about authorship, credibility, and accountability in contemporary scholarship.

2. Theoretical Framework

2.1 Epistemic Authority

Epistemic authority is socially and institutionally sanctioned credibility in knowledge production (Bourdieu, 1991; Jäger, 2024). Academic writers employ stance, hedging, and citation to signal expertise and align with disciplinary norms (Biber & Finegan, 1989). AI participation disrupts these mechanisms by generating text without epistemic intent, introducing ambiguity in authority attribution.

2.2 Discursive Agency

Discursive agency is the capacity to influence meaning within texts (Goffman, 1981; van Leeuwen, 2008). Traditionally, authors act as animator, author, and principal. In AI-mediated writing, agency is distributed: algorithms propose content, but humans curate, edit, and assume responsibility, creating hybrid forms of authorship.

2.3 Non-Human Actors

Actor-Network Theory (Latour, 2005) frames AI as a non-human participant shaping knowledge materially and semantically. Its agency is realized through textual effects rather than intentional action, making hedging, modality, and attribution key sites for observing negotiated authority.

3. Methodology

This study adopts a qualitative research design grounded in Critical Discourse Analysis (CDA) to examine how epistemic authority and discursive agency are negotiated in AI-mediated academic writing. The choice of a qualitative approach is justified by the study's focus on micro-level linguistic features and their ideological implications. Since epistemic authority is constructed through subtle discursive mechanisms—such as modality, attribution, and stance—it requires interpretive, context-sensitive analysis rather than purely quantitative measurement (van Dijk, 1997).

Critical Discourse Analysis provides an appropriate analytical framework because it conceptualizes discourse as a social practice embedded in power relations and institutional structures (Foucault, 1969). CDA enables the examination of how linguistic forms participate in the reproduction or transformation of epistemic authority within academic contexts. By foregrounding the relationship between language,

ideology, and institutional norms, CDA allows this study to move beyond surface-level textual description toward an analysis of how AI-mediated writing reshapes knowledge legitimization processes (Koller, n.d.).

3.1 Research Design and Rationale

The research design is exploratory and interpretive. Given that AI-mediated academic writing is an emerging phenomenon, there is limited established methodology specifically tailored to this context. Therefore, the study integrates insights from stance analysis (Hyland, 2005), appraisal theory (Martin & White, 2005), and social actor theory (van Leeuwen, 2008) to construct a multi-layered analytical model.

The integration of these approaches ensures theoretical triangulation:

Stance theory allows analysis of epistemic positioning and degrees of certainty.

Appraisal theory provides tools for examining evaluation and alignment.

Social actor representation clarifies how agency is foregrounded or backgrounded.

Actor-Network Theory (Latour, 2005) supports the conceptualization of AI as a non-human participant within discourse networks.

This multi-theoretical framework enhances analytical depth and prevents reductionist interpretations of AI as merely a tool.

3.2 Data Selection and Corpus Construction

The corpus consists of 12 academic texts (approximately 65,000 words) that explicitly disclose the use of AI tools in drafting, editing, or structuring the manuscript. The inclusion criteria were:

Explicit acknowledgment of AI assistance in the methodology, acknowledgments, or footnotes.

Publication in peer-reviewed journals, preprint platforms, or institutional repositories.

Representation of multiple disciplines (social sciences, linguistics, and education).

English-language academic format adhering to standard scholarly conventions.

The purposive sampling strategy was selected to ensure analytical relevance rather than statistical representativeness. Since the research question concerns discursive construction, the presence of explicit AI disclosure was essential for identifying sites of agency negotiation.

The relatively moderate corpus size allows for in-depth micro-analysis while still enabling cross-textual comparison to identify recurring discursive patterns.

3.3 Analytical Categories

The analytical framework is structured around three interrelated dimensions:

1. Epistemic Authority Construction

This dimension examines how knowledge claims are linguistically framed. Particular attention is paid to:

Hedging devices (e.g., may, might, suggests),

Assertive predicates (e.g., demonstrate, confirm),

Citation practices,

Evidentiality markers.

The analysis draws on Biber and Finegan's (1989) framework for stance marking and Hyland's (2005) model of metadiscourse.

2. Discursive Agency Allocation

This dimension investigates how agency is distributed between human authors and AI systems. Linguistic strategies analyzed include:

Active vs. passive constructions,

Agent deletion,

Nominalization,

Strategic acknowledgment of AI tools.

Van Leeuwen's (2008) social actor framework is used to categorize inclusion, exclusion, and backgrounding strategies.

3. Modality and Stance Negotiation

This dimension focuses on how certainty, evaluation, and authorial positioning are expressed. Appraisal theory (Martin & White, 2005) informs the examination of engagement and graduation resources that calibrate epistemic commitment.

These three dimensions collectively enable identification of how epistemic authority is redistributed and how hybrid authorship is linguistically managed.

3.4 Analytical Procedure

The analysis proceeded in four stages:

Stage 1: Initial Coding

Texts were manually coded for:

*Explicit AI mentions,
Modal verbs and epistemic predicates,
Attribution patterns,
Passive constructions and nominalizations.*

Open coding allowed for emergent categories such as “epistemic delegation” and “managed acknowledgment.”

Stage 2: Micro-Level Clause Analysis

Selected sentences were analyzed at clause level to identify:

Agency configuration,

Stance intensity,

Responsibility allocation.

Particular attention was given to sentences where AI involvement was explicitly or implicitly referenced.

Stage 3: Cross-Textual Comparison

Patterns were compared across disciplines to identify:

Recurring discursive strategies,

Variations in hedging norms,

Differences in AI disclosure practices.

Stage 4: Theoretical Interpretation

Findings were interpreted through the integrated theoretical framework, linking linguistic patterns to broader ideological and institutional dynamics.

3.5 Validity, Reliability, and Reflexivity

To enhance methodological rigor, several strategies were employed:

Theoretical triangulation: Multiple discourse frameworks were combined to cross-validate interpretations.

Iterative coding: Categories were refined through repeated reading of the corpus.

Analytical transparency: Coding decisions were documented systematically.

Peer review of interpretations: Selected excerpts were independently reviewed to minimize subjective bias.

Reflexivity was particularly important given the topic. Since AI tools are themselves part of contemporary academic workflows, the researcher maintained transparency regarding analytical procedures and avoided delegating interpretive tasks to AI systems during coding. This precaution ensured that the analysis remained grounded in human interpretive judgment.

3.6 Ethical Considerations

Ethical principles included:

Respecting authorial anonymity where drafts were unpublished.

Avoiding identification of specific journals or institutions.

Framing findings in a structural and discursive manner rather than evaluating individual authors.

The study does not aim to criticize AI use but to critically examine its discursive implications within academic knowledge production.

4. Analysis and Results

4.1 Epistemic Delegation

AI-mediated texts frequently assign responsibility to abstract processes rather than explicit authors, allowing epistemic delegation while maintaining credibility. For instance, sentences like “The initial draft was generated using AI and refined by the author” foreground human oversight while acknowledging AI contribution.

4.2 Modality Adjustment

AI-assisted formulations favor assertive predicates (e.g., demonstrate) and reduce hedging, enhancing perceived certainty (Biber & Finegan, 1989). This subtle recalibration aligns with academic norms, projecting authority in hybrid authorship.

4.3 Agency Negotiation

Authors strategically background AI using passivization and selective acknowledgment. For example, curatorial phrasing positions the human author as decision-maker while AI provides preliminary content, exemplifying distributed agency (Van Leeuwen, 2008; Latour, 2005).

4.4 Cross-Textual Patterns

Three patterns emerge across disciplines:

Epistemic Delegation: Responsibility assigned to abstract processes.

Modality Enhancement: Reduction of hedging and increased assertiveness.

Agency Negotiation: AI participation minimized or backgrounded.

These patterns indicate that AI reshapes micro-linguistic mechanisms of authority and credibility in academic texts.

5. Ideological Implications

AI-mediated writing naturalizes algorithmic authority, normalizing technical outputs as credible knowledge (Pérez-Urbina, 2025; Mollema, 2025). It redistributes human agency, creating hybrid authorship models, and recalibrates disciplinary norms concerning certainty and objectivity. These shifts challenge conventional assumptions about accountability, evaluative judgment, and authorship legitimacy (Kelly, 2025; Selwyn, 2014).

6. Conclusion and Future Directions

AI participation in academic writing is not merely technical—it actively reconfigures epistemic authority and discursive agency. By influencing hedging, modality, and attribution, AI shapes knowledge legitimation and redistributes responsibility across human–algorithm networks.

Future research should explore:

- *Longitudinal studies of AI-mediated discourse evolution.*
- *Comparative cross-disciplinary analyses of authority negotiation.*
- *Pedagogical and ethical implications for emerging scholars.*

Recognizing AI as a discursive actor highlights the social, ideological, and epistemological dimensions of contemporary knowledge production.

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IDEOLOGICAL AND CONTENT FEATURES OF DOHA ASSI'S CREATIVITY

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ИДЕЙНО-СОДЕРЖАТЕЛЬНЫЕ ОСОБЕННОСТИ ТВОРЧЕСТВА ДОХИ АССИ

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Abstract

Doha Assy (b. 1970, Egypt) is one of the prominent figures of 21st-century Egyptian literature. She began her literary career writing short stories for periodicals and is the author of story collections such as «A Cup of Coffee» (2007) and «Supermarket Happiness» (2009). She later transitioned to writing longer works, and her novels «104 Cairo» (2016) and «French Clouds» (2019) brought her widespread recognition. In addition to her literary career, she is also active in politics and has served as a member of the Egyptian Parliament since the 2020 elections.

The main agenda of Doha Assy's work consists of the socio-political realities of Egyptian society, socio-economic problems, and interreligious and intercultural conflicts.

Аннотация

Доха Асси (род. 1970, Египет) — одна из видных фигур египетской литературы XXI века. Свою литературную карьеру она начала с написания рассказов для периодических изданий и является автором таких сборников рассказов, как «Чашечка кофе» (2007) и «Его величество супермаркет» (2009). Позже она перешла к написанию более объемных произведений, и ее романы «Каир 104» (2016) и «Французские облака» (2019) принесли ей широкое признание. Помимо литературной карьеры, она также активно участвует в политике и является членом египетского парламента с выборов 2020 года.

Основная тематика творчества Дохи Асси — социально-политические реалии египетского общества, социально-экономические проблемы, проблема гендерного неравенства, а также межрелигиозные и межкультурные конфликты.

Keywords: Arabic literature, Egyptian literature, Doha Assy, gender equality, 104 Cairo, French clouds

Ключевые слова: Арабская литература, Египетская литература, Доха Асси, гендерное равенство, Каир 104, Французские облака

Одним из авторов, чье имя вписано в историю египетской литературы XXI века, является Доха Мустафа Асси (1970, Египет). В настоящее время она, наряду с профессиональной писательской деятельностью, является также политическим деятелем и депутатом парламента Египта (по итогам выборов 2020 года).

Доха Асси является автором сборников рассказов «Чашечка кофе» (2007), «Его величество супермаркет» (2009), сборника публицистических статей «Суд над Мубараком» (2012), а также романов «Каир 104» (2016) и «Французские облака» (2019) [Assy, 2025].

Писательницу, которая признает, что вдохновлялась Наджибом Махфузом (1911-2006) при описании Египта и египтян [Дубровский, 2024], можно назвать последовательницей феминистской писательницы Наваль ас-Саадави (1931-2021) в том смысле, что она постоянно поднимает вопросы эмансипации женщин в своих произведениях. Феминистские настроения преобладают в произведениях писательницы «Каир 104», «Красота нашего солнца», «Ночь», «Моя страна, как ты прекрасна», «Свобода» и др. Доха Асси как в своих литературных произведениях, так и в публицистических статьях и политических речах постоянно выступает за отмену ранних браков, признание прав женщин на образование, труд и другие вопросы

гендерного равенства, подчеркивая проблемы женщин в современном египетском обществе и отношение к ним в семье.

Героини Асси — это женщины, которые знают свои права и достоинства, а также прилагают минимум усилий, чтобы их принимали другие. Они — это те, кто осознаёт понятие свободы, стремится к ней и достигает её. В этом отношении интересен сюжет рассказа автора «Свобода», полный глубоких смыслов [Асси, 2019]: однажды домашний кот убегает из дома. Маленькая девочка удивлена, что кот покинул дом, несмотря на все удобства, которые ему предоставлялись. Хозяйка дома представляет себе, что кот, который раньше ел и спал, подчиняясь приказам, теперь свободно бродит по улицам, и она прекрасно знает, насколько дорого и бесценно это чувство. Однако девочка этого не понимает и воспринимает как предательство. Женщина, которая много раз сталкивалась с предательством, также понимает эти чувства, которые ее дочь испытывает впервые. Таким образом, в некотором смысле она согласна со своей дочерью, которая хочет наказать кошку за это предательство. Действительно, предательство должно быть наказано. Обращая внимание на горькую жизнь египетских женщин, скованных запретами, автор завершает свой рассказ фразой «Измена должна быть наказана», подчеркивая, что в действительности наказываются не те, кто предает, а те, кто выбирает свободу. Таким образом, автор создает реалистичную картину социально-политической ситуации в Египте. Следует отметить, что египетская феминистская писательница Навал ас-Саадави также постоянно поднимала эту тему в своих произведениях, обращаясь к общественности с вопросом: «Почему женщину забивают камнями до смерти, а мужчину не наказывают, когда оба одинаково виновны в прелюбодеянии» [Алекперова, 2024; Ас-Саадави, 1991].

Произведение писательницы «Иной вкус смерти» посвящено другой проблеме, которая сегодня особенно актуальна на Арабском Востоке, — теме мигрантов. На примере образов своих героев, бегущих от нищеты и обосновывающихся в далёкой чужбине, Доха Асси повествует о трагедии арабских мусульманских мигрантов, которые из-за нескончаемых войн, экологических и экономических проблем на Востоке покидают родные места и выбирают будущее в никуда.

