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ARTIFICIAL INTELLIGENCE AS A DRIVER OF DIGITAL TRANSFORMATION IN EDUCATION

Zhumagulova A.B.*[1], Yanovskaya O.A.[1]

[1]Independent Agency for Accreditation and Rating, Astana, Kazakhstan

ABSTRACT. This article examines the role of digital technologies and artificial intelligence (AI) in the economy. The study analyses the impact of AI on the development of education and science, as a key mechanisms for fostering human potential, which acts as a multiplier driving sustainable economic growth. The paper outlines guidelines for integrating AI into educational activities. The article pays particular attention to the benefits and concerns associated with using AI in the face of modern challenges within the educational environment, as well as how changes and IT technologies influence the development of academic freedom. In this context, cybersecurity, personal data protection, and the development of digital competencies emerge as important factors. The study aims to determine the role of AI as a digital tool in the development of the scientific and educational ecosystem. Developing sound models for integrating AI into educational activities is a key aspect of its effective implementation in the educational process. This is important for ensuring a balance between technological innovation, ethical principles, and high-quality education. To achieve the objective, the study examined the modern digital transformation of education, the use of AI, the impact of IT technologies on learning, and the risks associated with AI usage, while also substantiating the effectiveness of integrating AI into the educational environment.

The article presents a comprehensive study of AI as a key element in the digital transformation of the educational ecosystem in the current landscape, employing an integrated approach that encompasses the technological, organisational, pedagogical, and managerial processes of digital transformation.

The practical significance of the study lies in the potential to use the findings to develop digital development strategies for universities and educational platforms, as well as to design professional development programs for faculty and researchers regarding the application of AI technologies.

KEYWORDS: artificial intelligence, digital transformation, digital competencies, IT technologies, human potential, economic growth.

Искусственный интеллект как драйвер цифровой трансформации в образовании

Жумагулова А.Б.[1]*, Яновская О.А.[1]

[1]Независимое агентство аккредитации и рейтинга, Астана, Казахстан

АННОТАЦИЯ. В статье рассматривается роль цифровых технологий и искусственного интеллекта (ИИ) в экономике. Исследуется влияние ИИ на развитие образования и науки как ключевых механизмов формирования человеческого потенциала, выступающего мультипликатором устойчивого экономического роста. Определены основные направления интеграции ИИ в образовательную деятельность. Особое внимание уделяется преимуществам и рискам использования ИИ в условиях современных вызовов образовательной среды, а также влиянию происходящих изменений и ИТ-технологий на развитие академической свободы. В данном контексте важными факторами становятся кибербезопасность, защита персональных данных и развитие цифровых компетенций. Цель исследования заключается в определении роли ИИ как цифрового инструмента в развитии научно-образовательной экосистемы. Разработка обоснованных моделей интеграции ИИ в образовательную деятельность является ключевым аспектом его эффективного внедрения в образовательный процесс. Это имеет важное значение для обеспечения баланса между технологическими инновациями, этическими принципами и высоким качеством образования. Для достижения поставленной цели были рассмотрены современные процессы цифровой трансформации образования, применение ИИ, влияние ИТ-технологий на обучение и риски, связанные с использованием ИИ, а также обоснована эффективность интеграции ИИ в образовательную среду.

В статье представлено комплексное исследование ИИ как ключевого элемента цифровой трансформации образовательной экосистемы в современных условиях с применением интегрированного подхода, охватывающего технологические, организационные, педагогические и управленческие процессы цифровой трансформации.

Практическая значимость исследования заключается в возможности использования полученных результатов при разработке стратегий цифрового развития университетов и образовательных платформ, а также программ повышения квалификации профессорско-преподавательского состава и исследователей в области применения технологий ИИ.

КЛЮЧЕВЫЕ СЛОВА: искусственный интеллект, цифровая трансформация, цифровые компетенции, ИТ-технологии, человеческий потенциал, экономический рост.

Жасанды интеллект білім берудегі цифрлық трансформацияның драйвері ретінде

Жұмағұлова А.Б.[1]*, Яновская О.А.[1]