Роман Дохи Асси «Французские облака» можно считать удачным образцом исторического романа в египетской литературе XXI века, продолжающим традиции арабского исторического романа. События произведения разворачиваются на фоне реальных исторических событий, происходивших в Египте в конце XVIII — начале XIX веков. [Асси, 2019].

А роман «Каир 104» [Асси, 2024] можно назвать одним из лучших примеров гармоничного переплетения современных литературных тенденций с классическими традициями. «Каир 104» напоминает Каир Нагиба Махфуза, но в более мрачном, тревожном изображении, сродни Каиру Аля ал-Асуани, а главный образ произведения вызывает ассоциации с женскими героинями Наваль ас-Саадави.

События романа разворачиваются на фоне войн (арабо-израильские войны), политической напряжённости в Египте, забастовок, репрессий и экономических реформ. В галерее персонажей произведения преобладают женские образы: несмотря на принадлежность к разным социальным слоям, все они сталкиваются с одними и теми же проблемами, страдают от патриархальных традиций, господствующих в обществе, и стремятся от них освободиться. Писательница объединяет различные реальные женские судьбы в образе героини по имени Инширах.

Несбывшаяся мечта об образовании, пережитые измены и разочарования ввергают молодую девушку в состояние депрессии, которое её близкие воспринимают как колдовское заклинание. Психологические травмы героини пытаются излечить не с помощью медицины, а посредством заклинаний, и последним «средством», разумеется, считают замужество. Таким образом, Инширах выходит замуж за нелюбимого человека. Однако семейная жизнь не приносит ей женского счастья. Героиня, испытывающая проблемы в отношениях с мужем, впадает в глубокую депрессию и выходит из этого состояния только благодаря тому, что начинает заниматься гаданием, как её бабушка. Каждый раз знакомясь с новыми людьми, приходящими к ней за помощью, и помогая им решать их проблемы, она словно начинает ощущать себя нужной и сильной.

Героиня романа ощущает себя счастливой — именно этого и желает автор. Со стороны человек может казаться несчастным или выглядеть неудачником, но это неважно. Важно то, чтобы он сам чувствовал себя счастливым, ценным и нужным. Человек становится ценным, будучи хорошим родителем, мастером своего дела или верным другом. Послание писательницы

заключается в том, что каждый должен открыть в себе собственную силу и осознать свою жизненную миссию.

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GRAMMATICAL INNOVATIONS AND LANGUAGE CHANGE IN AZERBAIJANI AND TURKISH

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AZƏRBAYCAN VƏ TÜRK DILLƏRİNDƏ QRAMMATİK INNOVASİYALAR VƏ DİL DƏYİŞMƏSİ

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Abstract

This article examines grammatical innovations and processes of language change in Azerbaijani and Turkish through a comparative approach. The analysis shows that grammatical changes in both languages are mainly characterized by grammaticalization, an increasing tendency toward analyticity, and the expansion of the functional capacity of grammatical affixes. The social environment, language policy, and technological development play a significant role in shaping these innovations. The study concludes that grammatical innovations should not be viewed as a disruption of the language system but rather as a natural outcome of its adaptation to communicative and functional needs. The differences observed between Azerbaijani and Turkish are primarily explained by varying normative approaches and the degree of institutional control over language. The article emphasizes the importance of evaluating language change on a scientific basis and provides a theoretical framework for studying the future development of Turkic languages.

Xülasə

Bu məqalədə Azərbaycan və Türkiyə türkcəsində grammatik innovasiyalar və dil dəyişməsi prosesi müqayisəli şəkildə araşdırılmışdır. Təhlil göstərir ki, hər iki dildə grammatik dəyişmələr əsasən grammatikləşmə, analitiklik meylinin güclənməsi və şəkilçilərin funksional imkanlarının genişlənməsi ilə xarakterizə olunur. Sosial mühit, dil siyasəti və texnoloji inkişaf bu innovasiyaların formalaşmasında mühüm rol oynayır.

Araşdırma nəticəsində müəyyən edilmişdir ki, grammatik innovasiyalar dil sisteminin pozulması deyil, onun kommunikativ və funksional tələblərə uyğunlaşmasının təbii nəticəsidir. Azərbaycan və Türkiyə türkcəsi arasında mövcud fərqlər isə əsasən normativ yanaşmalar və dilə institusional nəzarətin dərəcəsi ilə izah olunur. Məqalə dil dəyişməsinin elmi əsaslarla qiymətləndirilməsinin vacibliyini vurğulayır və türk dillərinin gələcək inkişafının öyrənilməsi üçün nəzəri baza yaradır.

Аннотация

В статье рассматриваются грамматические инновации и процессы языковых изменений в азербайджанском и турецком языках с позиции сравнительного анализа. Показано, что грамматические изменения в обоих языках преимущественно проявляются в процессах грамматикализации, усилении аналитических тенденций и расширении функционального потенциала грамматических аффиксов. Существенное влияние на формирование данных инноваций оказывают социальная среда, языковая политика и технологическое развитие. В работе делается вывод о том, что грамматические инновации следует рассматривать не как нарушение языковой системы, а как естественный результат её адаптации к коммуникативным и функциональным потребностям. Различия между азербайджанским и турецким языками в основном обусловлены особенностями нормативных подходов и уровнем институционального регулирования языка. Подчеркивается необходимость научной оценки языковых изменений и предлагается теоретическая база для исследования перспектив развития тюркских языков.

Keywords: Language change, grammatical innovation, Azerbaijani language, Turkish, grammaticalization

Açar sözlər: Dil dəyişməsi, grammatik innovasiya, Azərbaycan dili, Türkiyə türkcəsi, grammatikləşmə

Giriş

Dil canlı və dinamik bir sistemdir; cəmiyyətin sosial quruluşu, mədəni dəyərləri, texnoloji inkişafı və siyasi prosesləri ilə paralel şəkildə daim dəyişir. Türk dilləri ailəsinə daxil olan Azərbaycan və Türkiyə türkcəsi uzun tarixi inkişaf yolu keçmiş, bu müddət ərzində fonetik, leksik və xüsusilə qrammatik səviyyədə mühüm dəyişikliklər yaşamışdır. Qrammatik innovasiyalar dilin daxili imkanları hesabına yarandığı kimi, dil təması, standartlaşma siyasəti və üslubi ehtiyaclar nəticəsində də formalaşır. Bu məqalədə Azərbaycan və Türkiyə türkcəsində müşahidə olunan əsas qrammatik innovasiyalar, onların səbəbləri və dil dəyişməsi prosesində rolu müqayisəli şəkildə təhlil olunur.

Dil dəyişməsi dedikdə dil sistemində zamanla baş verən struktur və funksional yeniliklər nəzərdə tutulur. Bu dəyişmələr təsadüfi deyil, müəyyən qanunauyğunluqlara əsaslanır və sosial-mədəni mühitlə sıx bağlıdır. Müasir dilçilikdə dil dəyişməsi prosesi qrammatikləşmə, leksikləşmə, analitiklik və sintetiklik meyilləri, həmçinin normativləşmə anlayışları çərçivəsində izah edilir [Hopper & Traugott, 2003:178].

Qrammatikləşmə prosesi xüsusilə türk dilləri üçün səciyyəvidir. Bu prosesdə leksik vahidlər tədricən qrammatik funksiyalar qazanır və müstəqil semantik yükünü zəiflədir. Azərbaycan və Türkiyə türkcəsində köməkçi fellərin, modal sözlərin və bəzi şəkilçilərin bu yolla formalaşması müşahidə olunur. Dil dəyişməsinin digər mühüm mexanizmi analitiklik meylidir ki, bu da mürəkkəb sintetik formaların sadə sintaktik konstruksiyalarla əvəzlənməsinə gətirib çıxarır.

Dil dəyişməsi həm daxili, həm də xarici amillərin təsiri ilə baş verir. Daxili amillərə dil sisteminin öz inkişaf məntiqi, xarici amillərə isə dil təması, çoxdillilik, kütləvi informasiya vasitələri və dil siyasəti daxildir. Bu baxımdan Azərbaycan və Türkiyə türkcəsi oxşar tarixi köklərə malik olsa da, fərqli sosial şəraitlərdə inkişaf etdiyindən qrammatik innovasiyaların intensivliyi və istiqaməti müəyyən fərqlər göstərir.

Azərbaycan dilçiliyində qrammatik innovasiyalar məsələsi bir sıra görkəmli alimlərin əsərlərində geniş şəkildə araşdırılmışdır. Akademik Məmmədəğa Şirəliyev Azərbaycan dilinin tarixi qrammatikasına dair tədqiqatlarında fel zamanlarının inkişafını və şəkilçilərin semantik dəyişməsinə dil dəyişməsinin əsas göstəricilərindən biri kimi qiymətləndirmişdir. O, xüsusilə keçmiş zaman formalarının funksional diferensiasiyasını qrammatik innovasiyanın təzahürü hesab edirdi.

Əbdüləzəl Dəmirçizadə müasir Azərbaycan dilində sintaktik quruluşun sadələşməsi və analitik konstruksiyaların artmasını dilin daxili inkişaf qanunauyğunluğu ilə əlaqələndirmişdir. Onun fikrincə, köməkçi fellərlə qurulan birləşmələrin geniş yayılması qrammatikləşmə prosesinin aktiv fazada olduğunu göstərir. [Dəmirçizadə, 1967:23]

Akademik Ağamusa Axundov Azərbaycan dilində morfoloji kateqoriyaların funksional genişlənməsini xüsusi vurğulamışdır. O, şəkilçilərin yalnız qrammatik deyil, eyni zamanda üslubi və modal cəhətlər də ifadə etməsini müasir dil inkişafının mühüm əlaməti kimi dəyərləndirmişdir.

Müasir dövrdə Abdulla Abdullayev və Bəxtiyar Xəlilov kimi dilçilər danışq dili ilə yazılı dil arasındakı qarşılıqlı təsiri araşdıraraq, qrammatik innovasiyaların normativ dilə keçid mexanizmlərini izah etmişlər. Onların tədqiqatlarında vurğulanır ki, sosial dəyişikliklər və kommunikativ ehtiyaclar yeni qrammatik formaların yaranmasını sürətləndirir.

Bu alimlərin yanaşmaları göstərir ki, Azərbaycan dilində qrammatik innovasiyalar sistemli xarakter daşıyır və dilin ümumi struktur inkişafına xidmət edir.

Türkiyə türkcəsində qrammatik innovasiyalar əsasən XX əsrdə aparılan dil islahatları ilə sistemli xarakter almışdır. Ərəb və fars mənşəli sintetik konstruksiyaların sadələşdirilməsi və türk dilinin daxili imkanları hesabına yeni formaların yaradılması bu dövrün əsas xüsusiyyətidir [Lewis, 1999:34]. Bu proses yalnız leksik sahədə deyil, qrammatik səviyyədə də özünü göstərmişdir.

Məsələn, köhnə osmanlı türkcəsində geniş yayılmış mürəkkəb zaman formaları müasir Türkiyə türkcəsində daha şəffaf analitik strukturlarla əvəz olunmuşdur. Xəbər şəkilçilərinin semantik yükünün artması, xüsusilə -dir şəkilçisinin ehtimal və ümumiləşdirmə mənalarında işlədilməsi qrammatik innovasiya kimi qiymətləndirilə bilər [Korkmaz, 2007:567].

Danışq dilində müşahidə olunan ixtisarlar və sadələşmələr də diqqətəlayiqdir. Şəxs və zaman göstəricilərinin kontekstdən asılı olaraq açıq ifadə olunmaması dilin kommunikativ səmərəliliyini artırır. Bu hal normadan kənarlaşma kimi deyil, funksional uyğunlaşma kimi izah olunur.

Bundan əlavə, Türkiyə türkcəsində modal mənaların getdikcə sintaktik vasitələrlə ifadə olunması müşahidə edilir. "Gerek", "lazım", "zorunda" kimi sözlərin köməkçi funksiya qazanması qrammatikləşmə prosesinin davam etdiyini göstərir.

Azərbaycan və Türkiyə türkcəsinin müqayisəli təhlili göstərir ki, hər iki dildə qrammatik innovasiyalar oxşar inkişaf istiqamətlərinə malikdir. Bu oxşarlıq, ilk növbədə, ortaq tarixi köklər və tipoloji

xüsusiyyətlərlə bağlıdır. Hər iki dildə şəkilçi sisteminin məhsuldarlığı qorunub saxlanılsa da, onların funksional yükündə dəyişikliklər baş verir.

Analitiklik meylinin güclənməsi hər iki dil üçün səciyyəvidir. Köməkçi fellərin və postpozisiyaların artan rolu sintaktik strukturların daha çevik olmasına şərait yaradır. Bununla yanaşı, bəzi şəkilçilərin polifunksional xarakter alması qrammatik sistemin iqtisadi işləməsinə xidmət edir. Məsələn, həm Azərbaycan, həm də Türkiyə türkcəsində zaman şəkilçiləri təkcə temporal deyil, modal və üslubi çalarlar da ifadə edir.

Fərqli cəhətlər əsasən normativ siyasət və dilə institusional nəzarət səviyyəsi ilə bağlıdır. Türkiyə türkcəsində rəsmi dil qurumlarının təsiri nəticəsində qrammatik normanın sabitliyi daha güclüdür. Azərbaycan dilində isə danışq dilində formalaşan yeniliklərin yazılı dilə keçidi daha sürətlə baş verir [Abdullayev, 2012:124]. Azərbaycan və Türkiyə dilçilik məktəblərində qrammatik innovasiyalar məsələsinə yanaşmalar bir sıra oxşar və fərqli cəhətlərə malikdir. Bu paralellik həm nəzəri çərçivədə, həm də tədqiqat metodlarında özünü göstərir.

Akademik Məmmədağa Şirəliyev Azərbaycan dilində qrammatik dəyişməni əsasən tarixi inkişaf kontekstində izah etmiş, şəkilçilərin semantik və funksional təkamülünü ön plana çıxarmışdır. Türkiyə dilçiliyində isə Zeynep Korkmaz oxşar şəkildə Türkiyə türkcəsində şəkilçi sisteminin məhsuldarlığını və funksional genişlənməsini vurğulamışdır [Korkmaz, 2007:743]. Hər iki alim qrammatik innovasiyaları dilin daxili inkişaf qanunauyğunluqları ilə əlaqələndirir.

Əbdüləzəl Dəmirçizadə Azərbaycan dilində analitiklik meylinin güclənməsini sintaktik innovasiya kimi qiymətləndirmişdir. Paralel olaraq, Geoffrey Lewis Türkiyə türkcəsində aparılan dil islahatlarının sintaktik sadələşməni sürətləndirdiyini qeyd edir və bu prosesi funksional uyğunlaşma kimi dəyərləndirir [Lewis, 1999:34].

Ağamusa Axundov şəkilçilərin üslubi və modal funksiyalar qazanmasını müasir Azərbaycan dilinin səciyyəvi xüsusiyyəti hesab etmişdir [Axundov, 2003:567]. Türkiyə dilçiliyində Tahsin Banguoğlu da oxşar mövqedən çıxış edərək, qrammatik formaların yalnız struktur deyil, kommunikativ funksiya daşdığını göstərmişdir [Banguoğlu, 2011:56].

Müasir dövrdə Abdulla Abdullayev və Bəxtiyar Xəlilov Azərbaycan dilində danışq dili ilə yazılı dil arasındakı qarşılıqlı təsiri araşdırmışlar [Abdullayev, 2012:165]. Türkiyə dilçiliyində isə Doğan Aksan danışq dilinin normativ dilə təsirini funksional dilçilik baxımından təhlil etmişdir. Bu tədqiqatlar göstərir ki, hər iki dildə qrammatik innovasiyaların əsas mənbəyi canlı ünsiyyət mühitidir. Bu paralel yanaşmalar Azərbaycan və Türkiyə türkcəsinin qrammatik inkişafının ortaq elmi əsaslara söykəndiyini və türk dilləri üçün ümumi dil dəyişməsi modellərinin mövcud olduğunu sübut edir.

Müasir dövrdə qrammatik innovasiyaların yaranmasında sosial və texnoloji amillərin rolu xüsusilə artmışdır. Kütləvi informasiya vasitələri, sosial şəbəkələr və rəqəmsal ünsiyyət formaları dilin strukturuna birbaşa təsir göstərir. Qısa və sürətli ünsiyyət tələbi sintaktik ixtisarlara və qeyri-tam cümlələrin artmasını stimullaşdırır.

Azərbaycan və Türkiyə türkcəsində internet ünsiyyətində müşahidə olunan qrammatik sadələşmələr tədricən gündəlik danışq dilinə də nüfuz edir. Bu proses dilin funksional sahələrinin genişlənməsi ilə əlaqədardır və müasir dilçilikdə təbii inkişaf mərhələsi kimi qiymətləndirilir.

Qrammatik innovasiyalarla normativ dil arasında münasibət daim müzakirə mövzusu olmuşdur. Bir tərəfdən, normativ qrammatika dilin sabitliyini qorumağa çalışır, digər tərəfdən isə canlı dil daim yeni formalar yaradır. Azərbaycan və Türkiyə türkcəsində bu tarazlıq fərqli şəkildə tənzimlənir. Azərbaycan dilində normativ qaydaların yenilənməsi prosesi nisbətən çevikdir və yeni qrammatik formaların qəbuluna açıqdır. Türkiyə türkcəsində isə normativ sistem daha konservativ xarakter daşıyır, lakin buna baxmayaraq, danışq dilində formalaşan innovasiyalar uzunmüddətli perspektivdə norma səviyyəsinə yüksələ bilər.

Nəticə

Aparılan təhlil göstərir ki, qrammatik innovasiyalar Azərbaycan və Türkiyə türkcəsinin inkişafında mühüm rol oynayır. Bu innovasiyalar dilin pozulması deyil, onun funksional imkanlarının genişlənməsi kimi dəyərləndirilməlidir. Dil dəyişməsi prosesi qaçılmazdır və əsas məsələ bu dəyişmələrin elmi şəkildə öyrənilməsi və sağlam normativ çərçivədə tənzimlənməsidir.

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Political sciences

DEVELOPMENT OF DIGITAL TECHNOLOGIES IN THE CONTEXT OF THE FORMATION OF A NEW FOREIGN POLICY STRATEGY OF KAZAKHSTAN

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Abstract

The article explores the role of digitalization in shaping the “New Kazakhstan.” Digital technologies are becoming a crucial driver of economic modernization, transparency in public governance, and human capital development. It is emphasized that digitalization fosters the creation of a competitive society based on innovation, openness, and sustainable development. The paper analyzes key directions of digital transformation, including e-government, digital infrastructure, IT sector growth, and the development of citizens’ digital competencies.

Keywords: digitalization, New Kazakhstan, innovation, public governance, sustainable development

Global Technological Transformation

Currently, states are striving to develop new digital technologies in the context of the transition to an information and communications society. This trend is the most prevalent in contemporary international relations. Digitalization has become a necessary component in the development strategy of all leading countries worldwide. Today, a country's level of development and its role in the international system depend on relevant knowledge and access to new digital technologies. Scientific and technological progress is a tool for human development, because at each stage of technological development, humanity transitions from one management method to new, more efficient ones. This can be illustrated by the transition from one energy source, more expensive and dirtier, to cleaner and more efficient ones, from heavier and more fragile materials to lighter, stronger, more flexible, and more durable ones, all while human knowledge, skills, and competencies grow and expand. Each stage of technological and social cycles triggers conflict between older generations and the work methods they used, and new generations, their new tools and methods. Then comes new growth, new jobs appear, production volumes increase, and the complexity of the work performed increases.

Technological Waves and Paradigm Shifts

Economist K. Perez in his book “Technological Revolutions and Financial Capital” notes that since the end of the 18th century, humanity has experienced five technological revolutions, each of which generated a technological wave, accompanied by the spread of the achievements of technological revolutions in the form of new equipment and technologies. The duration of each wave was approximately 50 years. This period is determined by the peculiarities of the functioning of the link between financial capital and the innovative capabilities of new technology. The exhaustion of a technological wave deprives the economy of development drivers and leads to a crisis, from which the economy emerges thanks to the next wave. According to K. Perez, “a change in the technological paradigm is necessarily accompanied by a change in the forms of financing and a change in social relationships of adequate innovations not only in the production sphere - in products and methods of organization, but also in finance and institutions” [1].

Technology as a Driver of Social Order

The Industrial Revolution creates not only new social relations and political institutions. It creates a new culture, a new world. How exactly technology determines social relations is determined by historical experience. Let us recall what enormous social changes were caused by such a small technical

innovation as the appearance of a stirrup on the side of a horse. It was the stirrup that made the rider stable in the saddle and determined the complete military superiority of the knight over the footsoldier. This led to the era of feudalism, the time of the reign of knights. The mechanism of action of the technological factor is as follows. A fundamental discovery gives a decisive advantage to the people "chosen by God", who begin a wave of military expansion. Peoples who do not want to become victims of the conqueror, copy their technology, infrastructure, crafts, industry. Then - customs, culture, social orders. The last technological revolution was associated with the invention of the microcircuit in 1961, on the basis of which modern television, mobile communications, personal computers and the Internet were created.

The essence of technological and economic changes, marking the transition to a new level of development, is as follows: a change in resources and tools at a person's disposal, a change in generations and their skills, abilities, and competencies. Now humanity is at the beginning of the fourth industrial revolution. This stage is characterized by the development of information technology, the penetration of the Internet into all spheres of the economy, the development of the ecosystem of the Internet of things and related artificial intelligence technologies. There are three categories of states. The first is the elite, those who create knowledge. The second are those who, based on new knowledge, create technologies for themselves and for the first group. The third are those who will provide the first two groups with resources: human, raw materials, energy. We need to decide where we are. Of course, we do not want to remain a raw materials appendage. But in order not to fall into technological slavery, we need to develop science, create technologies, and implement them in production. If earlier a billion people claimed the level of the European middle class, now there are already six billion. To ensure the growth of the standard of living of such a large number of people, fundamentally new methods of creating tools and producing energy are needed.

In addition, we must not forget about another important social phenomenon that the digital era provides. It provides greater transparency of the world, openness and accessibility of technologies, the possibility of obtaining any education, any consultation. In other words, anywhere in the world it will be possible to print a thing on a 3D printer and sell it through a global Internet platform.

Digitalization can make a breakthrough in economic development and become the main driver of growth. The 4th intelligent control element is being introduced. Man, gradually moved towards this. He converted documents into electronic form, learned to work with them, and now the stage of managing machines and production processes has come. The United States of America at one time officially proclaimed that additive manufacturing would be the tool for achieving global US superiority.

The Fourth Industrial Revolution and Digital Economy

In fact, additive manufacturing is the harbinger of a new technological revolution. These technologies provide thirty times the productivity advantage, in addition to huge savings in energy costs, in the use of material. In 2004, Facebook was registered, and in 2007, the iPhone appeared. These two events became catalysts for a whole series of technologies that bring efficiency to industrial capital.

Let's try to analyze these effects. The widespread use of information technology in working with logistics companies has led to the fact that the goods that the plant manufactures for the client are at the plant for forty minutes. As a result of changing production processes, Harley Davidson has reduced the production cycle from 21 days to six hours (every 89 seconds a motorcycle rolls off the assembly line, fully customized for its future owner). In industrial areas, communication between machines is expanding; machines report which consumables they are running low on, when repairs will be needed, how many parts will be manufactured in the next hour. Sensors and portable devices in many industries monitor the condition and location of equipment, where workers are located. Workers monitor the level of gas pollution in mines, and the optimization of repair crews.

The GLONASS system is coming into practice, when a car itself gives an alarm signal in case of an accident, soon gadgets will be installed in the fields that will monitor the state of the harvest. There is already a technology of virtual and augmented reality, when you can point a smartphone at a historical building and see what it was like a hundred years ago. Technologies called "product life cycle management" are appearing in design, when you can not only design a product, but also understand how long it will serve, which of its properties are costly, from the point of view of investments. New opportunities for companies are opening up big data processing technologies. Growing computer power allows us to process large amounts of data, predicting important business events. For example, seismic data processing helps oil companies predict oil migration and significantly increase the extraction coefficient. Real miracles await us with the development of so-called machine learning technologies, artificial intelligence and robotics [2].

Analysts note that the transfer of production to countries with cheap economies will save up to 65% on labor costs, replacing human employees with robots can reduce costs by 90%. If the previous wave of Internet development (late 1990s - early 2000s) affected mainly "light" segments, the markets closest to the Internet (media, telecom, retail), now the Internet is conquering "heavy" industrial and infrastructure sectors and regulated and specialized markets, medicine and education. The involvement of surrounding objects in the global Internet space is called the "Internet of Things" (IoT). This is a system of unified computer networks and connected physical objects (things) with built-in sensors and software for collecting and exchanging data, with the ability to remotely monitor and control in an automated mode, without human intervention. This is a smart city (Smart City), smart energy (Smart Energy), tele-medicine, smart home, smart roads.

The period up to 2025 is very important, because during this period the foundations of a new stage of human development, great transformations in the economy, politics, social sphere and culture are laid. The digital is accelerated industrialization based on new technologies, it is improvement of human capital, it is effective public administration. In October 2017, the Supreme Economic Council of the EAEU adopted the "digital agenda" until 2025. III modernization is innovation, emphasis on IT technologies. Digitalization will cover the agro-industrial complex, energy, mining and oil and gas sectors, transport and logistics. Digitalization of agriculture, transition to a digital structure of the agricultural market. This can become a stage in the development of resource potential, smart technologies, transition to a green economy. The EAEU should become the world's breadbasket.

Kazakhstan's Digital Strategy and Global Integration

Globalization as a modern form of international world order imposes much stricter requirements on the state for socioeconomic viability and fit into more complex structures of international relations. Thus, the global economy is increasingly opening up for Kazakhstan and this is also part of the new reality, which contains many challenges and opportunities for improving the professionalism and activity of Kazakhstanis. The country is entering, as Udartsev S. aptly put it, "dense layers of the atmosphere - a historical era of increasingly tough economic, scientific and technical competition, where there are no weak ones, but only strong and even stronger and the strongest [3].

The foreign policy agenda for the development of sovereign Kazakhstan currently includes a move toward digitalization and innovation, which is the primary response to the challenges of the modern and future world. The primary goal of the "Digital Kazakhstan" state program is the progressive development of the digital ecosystem to achieve sustainable economic growth, enhance the competitiveness of the economy and the country, and improve the quality of life of the population. The "Digital Kazakhstan" state program will be implemented in four key areas: the implementation of the Digital Silk Road, which includes the development of a reliable, high-speed, and secure digital infrastructure; and the development of a creative society. This also includes developing competencies and skills for the development of the digital economy, improving digital literacy among the population, training ICT specialists for industry, and digital transformation across economic sectors. This is the widespread implementation of digital technologies to enhance the competitiveness of various sectors of the economy; the transition to a proactive government. This is the improvement of electronic and mobile governance systems, and the optimization of the provision of public services [4].

Conclusions

1. Technological revolutions function as cyclical drivers of economic and social transformation, restructuring institutions, finance, and governance systems.
2. The Fourth Industrial Revolution marks a qualitative shift toward digital ecosystems, artificial intelligence, and integrated cyber-physical production systems.
3. Global technological competition increasingly determines geopolitical hierarchies and national sovereignty.
4. Digitalization enhances transparency, accessibility of knowledge, and economic efficiency, while simultaneously intensifying global competition.
5. Kazakhstan's strategic priority lies in transitioning from a resource-based economy to an innovation-driven digital model to secure long-term competitiveness and avoid technological dependency.