[1]Аккредиттеу және рейтингтің тәуелсіз агенттігі, Астана, Қазақстан

АҢДАТПА. Мақалада цифрлық технологиялар мен жасанды интеллекттің (ЖИ) экономикадағы рөлі қарастырылады. Тұрақты экономикалық өсуді қамтамасыз ететін мультипликатор ретінде әрекет ететін адами әлеуетті қалыптастырудың негізгі тетіктері болып табылатын білім мен ғылымның дамуына ЖИ-дің ықпалы зерттеледі. ЖИ-ді білім беру қызметіне интеграциялаудың негізгі бағыттары айқындалған. Білім беру ортасындағы заманауи сын-қатерлер жағдайында ЖИ-ді пайдаланудың артықшылықтары мен тәуекелдеріне, сондай-ақ болып жатқан өзгерістер мен IT-технологиялардың академиялық еркіндіктің дамуына әсеріне ерекше назар аударылады. Осы тұрғыда киберқауіпсіздік, дербес деректерді қорғау және цифрлық құзыреттерді дамыту маңызды факторларға айналады. Зерттеудің мақсаты ғылыми-білім беру экожүйесін дамытудағы цифрлық құрал ретінде ЖИ-дің рөлін анықтау болып табылады. ЖИ-ді білім беру қызметіне интеграциялаудың негізделген модельдерін әзірлеу оны білім беру үдерісіне тиімді енгізудің негізгі аспектісі болып табылады. Бұл технологиялық инновациялар, этикалық қағидаттар және жоғары сапалы білім беру арасындағы теңгерімді қамтамасыз ету үшін маңызды. Қойылған мақсатқа қол жеткізу үшін білім берудің заманауи цифрлық трансформациясы, ЖИ-ді қолдану, IT-технологиялардың оқыту үдерісіне ықпалы және ЖИ-ді пайдалануға байланысты тәуекелдер қарастырылып, сонымен қатар ЖИ-ді білім беру ортасына интеграциялаудың тиімділігі негізделді.

Мақалада қазіргі жағдайда білім беру экожүйесінің цифрлық трансформациясының негізгі элементі ретінде ЖИ кешенді түрде зерттеліп, цифрлық трансформацияның технологиялық, ұйымдастырушылық, педагогикалық және басқарушылық үдерістерін қамтитын интеграцияланған тәсіл қолданылған.

Зерттеудің практикалық маңыздылығы алынған нәтижелерді университеттер мен білім беру платформаларының цифрлық даму

стратегияларын әзірлеуде, сондай-ақ профессор-оқытушылар құрамы мен зерттеушілердің ЖИ технологияларын қолдану саласындағы біліктілігін арттыру бағдарламаларын әзірлеуде пайдалану мүмкіндігімен айқындалады.
ТҮЙІН СӨЗДЕР: жасанды интеллект, цифрлық трансформация, цифрлық құзыреттер, IT-технология, адами әлеует, экономикалық өсу.

INTRODUCTION. The impact of AI and IT technologies permeates all sectors of the economy. The current era of educational system development is characterised by the widespread adoption of modern IT technologies and artificial intelligence (AI), which is shaping new models of the educational environment. Artificial intelligence is emerging as a key driver of technological modernisation, significantly influencing knowledge generation, decision-making, and the development of new educational practices. In the digital economy, intelligent systems are moving beyond purely auxiliary roles to become full-fledged participants in research and educational activities. This is driving a qualitative transformation of research infrastructure, teaching methods, organisational processes, and the mechanisms of interaction among all stakeholders in the educational ecosystem.

The effectiveness of AI integration depends not only on the availability of digital infrastructure but also on the ability of universities to establish clear principles for its responsible and transparent use.

AI will help expand the capabilities of intellectual work. Innovative models will enable the processing of vast amounts of information, the conduct of advanced analysis and assessment, the advancement of deeper scientific research, and the determination of personalised educational pathways. This will enhance research efficiency, reduce information processing time, and facilitate the creation of an innovative model for digital science and education.

It is important to emphasise that the digitalisation of education extends beyond the mere implementation of specific IT technologies. Today, the modern university is evolving into an intelligent digital ecosystem in which AI is integrated into the educational environment, research activities, corporate governance, and the system for assessing educational quality. The adoption of intelligent educational platforms expands learning opportunities and accounts for individual student characteristics, enabling prediction of academic performance, identification of potential threats and educational risks, and determination of personalised learning pathways.

However, the adoption of AI also brings significant challenges. Key issues include academic integrity, the reliability of results, transparency, personal data protection, the digital divide, and copyright. Developing new professional competencies among educators is becoming important. Therefore, a pivotal role is played by the integration of new AI models into the educational environment that must define not only technological capabilities but also socio-ethical principles.

MATERIALS AND METHODS. In recent times, the study of AI and digital changes in education has taken on a global dimension. Research views AI as a key driver of institutional transformation that influences the development of human potential [1, 2, 3]. As noted in academic studies, the development of AI reflects the digital transformation of educational institutions. Research in the field of AI in education highlights the following key areas:

- intelligent tutoring systems;
- adaptive learning;
- personalised learning pathways;
- automated knowledge assessment;
- intelligent teaching assistants;
- educational analytics;
- generative educational services.