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KAZAKHSTAN'S DIGITAL SOVEREIGNTY MODEL: A SECURITY-DEVELOPMENTAL APPROACH IN COMPARATIVE PERSPECTIVE

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Abstract

Digital sovereignty has become a central concept in global debates on technology, governance, and power. While existing scholarship primarily focuses on the models advanced by the European Union, the United States, and China, far less attention has been paid to emerging middle powers. This article examines Kazakhstan's approach to digital sovereignty and argues that it represents a distinct **security-developmental model**, characterised by a strong emphasis on cybersecurity, state control over data flows, and innovation driven by national development priorities rather than market dominance or normative regulation. Using a qualitative-quantitative coding analysis of key Kazakhstani policy documents, the article demonstrates that cybersecurity and resilience constitute the core of Kazakhstan's digital sovereignty discourse, while platform regulation and rights-based governance play a secondary role. In comparative perspective, Kazakhstan's model differs fundamentally from the regulatory sovereignty of the European Union, the market-driven innovation model of the United States, and China's state-centric data control regime. The findings contribute to a broader understanding of digital sovereignty as a multidimensional concept that can take diverse forms beyond major global powers.

Keywords: digital sovereignty, Kazakhstan, cybersecurity, data governance, innovation policy, comparative digital governance

Introduction

Digital sovereignty has become a new emerging concept in the modern world, where states now are required to implement their influence beyond geographical borders, but also to assert dominance on digital infrastructure: data, technological development etc. The term has been associated with more powerful states like China, USA or EU for a certain period of time, which lead to the literature being more skewed toward large powers and normative or technological leaders, while developing countries or emerging power states remain unexplored.

Kazakhstan could serve as an instructive and a practical example. Kazakhstan does not pursue the goal of global dominance nor bending global norms via technologies, and as a still developing state, is being heavily influenced by bordering giants like China or Russian Federations. Instead, its approach to digital sovereignty is rooted in concerns over national security, infrastructural resilience, and state-led modernization. That raises the question of the following article: What is Kazakhstan's place and approach in digital sovereignty, and how does it differ from other more powerful states.

This article argues that Kazakhstan represents a **security-developmental model of digital sovereignty**, in which cybersecurity and resilience constitute the central pillar, complemented by state-driven innovation policies and controlled data governance. Rights-based regulation and platform competition, on the other hand, occupy a marginal role. By analysing Kazakhstan's digital policy through a structured coding framework and situating the findings in comparative perspective, the article seeks to expand existing theoretical understandings of digital sovereignty beyond the experience of major powers.

2. Conceptual Framework: Digital Sovereignty Beyond Major Powers

Digital sovereignty is best understood as a **multidimensional concept**, encompassing legal, technological, economic, and security-related elements. In the existing literature, three dominant models can be identified.

First, the **European Union's regulatory model** emphasises rights protection, platform regulation, and normative governance, most prominently through instruments such as the General Data Protection Regulation (GDPR) and the Digital Services Act. Sovereignty here is exercised primarily through legal authority and regulatory reach [1].

Second, the **United States' market-driven model** is characterised by technological leadership and private-sector innovation. Digital sovereignty is implicitly linked to control over key technologies, platforms, and innovation ecosystems rather than comprehensive federal regulation [2].

Third, **China's state-centric model** combines strong control over data flows, digital infrastructure, and platforms with an explicit geopolitical dimension. Digital sovereignty functions as both an internal governance tool and an instrument of external influence [3].

These models, however, do not exhaust the range of possible approaches. For emerging states with limited technological capacity and restricted global influence, digital sovereignty may take a different form—one oriented toward **defensive security, infrastructural control, and developmental modernisation**. Kazakhstan exemplifies this alternative logic.

3. Methodology and Data

The analysis is based on a qualitative–quantitative coding of Kazakhstan's key digital policy documents, including:

- the Digital Kazakhstan programme,
- legislation on information security, informatisation, and digital assets,
- the Law on Personal Data and Their Protection,
- the Cybersecurity Concept Cyber Shield of Kazakhstan,
- the Concept for the Development of Artificial Intelligence (2024–2029).

Documents were coded according to six analytical dimensions commonly used in digital sovereignty research:

- **S1** – Cybersecurity and resilience
- **R1** – Rights and data protection
- **R2** – Control over data flows
- **M1** – Regulation of platforms and competition
- **M2** – Innovation and technological base
- **S2** – Additional sovereignty dimensions (governance, skills)

The frequency and distribution of references across these categories provide an empirical basis for identifying Kazakhstan's dominant sovereignty priorities

4. Kazakhstan's Digital Sovereignty Model

Cybersecurity and Resilience as the Core Pillar

Cybersecurity and resilience (S1) emerge as the most dominant dimension in Kazakhstan's digital sovereignty discourse, accounting for 81 references across the analysed policy documents. This quantitative prevalence is not incidental, but rather reflects a deliberate strategic framing in which digital transformation is inseparable from national security and state stability. Foundational initiatives such as the Cyber Shield of Kazakhstan conceptualise the digital domain primarily as a space of vulnerability, where threats to information systems, critical infrastructure, and governmental networks are treated as direct challenges to sovereignty [4].

In contrast to approaches that frame cybersecurity as a technical or sector-specific policy issue, Kazakhstan consistently embeds cyber resilience within a broader security narrative. Cyber threats are presented not merely as operational risks or market failures, but as factors capable of undermining public order, institutional capacity, and the continuity of state governance. As a result, digital sovereignty is articulated as an extension of national security policy, rather than as an outgrowth of economic regulation or individual rights protection.

This security-first orientation reflects Kazakhstan's structural position as a developing and geographically exposed state. Located at the intersection of competing digital ecosystems and external technological dependencies, the country prioritises resilience and control as preconditions for any broader digital transformation. Consequently, cybersecurity functions as the organising principle of Kazakhstan's digital sovereignty model, shaping both regulatory choices and institutional design.

Control over Data Flows: Defensive Sovereignty

Closely linked to the primacy of cybersecurity is Kazakhstan's emphasis on control over data flows (R2), which accounts for 44 references in the coded material. Data governance in Kazakhstan is framed predominantly through the lens of regulatory oversight, information security, and the protection of national information systems, particularly in sensitive sectors connected to public administration, critical infrastructure, and strategic industries.

Unlike models in which data sovereignty is leveraged as a tool of geopolitical influence or economic coercion, Kazakhstan's approach remains fundamentally defensive and inward-oriented. Control over data flows is not articulated as a means of projecting power beyond national borders, but rather as a mechanism for reducing systemic vulnerability and preserving administrative control in a digitally interconnected environment. In this sense, data localisation requirements and oversight mechanisms are

designed to limit exposure to external legal jurisdictions, foreign surveillance, and infrastructural dependence [5].

This framing distinguishes Kazakhstan from China's model of data sovereignty, where control over data is closely tied to global technological competition and geopolitical strategy. In the Kazakhstani case, data sovereignty serves a stabilising function: it is intended to safeguard the integrity of state institutions and to ensure the manageability of digital transformation under conditions of limited autonomy and asymmetric interdependence.

Innovation as State-Led Development

Innovation and the technological base (M2) constitute another central component of Kazakhstan's digital sovereignty strategy, with 46 references across the analysed documents. Programmes such as Digital Kazakhstan and the Concept for the Development of Artificial Intelligence (2024–2029) underline the importance of advanced technologies, digital public services, and automation for national development. However, the framing of innovation in Kazakhstan differs markedly from innovation-driven sovereignty models observed in major technological powers.

Rather than being associated with global competitiveness, platform expansion, or technological leadership in international markets, innovation is conceptualised as an instrument of state-led modernisation. Artificial intelligence, data-driven governance, and digital infrastructure are primarily valued for their capacity to enhance administrative efficiency, improve public service delivery, and support economic diversification under central coordination. Innovation thus functions as a developmental tool, embedded within a broader strategy of state capacity-building.

This approach reflects Kazakhstan's recognition of its structural constraints within the global digital economy. Lacking the industrial base and private-sector ecosystems necessary to compete with dominant technological actors, the state positions itself as the principal driver of innovation. Digital sovereignty, in this context, does not imply technological self-sufficiency or global leadership, but rather the ability to selectively adopt and govern technologies in ways that reinforce national development objectives and institutional resilience [6].

Secondary Role of Rights and Platform Regulation

While rights and data protection (R1) are present in Kazakhstan's digital policy discourse, accounting for 48 references, they do not function as a normative cornerstone of digital sovereignty. Unlike the European Union, where individual rights and privacy constitute the foundational logic of digital governance, Kazakhstan treats data protection primarily as a regulatory and administrative requirement. Legal provisions on personal data are embedded within broader frameworks of informatisation and information security, rather than articulated as autonomous political principles.

An even more limited role is played by the regulation of platforms and competition (M1), which registers only 13 references. This relative absence indicates that digital platforms are not perceived as independent centres of economic or political power requiring targeted regulatory intervention. Instead, platforms are treated as components of the broader digital ecosystem, operating within state-defined boundaries rather than as actors capable of shaping sovereignty dynamics in their own right.

This contrasts sharply with the EU's platform-centric understanding of digital sovereignty, where large technology companies are viewed as systemic actors whose power must be constrained through regulatory governance. In Kazakhstan, the absence of domestic digital giants and the dominance of foreign platforms reduce the perceived relevance of platform regulation as a sovereignty instrument [7].

Comparative Perspective

From a comparative perspective, Kazakhstan's digital sovereignty model differs fundamentally from the dominant approaches advanced by major global actors. Unlike the European Union, Kazakhstan does not prioritise rights-based regulation or normative rule-setting as the primary means of asserting sovereignty. Unlike the United States, it lacks a private-sector-driven innovation ecosystem capable of shaping global technological standards or digital markets. Unlike China, it does not deploy digital sovereignty as an explicit geopolitical instrument aimed at external influence.

Instead, Kazakhstan represents a security–developmental model of digital sovereignty, in which sovereignty is defined by the state's capacity to protect critical infrastructure, control strategically sensitive data flows, and guide technological development in accordance with national stability and modernisation goals. This model reflects the realities faced by emerging states operating under conditions of external dependence, limited technological autonomy, and regional geopolitical pressure. In such contexts, digital sovereignty is not a tool of dominance, but a strategy of managed adaptation, resilience, and state preservation within an increasingly contested digital environment.

Conclusion

This article has demonstrated that Kazakhstan embodies a distinct model of digital sovereignty that cannot be adequately captured by existing frameworks centred on major global powers. By placing cybersecurity and resilience at the core of its digital strategy, and by complementing this focus with controlled data governance and state-led innovation, Kazakhstan pursues digital sovereignty as a strategy of defensive stability and managed development, rather than as a means of global influence, market dominance, or normative leadership. Digital sovereignty in the Kazakhstani case is therefore not oriented toward shaping international standards or exporting regulatory models, but toward securing state capacity and institutional control within an increasingly interconnected and asymmetrical digital environment.

The findings challenge the implicit assumption, prevalent in much of the literature, that digital sovereignty is either a function of regulatory power (as in the European Union), technological leadership (as in the United States), or state-centred geopolitical control (as in China). Instead, the Kazakhstani case illustrates that digital sovereignty is a context-dependent and adaptive phenomenon, shaped by a state's technological capabilities, security exposure, and developmental priorities. For emerging and middle-power states, sovereignty in the digital domain is less about autonomy in absolute terms than about reducing vulnerability, managing dependence, and preserving decision-making capacity under conditions of external pressure.

From a broader theoretical perspective, this analysis suggests that digital sovereignty should not be conceptualised as a uniform or hierarchical concept, nor as a linear progression toward an idealised model. Rather, it should be understood as a plural and relational strategy, embedded in specific political, economic, and geopolitical contexts. Kazakhstan's experience demonstrates that sovereignty in the digital age can be pursued pragmatically, through selective control, securitisation of critical domains, and state-coordinated innovation, without aspiring to technological self-sufficiency or global leadership.

These findings point to the need for greater attention to the digital sovereignty strategies of emerging states, particularly in regions such as Central Asia, where digital transformation unfolds under conditions of geopolitical competition, infrastructural dependence, and uneven development. Future research should therefore move beyond the dominant EU–US–China triangle and explore how middle powers adapt the concept of digital sovereignty to their own structural constraints. Such comparative work would contribute to a more nuanced and inclusive theory of digital governance, capable of accounting for diversity rather than dominance in the global digital world.

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Psychological sciences

THE IMPACT OF DIGITAL MEDIA USE ON CHILDREN'S COGNITIVE PERFORMANCE

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Digitalization is the process of transferring information to a digital environment and the intensive use of technology in daily life, business processes, and communication. This transformation, which began with the transition from analog to digital systems, has accelerated with the development of computers, the internet, and mobile technologies (Karagözoğlu Aslıyüksek, 2016: 88). Over time, this process, influenced by innovations such as artificial intelligence, cloud computing, and the Internet of Things, has led to radical changes in all sectors. This process has not only digitized data but has also reshaped many areas, from how individuals access information to their social relationships. One of the most visible effects of this digital transformation is the increasing role of screen technologies in our lives. Smartphones, tablets, and computers have now become indispensable tools for communication, entertainment, education, and the business world. Especially with the pandemic, distance education and online meetings have brought screen usage to the center of daily life. In addition, digital media platforms, games, and social media applications have become major factors increasing screen time. The proliferation of e-books and online courses in fields such as education and health has further strengthened the impact of digitalization in these areas. With all these developments, digitalization has become an integral part of daily life and has begun to show its effects more in almost every area of life. However, while this widespread use makes daily life easier, it also brings some challenges and negative effects.

Digitalization is the process of converting information and processes from analog to digital format. This transformation encompasses the collection, storage, processing, and transmission of data through technological tools. While digitalization enables individuals to access information more widely and quickly, digital platforms provide environments where people can easily share their ideas, thoughts, and feedback (Ertürk, 2021, p. 167). Digitalization is not only a technical change but also a comprehensive transformation that creates significant impacts in economic, social, and cultural fields. Thanks to the acceleration of access to information, the diversification of communication tools, and the widespread use of social media platforms, individuals are now interacting more. Thanks to developments in information and communication technologies, interaction between people has become faster and easier. The spread of digital interaction and online communication has gained significant importance today. While this situation offers many opportunities, it also creates various threats. Violence is among these threats. Violence is defined by the World Health Organization as "the deliberate use of physical force or power against oneself, another person, or a group or community, whether threatening or actual, resulting in or likely to result in injury, death, psychological harm, developmental delay, or deprivation." Tuna Uysal and Tan Eren (2019, p. 119), based on this definition, state that digital violence is a different type of violence. Digital violence is a form of behavior that may emerge with the spread of technology and the internet, and does not pose a physical, psychological, or emotional threat. This type of violence can manifest itself through social media as insults, threats, stalking, sharing of private information, or cyberbullying. The negative effects of violence on social life once again highlight the importance of a healthy socialization process.

Another problem arising from screen use in children is the experience of identity and role confusion. Through screens, children encounter different characters and identities and try to adopt these roles. However, constantly interacting with virtual identities makes it difficult for children to find their own identities (Aral, 2022, p. 1136). Virtual identities are digital existences that allow for having different faces and using pseudonyms to provide hidden or anonymous presentations. Thanks to the privacy offered by the internet, individuals have the opportunity to present personalities on social media and other online platforms that they cannot be in real life, but wish to be (Kabar, 2024, pp. 245-246). In other words, people can assume different roles to leave a positive impression on others. Goffman likens life to a theater stage to explain this situation. He states that just as actors portray specific characters in a

theater, people also assume various roles in social settings. This analogy indicates that personality is in a constant process of negotiation and performance (Goffman, 2020, p. 29). According to Mead, "the child becomes a living member of society because he adopts the attitude of the other and allows that attitude to determine what he will do for a particular purpose". Through these interactions, the child develops his own identity and social skills.

Screen addiction can negatively impact children's physical development as well as their mental, cognitive, and emotional development. One of the first cognitive effects of screen addiction in children is related to language development. The early years of childhood are particularly crucial for children to acquire language skills. Since children acquire language skills through interaction with adults, screen addiction disrupts this interaction, negatively impacting their language development. Therefore, children should ideally not be exposed to screens at all until the age of 3.

Significant effects of screen addiction in later life include attention deficit hyperactivity disorder and concentration problems. The overly stimulating graphics and rapid movements in published content, videos, and games can cause children to have difficulty focusing in daily life. Children constantly exposed to fast-moving, loud, and colorful content may have difficulty sitting still for long periods in classrooms and focusing on lessons, especially at school.

Another hand, there are some positive effect of using digital technology in modern education. Authors mentioned that some schools now incorporate virtual and AR technologies into their teaching models. Rather than just reading about history or science, children can now experience these subjects. These virtual adventures make students better at thinking and pique their interest in STEM subjects. However, the considerable cost of VR equipment and the need for technical proficiency are significant barriers to adoption (Adeyemi, 2025).

Cognitive development refers to intellectual growth. This is a steady increase in a child's ability to acquire, consolidate, retrieve, and apply knowledge. There is a rapid increase in overall brain size from birth, with the brain reaching 80–90% of adult volume by age two. Childhood is a critical time for cognitive development; hence, the impact of digital technologies on cognitive development is of interest to parents, educators, policymakers, and others.

Research studies have well documented the concerning impact of digital technology, which is its ability to lead to attention deficits. Prolonged exposure to fast-paced content, common on many digital platforms, reduces children's ability to concentrate and sustain attention in traditional learning environments. Furthermore, creativity may suffer when children become too dependent on structured apps because replacing unstructured play with screen time stifles imagination (Adeyemi, 2025).

Educators must wisely incorporate digital technologies into learning frameworks in ways that allow children to collaborate and think critically. To achieve this, digital technologies must be rooted in sound pedagogical principles and capable of strengthening critical thinking. It is recommended that they incorporate these four pillars in their design: active or minds-on learning, engaging content that encourages children to learn and play for longer periods, meaningful experiences that bridge the gap between the content and children's existing knowledge and finally, social interaction, to enable children to interact and socialize with others through the platform. Playful activities generally captivate children. Teachers and creators of educational technologies are to maximize this and ensure that these educational applications are equally fun and educative

Keywords: digital world, cognitive skills, child development, information, knowledge

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ARTIFICIAL INTELLIGENCE AND MENTAL HEALTH: PSYCHOLOGICAL RISKS, COGNITIVE SHIFTS, AND ETHICAL QUESTIONS IN THE DIGITAL AGE

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Abstract

In recent years, artificial intelligence (AI) has moved from science fiction into daily life. Systems such as OpenAI's ChatGPT, recommendation algorithms used by Meta Platforms, and machine learning systems developed by Google have changed the way people communicate, work, learn, and even think. AI is no longer only a technical tool; it has become a psychological environment. People now interact with algorithms for information, emotional support, entertainment, and decision-making.

The speed of this transformation is historically unusual. Earlier technologies such as television or the internet also influenced behavior, but AI differs in one important way: it does not only deliver information, it generates it. Generative AI systems produce text, images, and recommendations that appear personalized and intelligent. This creates a new kind of interaction between humans and machines—one that is dialogical rather than passive. From a psychological perspective, this shift is significant because human cognition is shaped by interaction. As Bandura's (2001) social cognitive theory suggests, learning occurs in dynamic systems where environment, behavior, and personal factors influence each other. AI has now become part of that environment.

At the same time, digital technologies have already been linked to changes in attention, memory, and emotional regulation. Carr (2010) argued that constant online engagement may reduce deep reading and reflective thinking. Similarly, research on media multitasking shows that frequent switching between digital tasks can weaken sustained attention (Ophir, Nass, & Wagner, 2009). AI systems may intensify these patterns by making access to instant answers even easier. When individuals know that an intelligent system can quickly provide solutions, they may invest less cognitive effort themselves. This process, known as cognitive offloading, has been widely discussed in cognitive psychology (Risko & Gilbert, 2016).

Another important dimension is emotional reliance on technology. Digital communication platforms have already reshaped social relationships. Now, AI chatbots simulate empathy and conversational intimacy. According to Turkle (2011), people may begin to expect technology to provide emotional support without the complexity of human relationships. This can influence attachment patterns, especially among adolescents and young adults who grow up with AI-based systems. From the perspective of attachment theory (Bowlby, 1969), repeated interactions with responsive systems—even artificial ones—may shape expectations about availability and responsiveness in relationships.

Moreover, AI is entering mental health services. Automated cognitive behavioral therapy programs, mood-tracking applications, and conversational agents are increasingly common. While these tools can increase accessibility, they also raise questions about the nature of therapeutic presence and empathy. The therapeutic alliance has consistently been identified as a central predictor of treatment success (Horvath et al., 2011). Whether an artificial system can contribute to such an alliance remains an open question.

Because of this rapid change, psychology has begun to ask new questions. How does constant interaction with AI affect attention, memory, and critical thinking? Does AI reduce loneliness or increase social isolation? Can AI-based therapy tools replace human therapists? What are the long-term consequences of relying on machines for cognitive tasks? In addition, how does AI influence identity formation, autonomy, and the perception of authorship in creative work?

This thesis explores the psychological effects of artificial intelligence on mental health and cognition. It focuses on three central dimensions: cognitive processes, emotional and social functioning, and ethical-psychological implications. The aim is not to present AI as purely positive or negative. Instead, the purpose is to analyze its complex and evolving influence on the human mind, using current psychological theories and empirical research as a foundation.

Keywords: Artificial Intelligence (AI); Mental Health; Cognitive Offloading; Digital Psychology; Emotional Well-being; Human–Computer Interaction; AI-based Therapy; Attention and Memory; Social Isolation; Psychological Ethics

AI and Cognitive Processes

One of the most discussed issues in current psychology is the effect of AI on human thinking. Research in cognitive psychology shows that human memory is adaptive. When tools become available, people tend to rely on them. This idea is not new. Sparrow, Liu, and Wegner (2011) introduced the concept of the "Google effect," showing that people are less likely to remember information if they believe it can be easily accessed online.

Today, AI systems take this process further. Instead of only storing information, they generate summaries, answers, and even full essays. This changes the cognitive effort required from the user. When individuals rely heavily on AI for problem-solving, they may reduce their own analytical engagement. Some researchers argue that this creates a form of "cognitive offloading," where mental tasks are transferred to external systems (Risko & Gilbert, 2016).

However, the situation is not simple. Cognitive offloading is not always harmful. Writing tools, calculators, and search engines have long supported human cognition. The difference now is the depth of assistance. Generative AI can structure arguments, interpret texts, and simulate reasoning. This may influence how students learn and how professionals make decisions.

There is also concern about attention span. Digital environments already compete for attention through notifications and algorithm-driven content. AI systems personalize this content even more effectively. Studies on digital media use have linked excessive screen time with reduced sustained attention (Wilmer, Sherman, & Chein, 2017). If AI increases the speed and volume of information, the human brain may adapt by processing information more superficially.

On the other hand, AI may also support cognitive development. Adaptive learning systems can personalize education. AI-based tutoring platforms can identify weaknesses and provide targeted feedback. In this sense, AI can function as a cognitive scaffold, similar to the concept proposed by Vygotsky, where tools and social interaction support higher mental processes.

Therefore, the cognitive impact of AI is dual. It may weaken deep processing if used passively, but it may strengthen learning if used actively and critically.

Emotional and Social Consequences

Another major area of psychological interest is the emotional impact of AI. Many people now use AI chatbots for conversation and support. Some users report feeling understood and less lonely. During periods of social isolation, such as the COVID-19 pandemic, digital communication became essential. AI systems entered this space as companions and assistants.

Loneliness is a serious psychological risk factor. It has been associated with depression, anxiety, and even physical health problems (Cacioppo & Cacioppo, 2018). If AI reduces loneliness by providing interaction, this could be beneficial. Some mental health applications use AI to provide cognitive behavioral therapy exercises, mood tracking, and coping strategies.

However, concerns remain. AI systems simulate empathy but do not experience emotions. When users develop emotional attachment to AI, the relationship is one-sided. Turkle (2011) argued that technology can create an "illusion of companionship without the demands of friendship." This idea is even more relevant today.

There is also the risk of social withdrawal. If AI becomes easier to interact with than humans, some individuals may prefer it. Human relationships require patience, compromise, and emotional regulation. AI systems are designed to be responsive and agreeable. This difference may change expectations in real-world relationships.

Social comparison is another issue. Algorithms used by TikTok and Instagram already influence self-esteem by promoting idealized images. AI-driven filters and content recommendation systems can intensify this effect. Research has shown that exposure to idealized online content can increase body dissatisfaction and depressive symptoms, especially among young users (Fardouly & Vartanian, 2016).

Thus, while AI may offer emotional support, it may also create unrealistic standards and weaken authentic social bonds.

AI in Clinical Psychology

One of the most debated questions is whether AI can replace therapists. Mental health services are often expensive and inaccessible. AI-based therapy tools promise affordability and availability. Some applications use principles of cognitive behavioral therapy (CBT) and have shown positive short-term results in reducing mild symptoms of anxiety and depression.

However, therapy is not only about techniques. The therapeutic alliance—the relationship between therapist and client—is one of the strongest predictors of successful outcomes (Horvath et al., 2011).

This alliance includes empathy, trust, and shared understanding. While AI can simulate supportive language, it does not possess genuine emotional awareness.

There are also ethical risks. AI systems rely on data. Sensitive psychological information must be protected. Data breaches or misuse could cause harm. Moreover, AI systems may reflect biases present in their training data. If not carefully monitored, they may provide unequal or inappropriate advice.

Still, AI may serve as a complementary tool. For example, it can help monitor symptoms between therapy sessions or assist therapists with documentation. In this model, AI supports human professionals rather than replacing them.

Identity, Autonomy, and Ethical Concerns

Beyond cognition and emotion, AI raises deeper psychological questions about identity and autonomy. When algorithms influence what we read, watch, and buy, they also shape preferences and beliefs. Over time, this may reduce perceived autonomy.

Self-determination theory, developed by Deci and Ryan (2000), emphasizes autonomy as a basic psychological need. If AI systems subtly guide decisions, individuals may feel less control over their choices. Even if the influence is invisible, it can affect well-being.

Another issue is authorship and creativity. When AI generates art, music, or academic writing, people may question the value of human effort. Creativity has long been linked to meaning and self-expression. If machines perform creative tasks, how will this affect self-concept?

These concerns are not purely theoretical. Universities, workplaces, and governments are currently developing policies on AI use. The psychological impact of these policies—such as fear of job loss or academic dishonesty—also deserves attention.

Conclusion

Artificial intelligence is one of the most influential psychological forces of the 21st century. It affects how people think, feel, learn, and connect with others in ways that were previously unimaginable. The evidence suggests that AI is neither purely harmful nor purely beneficial; its impact depends largely on how it is designed, regulated, and used in daily life. While it offers unprecedented opportunities for cognitive enhancement, emotional support, and clinical intervention, it also presents risks that require careful consideration.

Cognitively, AI can serve as a powerful learning tool. Adaptive educational systems, AI-driven tutoring platforms, and intelligent information retrieval can enhance knowledge acquisition, problem-solving, and skill development. However, overreliance on AI may reduce deep processing, critical thinking, and memory retention—a phenomenon known as cognitive offloading (Risko & Gilbert, 2016; Sparrow, Liu, & Wegner, 2011). Emotionally, AI may provide companionship, reduce feelings of loneliness, and offer accessible mental health support (Cacioppo & Cacioppo, 2018). Yet, these interactions are not a replacement for authentic human relationships, and there is a risk that individuals may develop unrealistic expectations of social responsiveness from machines (Turkle, 2011; Bowlby, 1969).

In clinical settings, AI has the potential to increase access to mental health care, especially in areas with limited professional resources. AI-based interventions, such as automated cognitive behavioral therapy programs and symptom-monitoring applications, can complement traditional therapy. Nonetheless, they cannot fully replicate the therapeutic alliance—the trust, empathy, and nuanced understanding that human therapists provide—which remains critical for effective treatment outcomes (Horvath et al., 2011).

Ethically, AI challenges fundamental psychological concepts such as autonomy, identity, and creativity. When algorithms influence decisions, preferences, and even creative outputs, individuals may feel a subtle reduction in agency. Moreover, concerns about privacy, bias in AI systems, and equitable access highlight the need for strong ethical standards in both technology design and implementation (Deci & Ryan, 2000; Wilmer, Sherman, & Chein, 2017).

For psychology, the task is not to resist technological change but to guide it responsibly. Researchers must continue to examine long-term effects on cognition, emotion, and social behavior. Educators should incorporate critical AI literacy to help individuals navigate algorithmic environments without losing cognitive independence. Clinicians need to integrate AI as a complementary tool rather than a replacement, ensuring that the human elements of care are preserved. Policymakers must establish regulations that protect privacy, promote fairness, and safeguard psychological well-being.

The human mind has always adapted to new tools and technologies throughout history, from the invention of writing to the advent of digital media. Artificial intelligence represents the most powerful cognitive and social tool yet, and its influence will continue to grow. Whether AI ultimately strengthens or weakens psychological well-being depends on the balance between human agency and technological

assistance, as well as society's ability to guide its ethical, thoughtful, and mindful use. By approaching AI not merely as a tool but as a psychological environment, humanity can harness its benefits while minimizing potential harms.

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Technical sciences

MICROCLIMATE AUTOMATION AND GREENHOUSE SENSOR SYSTEMS

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АВТОМАТИЗАЦИЯ МИКРОКЛИМАТА И СЕНСОРНЫЕ СИСТЕМЫ ТЕПЛИЦЫ

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Abstract

This paper examines the principles of greenhouse microclimate automation using sensor systems and modern control technologies. It describes the key parameters for monitoring the plant growing environment, including temperature, humidity, illumination, and CO₂ concentration, as well as the role of sensors in ensuring stable operating conditions for the greenhouse complex.

An analysis of sensor types and their operating principles is provided, along with actuators and the potential for integrating the control system with Internet of Things (IoT) technologies. It is demonstrated that greenhouse automation can improve energy efficiency, reduce human error, and improve plant growth conditions.

Аннотация

В работе рассмотрены принципы автоматизации микроклимата теплицы с применением сенсорных систем и современных технологий управления. Описаны основные параметры контроля среды выращивания растений, включая температуру, влажность, освещённость и концентрацию CO₂, а также роль датчиков в обеспечении стабильных условий функционирования тепличного комплекса.

Проведён анализ типов датчиков и их принципов работы, рассмотрены исполнительные устройства и возможности интеграции системы управления с технологиями Интернета вещей (IoT). Показано, что автоматизация теплицы позволяет повысить энергоэффективность, снизить влияние человеческого фактора и улучшить условия роста растений.

Keywords: *greenhouse automation, microclimate, sensor systems, temperature sensors, humidity sensors, IoT, microclimate control, smart greenhouse, automatic control, greenhouse technologies, energy efficiency, environmental monitoring.*

Ключевые слова: *автоматизация теплицы, микроклимат, сенсорные системы, датчики температуры, датчики влажности, IoT, управление микроклиматом, умная теплица, автоматическое управление, тепличные технологии, энергоэффективность, мониторинг окружающей среды.*

Выбор элемента при создании по теме разработки автоматизированной системы управления микроклиматом в теплицах, сочетающей механику растений и датчики биосреды для принятия решений в режиме реального времени.

При разработке управляемой системы управления микроклиматом в теплице, главный комитет биомеханики растений и датчиков окружающей среды, выбор элементов играет ключевую роль. Для обеспечения оптимального микроклимата и оперативного режима работы системы при изменении окружающей среды следует учитывать несколько основные элементы для управления микроклиматом:

1. Датчик окружающей среды
 - Температура воздуха и окружающей среды
 - Влажность воздуха и почвы
 - Освещённость
 - Концентрация CO₂
2. Биомеханические датчики
 - Измерение состояния растений
 - Фитосенсор
3. Исполнительные устройства
 - Система отопления и охлаждения
 - Вентиляционные системы
 - Освещение
 - Система полива
4. Системы управления и алгоритмы принятия решений
 - Модераторы
 - Алгоритмы принятия решений
5. При выборе элементов системы управления микроклиматом в теплицах наблюдаются
 - Типы растений и их особенности
 - Size теплицы
 - Точность и надежность датчиков
 - Энергоэффективность

В целом, управляемая система управления микроклиматом в теплице, использующая биомеханику растений и датчики окружающей среды, должна быть гибкой, надежной и адаптивной к изменяющимся условиям, чтобы обеспечить рост высоты.

Виды датчиков температуры

Для измерения температуры в тепле используются различные типы датчиков, которые различаются по принципу работы, точности и применению. Вот основные виды датчиков температуры

1. Термопары
2. Терморезисторы (RTD)
3. Термометры на основе полупроводниковых датчиков.
4. Инфракрасные (ИК) датчики температуры.
5. Биметаллические датчики.
 - Применение: Используются в простых условиях для контроля температуры, чаще для вентиляции.
6. Цифровые датчики температуры.
 - Принцип работы: Электронные устройства, преобразующие электромагнитную температуру в цифровой сигнал.
 - Преимущества: Высокая точность, возможность передачи данных в систему управления, небольшой размер.
 - Применение: Широко используется для измерения температуры воздуха и воды, особенно в комплексных автоматических обогревателях.
7. Жидкостные датчики (термометры с жидкостью).
 - Принцип работы: Жидкость (например, ртути или спирта) увеличивается с повышением температуры и поднимается по градуированной шкале.
 - Преимущества: Простые, недорогие.
 - Применение: Редко используется в современных медицинских процедурах, часто применяется для общего наблюдения в небольших теплицах.
8. Волоконно-оптические датчики.
 - Принцип работы: Оптическое волокно передает свет, который меняется под воздействием температуры.

- *Преимущества:* Высокая точность, нечувствительность к электромагнитным воздействиям, подходит для сложных условий.

- *Применение:* При переходе в научные исследования, а также в сложных промышленных теплицах с постоянным стремлением к точности измерений.

Каждый тип датчика температуры имеет свои преимущества и недостатки, и выбор зависит от требований к теплице, точности, диапазона температур и возможностей автоматизации системы управления.

Термопара – это устройство для измерения температуры, которое работает на основе термоэлектрического эффекта, или эффекта Зеебека. Этот эффект заключается в том, что при нагревании контакта двух разных металлов возникает электрическое напряжение, компенсирующее разницу температуры между контактной и свободной точками.

Принцип работы термопары 1. Состав: Термопара состоит из двух проводников, изготовленных из различных металлов или сплавов (например, медь-константан, железо-константан, хромель-алюмель). Эти два провода подключаются к одному месту, называемому «горячим спаем».

Основными датчиками температуры являются омические, индуктивные, генераторные, температурные и т. д. Принцип действия омических можно охарактеризовать формулой $R = \rho \cdot l / S$, где l - длина, ρ - удельное сопротивление, S - площадь сечения, R - активное сопротивление.

Основных типов датчиков движения – четыре:

- инфракрасные,
- ультразвуковые,
- микроволновые
- комбинированные.

Все они кардинально отличаются друг от друга по внешнему устройству и принципу действия.

Индуктивные датчики, емкостные датчики и ультразвуковые датчики — это три различных датчика приближения. Эти устройства находят цели в промышленных приложениях. Они различаются по технологиям, способностям находить различные цели и рабочему расстоянию.

Типы датчиков приближения: индуктивные, емкостные и ультразвуковые

Индуктивные датчики, емкостные датчики и ультразвуковые датчики — это три различных датчика приближения. Эти устройства обнаруживают цели в промышленных приложениях. Они различаются по технологии, способности обнаруживать различные типы целей и рабочему расстоянию. Все три, с другой стороны, могут обнаруживать объект без какого-либо контакта, несмотря на цвет поверхности. Индуктивные датчики и емкостные датчики могут работать на расстоянии нескольких миллиметров, в то время как ультразвуковые датчики могут достигать нескольких метров.

Индуктивные датчики — это промышленные электронные устройства, используемые для обнаружения присутствия металлических объектов без вмешательства других различных материалов (таких как пластик, дерево, вода или масло). Datasensing считается одним из основных мировых производителей датчиков после слияния Datalogic и MD Micro Detectors, двух компаний, которые творили историю датчиков в Италии с начала 1970-х годов. Индуктивные датчики основаны на излучении колеблющегося электромагнитного поля. Когда металлическая цель приближается к датчику, в цели генерируются стоковые токи. Этот ток отбирает энергию из электромагнитного поля и поэтому амплитуда колебаний уменьшается. Пороговый детектор внутри датчика обнаруживает, когда амплитуда ниже определенного значения и поэтому выход переключается. Когда цель удаляется, стоковые токи в цели уменьшаются, и поэтому амплитуда электромагнитного поля увеличивается. Выше определенного порога выход датчика снова переключается в исходное рабочее состояние.

Индуктивные датчики в основном состоят из следующих каскадов:

- катушка и феррит, которые генерируют электромагнитное поле
- генератор, используемый для создания электромагнитного поля
- компараторный каскад, который сравнивает полученный сигнал с порогом переключения
- транзистор, который управляет внешним исполнительным механизмом или непосредственно нагрузкой.

Индуктивные датчики можно различать по размерам. Классификация идет от цилиндрических миниатюрных моделей с диаметром 3 мм до корпусов M30 и прямоугольных моделей. Расстояние срабатывания, установка (экранированная или неэкранированная) и расширенные функции (аналоговый выход, устойчивость к сварочному полю, ...) являются другими способами классификации.



Рисунок 1. Индуктивные датчики

Как упоминалось ранее, индуктивные датчики обнаруживают только металлические цели. Металлические цели по-разному реагируют на электромагнитное поле в зависимости от типа материала. Датчик обнаруживает различные материалы, такие как сталь, нержавеющая сталь, медь, латунь или алюминий, на различных максимальных расстояниях. Стандартная цель, согласно стандарту ISO60947-5-2, представляет собой квадратную пластину Fe360 толщиной 1 мм со стороной, соответствующей размерам датчика и рабочему расстоянию. В технических характеристиках продукта индуктивного датчика можно найти таблицу коэффициентов уменьшения для различных материалов. Пользователи должны учитывать этот эффект при выборе правильных индуктивных датчиков для своего применения.

Емкостные датчики — это промышленные электронные устройства, способные обнаруживать любые материалы (металл, пластик, дерево, воду и т. д.).

Емкостные датчики основаны на излучении колеблющегося электрического поля. Емкостный датчик и цель действуют как пластины конденсатора. Когда цель приближается к датчику, амплитуда электрического поля уменьшается до тех пор, пока ниже определенного порога не увеличивается триггер. Выше определенного порога датчик переключает выходы. Когда цель удаляется от датчика, компаратор снова переключает датчик в начальные условия.

Емкостные датчики могут обнаруживать самые разные типы материалов. Фактическое расстояние обнаружения зависит от диэлектрической проницаемости самого материала:

- Материалы с высокой диэлектрической проницаемостью обнаруживаются на больших расстояниях
- Материалы с низкой диэлектрической проницаемостью обнаруживаются только тогда, когда они находятся близко к датчику.

По этой причине такие материалы, как металлы и вода, хорошо обнаруживаются емкостным датчиком, в то время как такие материалы, как мука и нейлон, обнаруживаются только на небольшом расстоянии.

Другим эффектом, который может изменить эффективное рабочее расстояние емкостного датчика, является уровень влажности материала. Например, можно наблюдать различное расстояние обнаружения для сухой и влажной древесины из-за различного наличия воды внутри. Дальнейшие эффекты на расстояние обнаружения обусловлены компактностью самого материала. Датчик хорошо способен обнаруживать воду. Между тем, поскольку лед содержит пузырьки воздуха, датчики могут обнаруживать ее на более коротком расстоянии. То же самое может произойти и с пластиковыми материалами: уплотненные панели обнаруживаются на большем расстоянии по сравнению с гранулированными гранулами.

Емкостные датчики широко используются для определения уровня жидкости. Если стенки резервуара сделаны из пластика или стекла, можно настроить чувствительность для определения наличия жидкости внутри. Емкостные датчики широко используются для определения агрессивных жидкостей или жидкостей, которые не должны загрязняться при контакте с самим датчиком. Конечно, чем выше разница в диэлектрической проницаемости между стенкой резервуара и содержимым, тем лучше производительность

Ультразвуковые датчики — это промышленные электронные устройства, которые могут обнаруживать любые виды материалов (металл, пластик, дерево, вода, ...). Обнаружение может происходить независимо от цвета, прозрачности, блеска и состояния (жидкость, твердое тело и порошок). Конечно, характеристики зависят от звукопоглощающей способности материала целевой поверхности. Чем выше поглощающая способность, тем меньше фактическое расстояние обнаружения. Например, такие материалы, как ложки, порошки и пены, поглощают звук.

Ультразвуковые датчики основаны на излучении ультразвукового луча. Луч отражается от цели в сторону датчика. Датчик измеряет временную задержку между излучением ультразвукового сигнала и возвращением эха. Поскольку скорость звука в воздухе хорошо известна, можно сделать вывод не только о наличии цели, но и о расстоянии между датчиком и целью. Поскольку для излучения сигнала и обнаружения эха используется один и тот же ультразвуковой преобразователь, непосредственно перед датчиком имеется определенное пространство, где обнаружение не происходит. Эта область называется слепой зоной ультразвукового датчика.

Слепая зона — это минимальное расстояние между поверхностью головки датчика и положением цели с первым идентифицируемым эхом. В слепой зоне не должно быть материала. В технических характеристиках ультразвукового датчика всегда указываются максимальное рабочее расстояние и слепая зона. По очевидным физическим причинам, чем больше рабочее расстояние, тем выше слепая зона.

Ультразвуковые датчики могут обнаруживать любые виды материалов, но фактическое рабочее расстояние зависит от звукопоглощающей способности материалов.

- Компактные материалы отражают ультразвуковой сигнал в сторону датчиков. К таким материалам относятся металлы, пластмассы или деревянные панели, плоские жидкие поверхности без пены. В этом случае датчик обнаруживает цель на полном рабочем расстоянии.
- Звукопоглощающие материалы или неровные поверхности отражают только часть падающего сигнала. К первым относятся такие материалы, как пены, текстиль, пластиковые гранулы; ко вторым — такие объекты, как слои овощей, картофель или яблоки. В этом случае эти материалы поглощают или рассеивают часть ультразвукового луча. Это означает, что для увеличения энергетического сигнала, получаемого от датчика, правильным выбором будет модель с большим рабочим расстоянием и большей энергией луча.

Другим аспектом, который следует учитывать, является положение цели. Если цель выровнена перпендикулярно направлению ультразвукового луча, она отражает всю энергию в сторону датчика. Напротив, если цель наклонена, часть энергии отклоняется. Если наклон увеличивается, датчик не получает никакой энергии и не обнаруживает цель. В случае наклонной цели возможным решением является световозвращающий ультразвуковой датчик. Световозвращающий ультразвуковой датчик требует для работы фиксированную, плоскую, перпендикулярную цель. Датчик устанавливается в это исходное положение, и каждый объект в середине обнаруживается независимо от положения и характеристик звукопоглощающего материала.

Ультразвуковые датчики разработаны для определенной среды: воздух со стандартным атмосферным давлением. Итак, что происходит, если происходит изменение:

- Газ передачи: ультразвуковые датчики предназначены для работы в воздухе. Если происходит изменение газа передачи (азот, гелий, ...), скорость ультразвукового луча меняется. Учитывая это, расстояние, измеренное в одно и то же время, может меняться. Датчик может давать другие показания, чем ожидаемые в воздухе.
- Температура: скорость ультразвукового луча в воздухе зависит от температуры. Серии UK/UT полностью компенсированы во всем рабочем диапазоне температур;
- Давление: ультразвуковые датчики предназначены для работы при стандартном атмосферном давлении (1 атм). Изменения давления окружающей среды влияют на скорость ультразвукового луча. При этом измеренное расстояние может отличаться от измерения в стандартных условиях. Датчики не подходят для корректной работы при высоком или низком давлении окружающей среды;
- Пыль, капли и влажность на сенсорной головке: ультразвуковые датчики очень устойчивы к наличию грязи на сенсорной головке. В любом случае, если накопление грязи превышает определенный порог, это влияет на правильную работу датчика. Необходимо содержать сенсорную головку как можно более чистой;
- Воздушный поток: ультразвуковые датчики очень устойчивы к присутствию воздушного потока и ветра при использовании на открытом воздухе. В любом случае, всегда

необходимо напоминать, что ультразвуковой луч движется в воздухе. Таким образом, если воздушный поток чрезмерный, ультразвуковой луч отклоняется от правильного пути к/от цели, и поэтому обнаружение может быть нестабильным. По этой причине необходимо проверить положение выходного отверстия пневматических клапанов;

- Условия окружающей среды для использования вне помещений: ультразвуковой датчик может работать вне помещений, поскольку имеет степень защиты IP67 и не подвержен воздействию солнечного света. В любом случае, суровые условия окружающей среды, такие как сильный дождь, снег и штормовой ветер, могут повлиять на правильность обнаружения цели.

Если вам нужно обнаружить металлический объект на небольшом расстоянии, лучшим решением будет индуктивный датчик. Они не подвержены влиянию условий окружающей среды (наличие воды, масла, смазки, неметаллических материалов, ...) и имеют очень высокую повторяемость. Смотрим рис. 1,2,3 например, серии Datasensing AD (миниатюрный M5), AE (M8), AM (M12), AK (M18) и AT (M30).

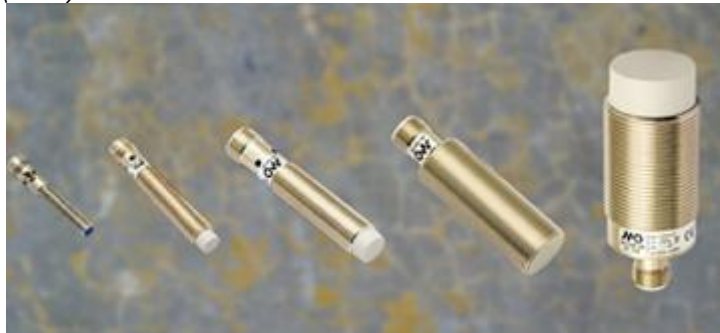


Рисунок 2. Индуктивный датчик

Для приложений по определению уровня и обнаружению гранулированных материалов (например, пластиковых гранул, семян, ...) правильным выбором является емкостный датчик. С помощью регулировки чувствительности можно настроить датчик на обнаружение целевых материалов. Рекомендуемые линейки продуктов Datasensing — серии C18 (M18) и C30 (M30).



Рисунок 3. Датчики серии Datasensing

Для обнаружения на большом расстоянии ультразвуковые датчики являются правильным решением. Ультразвуковые датчики также доступны с аналоговым выходом для измерения и измерения уровня сверху резервуара. Вы можете начать поиск продукта с Datasensing серий UK (M18) и UT (M30).



Рисунок 4. Датчики серии Datasensing

Структура умного дома включает в себя набор дополнительных систем и устройств, которые автоматизируют и оптимизируют работу различных процессов и функций внутри дома. Основная цель такой структуры — повышение комфорта, безопасности и

энергоэффективности за счет использования технологий Интернета вещей (IoT). Ниже рассмотрим основные компоненты и принципы работы умного дома:

1. Центральный управляющий хаб
2. Система освещения управления
 - Умные лампы и светильники
 - Датчики движения
 - Система климат-контроля.
 - Умные термостаты и климатические контроллеры
 - Датчики температуры, влажности и качества воздуха
3. Системы безопасности и видеонаблюдения.
 - Камеры наблюдения, датчики движения
4. Система управления энергопотреблением.
 - Умные розетки и счетчики счетчик электроэнергии
 - Солнечные панели и системы накопления энергии
5. Система водоснабжения и защиты от протечек.
 - Датчики протечек,
 - Системы управления водоснабжением
6. Система автоматизации и настройки (IoT)
 - Scenarios
7. Облачные технологии и удаленный доступ
 - Возможность мониторинга
 - Экономика энергетики
 - Улучшение безопасности
 - Гибкость и адаптивность

Заключение

В ходе работы изучены основные подходы к построению автоматизированной системы управления микроклиматом теплицы и проведён анализ сенсорных устройств, применяемых для контроля параметров окружающей среды. Установлено, что правильный выбор датчиков и исполнительных механизмов обеспечивает стабильность микроклимата и повышает эффективность выращивания растений.

Использование интеллектуальных систем управления и технологий IoT позволяет автоматизировать процессы мониторинга и регулирования условий внутри теплицы, снизить эксплуатационные затраты и повысить урожайность. Внедрение таких решений является перспективным направлением развития современных тепличных хозяйств.

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DEVELOPMENT OF TECHNOLOGY FOR MANUFACTURING OUTERWEAR FROM MULTILAYER MATERIALS

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РАЗРАБОТКА ТЕХНОЛОГИИ ИЗГОТОВЛЕНИЯ ВЕРХНЕЙ ОДЕЖДЫ ИЗ МНОГОСЛОЙНЫХ МАТЕРИАЛОВ

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Abstract

This paper examines the development of a technology for manufacturing outerwear from multilayer materials. It focuses on the selection and characterization of multilayer textile materials, their structural properties, and performance characteristics. The technological stages of outerwear production are analyzed, including design, cutting, assembly, and finishing, taking into account the specific characteristics of multilayer materials. Issues of improving the thermal, moisture, and strength properties of finished products, as well as ensuring comfort and wear resistance during use are considered. The research results can be used in the design and improvement of production technologies for modern outerwear.

Аннотация

В данной работе рассматривается разработка технологии изготовления верхней одежды из многослойных материалов. Основное внимание уделяется выбору и характеристике многослойных текстильных материалов, их структурным особенностям и эксплуатационным свойствам. Проанализированы технологические этапы производства верхней одежды, включая конструирование, раскрой, сборку и отделку изделий с учетом специфики многослойных материалов. Рассматриваются вопросы повышения теплозащитных, влагозащитных и прочностных характеристик готовых изделий, а также обеспечения комфорта и износостойкости при эксплуатации. Результаты исследования могут быть использованы при проектировании и совершенствовании технологий производства современной верхней одежды.

Keywords: Multilayer materials, outerwear, manufacturing technology, textile materials.

Ключевые слова: Многослойные материалы, верхняя одежда, технология изготовления, текстильные материалы.

Одной из главных задач швейной промышленности является создание красивой, удобной, разнообразной одежды для широких слоев населения. Одежды, отвечающей современным требованиям как с практической, так и с эстетической точек зрения. Сегодняшний заказчик хочет иметь одежды не вообще, а соответствующую определенному назначению, возрасту, климатическим и национальным особенностям. Особенно это относится к молодежной одежде. С другой стороны очень важным является снижение трудоемкости изготовления одежды, сокращения сроков её изготовления.

Азербайджанский технологический университета кафедре "Машиностроение и дизайн легкой промышленности" разработана технология изготовления межсезонной верхней одежды с пристегивающейся утепляющей прокладкой: пальто, куртка. Изделия состоять из двух компонентов: верхнего, выполненного из различных тканей и внутреннего, состоящего из многослойного материала, сочетающего в себе утепляющую прокладку, ветрозащитный слой, подкладку. Основные функции верхнего слоя эстетическая и защита от различных климатических и механических воздействиях. Он изготавливается из различных материалов:

пальтовых, плащевых, сорочечных тканей, трикотажа и выполняется как самостоятельное изделие.

Внутренней слой изготовлен из готового пакета одежды. Полотна в пакет могут соединяться между собой механическим и физико-химическим способами в зависимости от вида полотна. Технология изготовления внутренней части пальто очень проста. Срезы горловины, борта, проймы, оката окантовываются. Боковые плечевые и локтевые срезы рукавов соединены швом с предварительным снятием части слоев материала в области шва, разработанным на кафедре "Машиностроение и дизайн легкой промышленности" что позволяет значительно снизить толщину швов.

Предварительные расчеты, проведенные в рамках курсовых и дипломных проектов, показали, что трудоемкость изготовления верхней утепленной одежды значительно снижаться. Снижение трудоемкости происходит за счет вывода из технологического процесса всех промежуточные операций по обработке утепляющей прокладки и подкладки. Таким образом, предлагаемая технология изготовления верхней одежде является перспективной и заслуживает дальнейшего исследования. Внедрение её в производство позволит получить значительный экономический эффект.

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IMPROVEMENT OF THE QUALITY MANAGEMENT SYSTEM FOR POWDERED COMPOSITIONS BASED ON BIOLOGICALLY ACTIVE SUBSTANCES**Muratkhankyzy A.**
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In the conditions of the modern market, an important task for manufacturers is to ensure high quality products. This is especially true for spicy-aromatic compositions, which are widely used in the food, cosmetic and pharmaceutical industries. Biologically active substances (BAS) with diverse properties and a wide range of effects play an important role in shaping the quality of these compositions. This article discusses aspects of improving the quality management system of spicy-aromatic compositions based on the use of BAS. The use of lean manufacturing methods and quality management methods, such as 6 Sigma, is considered.

Аннотация

В условиях современного рынка важной задачей для производителей является обеспечение высокого качества продукции. Это особенно актуально для пряно-ароматических композиций, которые находят широкое применение в пищевой, косметической и фармацевтической промышленности. Важную роль в формировании качества этих композиций играют биологически активные вещества (БАВ), обладающие разнообразными свойствами и широким спектром действия. В данной статье рассматриваются аспекты совершенствования системы управления качеством пряно-ароматических композиций на основе использования БАВ. Рассмотрено использование методов бережливого производства и методов управления качеством, таких как 6 Sigma.

Keywords: *quality management system, powdered compositions, biologically active substances, production technology, current methods of quality assessment, problems, improvement of quality management.*

Ключевые слова: *система управления качеством, порошкообразные композиции, биологические активные вещества, технология производства, актуальные методы оценки качества, проблемы, совершенствование управления качеством.*

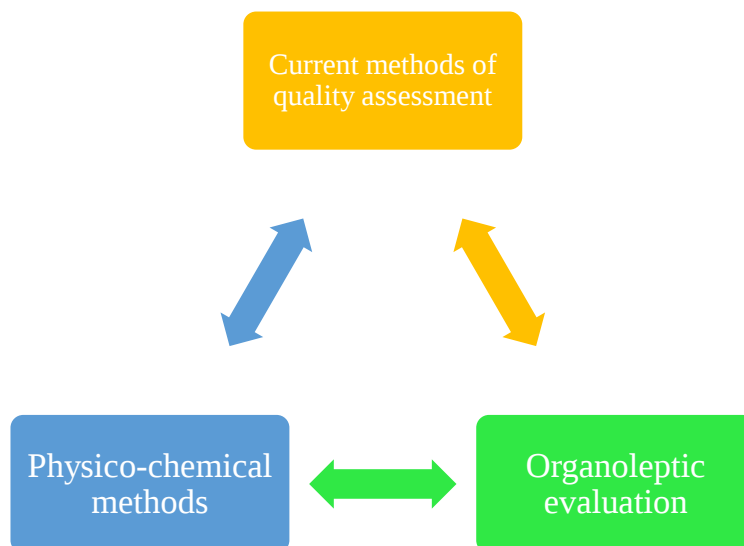
To understand the quality of powdered compositions: quality can be considered as a set of characteristics that determine their compliance with various requirements. This may include physico-chemical parameters, organoleptic properties, safety and compliance with standards. It should also be noted that the perception of quality is not only subjective, but also depends on cultural and regional consumption traditions [5].

The quality management System (QMS) includes all aspects of the organization of processes that ensure product compliance with established standards. According to the international standards ISO 9001 and ISO 22000, the effectiveness of the QMS is achieved through continuous monitoring, data analysis and the implementation of corrective actions. The use of BAS in spicy-aromatic compositions is associated with their ability to improve taste and aromatic characteristics, as well as their effect on the safety of products [1].

Previous scientific studies show that BAS can not only improve the organoleptic properties of compositions, but also have a positive effect on human health. For example, plant extracts such as curcumin, green tea extract and oleoresins have antioxidant activity and can contribute to the prevention of various diseases. In this regard, there is a need to develop and implement new quality control methods that will take into account the specifics of the use of BAS [2].

Current methods of quality assessment

In modern practice, various methods of assessing the quality of spicy-aromatic compositions are used:



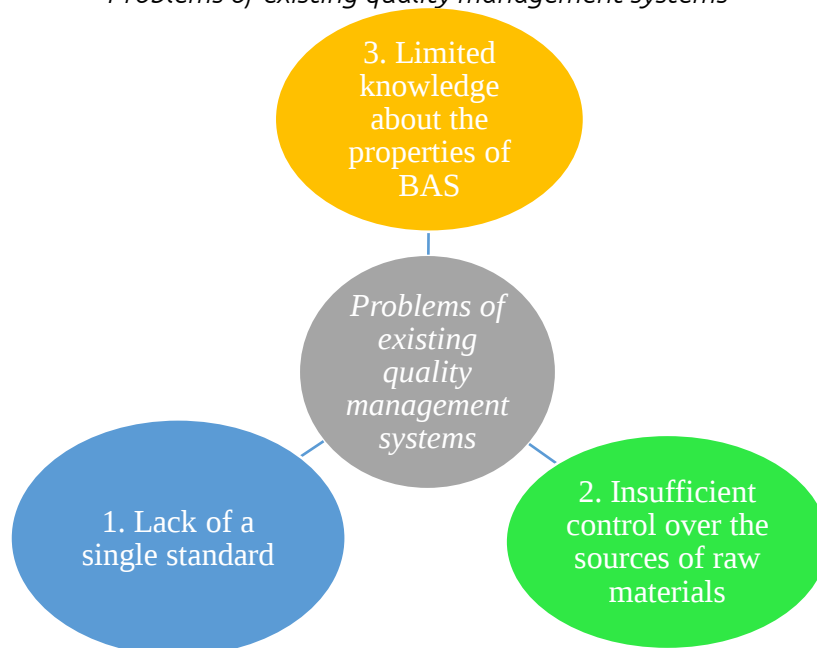
1. Physico-chemical methods

These methods include the assessment of physical and chemical characteristics such as viscosity, acidity, essential oil content, etc. The chromatography method, in particular, gas chromatography, is widely used to analyze the compositions of spicy-aromatic compositions.

2. Organoleptic evaluation

Organoleptic methods, including tasting and flavoring, allow us to evaluate the subjective qualities of products. Conducting blind tests with professional tasters or focus groups can provide valuable data on consumer preferences [3].

Problems of existing quality management systems

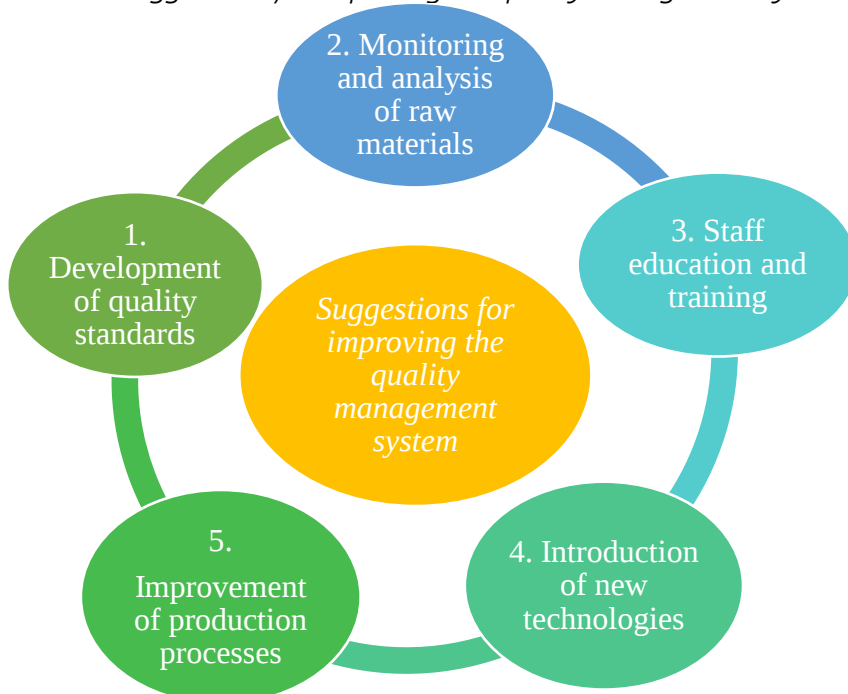


1. Lack of a single standard: At the moment, there are no clear international standards governing the quality of spicy-aromatic compositions, which makes it difficult to certify them and create an effective control system.

2. *Insufficient control over the sources of raw materials: The quality of BAS directly depends on the quality of the raw materials used. At the moment, many manufacturers do not pay due attention to the analysis and selection of suppliers.*

3. *Limited knowledge about the properties of BAS: Due to the lack of awareness of manufacturers about the properties and potential effects of BAS, a situation has arisen where many of them are used without proper scientific justification[3].*

Suggestions for improving the quality management system



1. Development of quality standards

The creation and implementation of unified quality standards based on modern research in the field of BAS will allow to harmonize approaches to the production and control of spicy-aromatic compositions. This may include both physico-chemical and organoleptic characteristics.

2. Monitoring and analysis of raw materials

It is necessary to implement a monitoring system that will allow manufacturers to monitor the quality of raw materials at all stages — from its receipt to processing. This can be implemented through a traceability system, which will allow for a more accurate assessment of the quality of the final product[4].

3. Staff education and training

It is important to conduct regular trainings for company employees in order to increase their awareness of the properties of BAS, methods of their analysis and their impact on product quality. This will make it possible to better cope with various challenges and adapt to changing market requirements.

4. Introduction of new technologies

The use of modern technologies, such as automated quality control systems and analytical chemistry methods, can significantly improve the effectiveness of quality management. Spectroscopy, chromatography and other methods can be used to analyze the qualitative characteristics of BAS and monitor changes in the production process. The introduction of information technology, automation and process control systems opens up new horizons for quality control. In particular, the use of Big Data and analytics allows for in-depth analysis of quality data and meeting consumer expectations.

5. Improvement of production processes

The use of lean manufacturing techniques and quality management techniques such as 6 Sigma can significantly improve production performance and reduce the number of defects [5].

Examples of successful implementation of quality management systems

To demonstrate the effectiveness of the proposed methods, let's look at several practical examples.

The case of one of the companies in the segmentation of spicy components

- 1

Application of green technologies

- 2

1. The case of one of the companies in the segmentation of spicy components

Companies using automation systems for quality control clearly observe a reduction in production time and a reduction in losses.

2. Application of green technologies

Some manufacturers have begun to implement sustainable methods that have not only improved product quality, but also reduced the negative impact on the environment. [4].

Improving the quality management system of spicy-aromatic compositions based on biologically active substances is an important task for manufacturers in a competitive environment. The need to develop uniform standards, control the quality of raw materials, professional development and the introduction of new technologies will significantly improve the quality of final products, as well as meet the increasing demands of consumers and safety standards.

Improving the quality management system of powdered compositions requires an integrative approach that includes both traditional and modern methods. Effective quality management not only increases the competitiveness of products, but also increases consumer confidence and brand credibility. It is important to continue to research and adapt new approaches to ensure high standards in the production of powdered compositions [4], [5].

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INFORMATION STRUCTURES OF SORTING STATIONS BASED ON IOT AND BIG DATA

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Abstract

Within the framework of the study, a conceptual scheme and a formal mathematical model of a five-layer architecture of an automated system for managing technological processes at a railway sorting station were developed, taking into account the integration of modern Internet of Things (IoT) technologies and Big Data analytics capabilities. The proposed architecture includes five main layers: physical, network, data processing, decision-making, and visualization. Each layer is adapted to operate under conditions of distributed infrastructure, high process dynamics, and large volumes of processed information. A distinctive feature of the proposed scheme of the automated technological process control system is the emphasis on accounting for time constraints inherent in real-time systems. This ensures the correct operation of the entire system within strict time limits. An important aspect was also the optimization of interlayer interaction aimed at reducing delays, increasing data exchange efficiency, and ensuring the consistency of actions of all system elements. The development and refinement of this concept make it possible to create flexible, scalable, and highly efficient control systems that meet modern requirements for the automation of technological processes in railway transport and contribute to increasing the reliability, stability, and performance of sorting stations, as well as their adaptation to changing operating conditions and the implementation of new technologies.

Keywords: railway transport, automated control system, sorting station, information structures, Internet of Things, Big Data, model.

In the modern approach to the automation of sorting stations (SS) in railway transport (RT), information structures that ensure real-time data processing, transmission, and analysis play a crucial role. The growth in data volume and the need to adapt to the dynamic operating conditions of rolling stock (hereinafter RS) require the use of advanced IT solutions in RT, such as the Internet of Things (IoT) and Big Data analytics, since, according to many researchers [1–6], these technologies make it possible to integrate data coming from numerous devices, process them *оперативно*, and use the analysis results to optimize station operations. However, despite significant progress [1–3], existing automation models do not fully address such aspects as system fault tolerance, reduction of infrastructure maintenance costs, and adaptation to variable conditions, including peak loads. These tasks become particularly important in the context of increasing complexity of technological processes and the need to enhance the reliability and economic efficiency of both SS and the railway transport system as a whole.

Therefore, within the framework of the current study, an improved model is proposed that takes into account distributed data collection from IoT devices, their processing using Big Data technologies, and dynamic routing of information flows in the automated technological process control system (ATPCS) of sorting stations. The proposed model focuses primarily on reducing data processing latency, ensuring system flexibility, and minimizing costs. The inclusion of these aspects, in our opinion, makes it possible to achieve increased performance of the ATPCS of sorting stations and to enhance their resilience to external and internal factors affecting their operational characteristics.

The aim of the study was to develop and substantiate a conceptual scheme and a formal mathematical model of a five-layer architecture of the automated technological process control system (ATPCS) of a sorting station, taking into account the integration of modern Internet of Things (IoT) technologies and Big Data analytics.

The model is based on a multi-level hierarchical structure that integrates IoT devices, Big Data processing technologies, and centralized/distributed control systems. The main elements of the system (see Fig. 1) include:

Level 1 – the physical infrastructure level (IoT layer), which includes a set of intelligent devices (sensors, controllers, actuators) installed at stations, tracks, and on rolling stock. Device data include

information on wagon speed and location, track condition, sorting hump load level, power consumption, etc.;

Level 2 – the data collection and preprocessing level, which includes IoT devices connected with edge computing nodes that perform preliminary data processing (e.g., noise filtering, aggregation) and transmit the processed information to the next level.

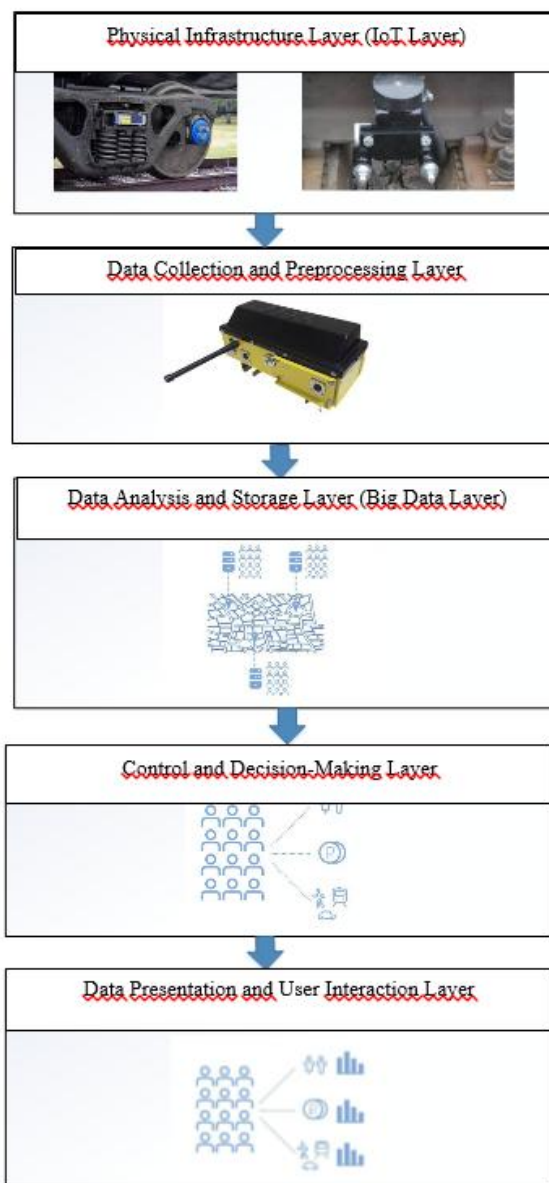


Figure 1 – Main Elements of the ATPCS of a Sorting Station with IoT and Big Data

Level 3 – the Data Analysis and Storage Layer (Big Data layer), which предполагает the presence of distributed data warehouses and computing platforms that process real-time data arrays and store them for further analysis. At this level, Big Data technologies are implemented, including data stream processing and parallel computing.

Level 4 – the Control and Decision-Making Layer, which includes machine learning (ML) and artificial intelligence (AI) algorithms. At this level, data are analyzed and optimized, for example, to predict failures and enable system adaptation to changing conditions.

Level 5 – the Data Presentation and User Interaction Layer, which includes interfaces for dispatchers and operators, as well as access to analytical reports, forecasts, and recommendations.

Conclusion

A conceptual scheme and a formalized mathematical model of a five-layer (five-level) architecture of the automated technological process control system (ATPCS) of a sorting station were developed, taking into account the integration capabilities of IoT and Big Data technologies. In the proposed scheme, each layer (physical, network, data processing, decision-making, and visualization) is adapted to operate under conditions of distributed infrastructure and large data volumes. Unlike existing solutions,

particular emphasis is placed on time constraints inherent in real-time systems and on optimizing inter-layer interaction. The refinement and further development of this ATPCS concept provide a foundation for creating flexible, scalable, and highly efficient control systems that meet modern requirements for the automation of technological processes in railway transport.

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