Most studies demonstrate the positive impact of AI on learning personalisation, increased motivation, and the quality of feedback. However, the effectiveness of these technologies depends on instructional design, the digital competencies of educators, and the level of AI integration into the educational process. [4,5]

Accordingly, our research methodology is based on systems, competence-based, process, and risk-oriented approaches, as well as a comparative analysis of international scholarly literature and the regulatory acts of the Republic of Kazakhstan:

- Systems approach - views AI as a factor simultaneously influencing teaching, assessment, academic culture, management, and learning outcomes.
- Competency-based approach - AI competence is viewed as part of modern educational outcomes.
- Process-based approach - quality is analyzed not only through the final result but also through the process of achieving it.
- Risk-based approach - assessment of risks (academic dishonesty, unreliability of information, breaches of confidentiality, and reduced learner autonomy).
- Comparative approach - comparison of international and national quality assurance frameworks.

Currently, despite the potential of AI, greater attention must be paid to ethical issues: academic integrity, personal data protection, copyright, and digital development.

RESULTS AND DISCUSSION. As noted in academic publications, the development of AI requires regulatory mechanisms and the responsible use of IT technologies. [6,7,8]

The Law of the Republic of Kazakhstan "On Education" establishes the fundamental legal framework for the functioning of the education system and the assurance of educational service quality. The Law enshrines the powers and responsibilities of education system stakeholders and the institutional basis for quality assurance. [9]

At the level of regulating the activities of higher and postgraduate education organisations, provisions are made for a quality assurance policy, the development of educational programmes, student-centred learning and assessment, teaching staff, resources, information management, public information, continuous monitoring and periodic program evaluation, as well as external quality assurance in accordance with the ESG.

The State Compulsory Standard of Higher Education is focused on learning outcomes. In the current version of the document, learning outcomes are defined as knowledge, abilities, and skills acquired by the student and validated through assessment, as well as the values and attitudes they have developed. Furthermore, the current version explicitly stipulates that higher education institutions must develop and implement educational programmes aimed at mastering competencies related to the application of artificial intelligence.

All of this establishes a regulatory framework for incorporating AI competencies into the system of educational outcomes.

In this context, the Concept for the Development of Artificial Intelligence for 2024-2029, approved by a decree of the Government of the Republic of Kazakhstan, serves as a key document. It views AI as a strategic direction for the country's development. At the same time, the Concept for the Development of Higher Education and Science for 2023-2029 outlines the digital transformation of higher education. The implementation plan for this Concept specifically provides for the development of an inter-university standard regarding the use of AI in education.[10]

In 2025, the Ministry of Science and Higher Education of the Republic of Kazakhstan adopted AI standards for

higher education institutions and advanced the AI-Sana programme. Thus, Kazakhstan is actively transitioning from general digitalisation to the institutional AI transformation of higher education.

In conducting a comparative analysis of international approaches, it is important to highlight five key principles:

1. Student-centredness – AI should expand the learner's capabilities rather than replace their responsibility.
2. Pedagogical rationale – AI should be used to improve the educational process.
3. Evidence-based approach – AI implementation should be evaluated based on its educational impact.
4. Transparency – learners and instructors must understand the rules for AI use and the responsibility for outcomes.
5. Continuous improvement – AI policies should be regularly reviewed.

These principles form the foundation for integrating AI into education. The study proposes a series of practical recommendations for Kazakhstani higher education institutions:

1. Develop an institutional AI policy that includes not only digitalisation but also a quality assurance system.
2. Integrate AI into the internal quality assurance system.
3. Revise academic policies of academic integrity rules to address provisions regarding permissible AI use, disclosure of AI usage, responsibility, data protection, and procedures for resolving disputes.
4. Revise assessment practices, shifting the primary focus from control to demonstrating the attainment of competencies.
5. Incorporate AI competencies into educational programmes. This is particularly relevant given that the current State Compulsory Educational Standard already mandates the development and implementation of programmes aimed at mastering AI application competencies.

It is important for the university to annually monitor the level of AI competence, indicators of academic integrity, assessment quality, educational outcomes, and participant satisfaction.

6. Conduct an annual AI audit covering not only the technological infrastructure but also educational, ethical, and organisational aspects.
7. Implement pilot projects to test AI tools within specific educational programmes and evaluate the effectiveness of the solutions.
8. Engage with employers to involve them in defining the AI competencies that graduates genuinely need.

Artificial intelligence is being actively integrated into the educational process. The spread of AI decrease the adequacy of traditional methods for assessing the final educational outcome. In the context of AI adoption, academic integrity must be grounded in transparency and the responsible use of digital technologies. AI competence is emerging as a new component of educational outcome quality, consequently, the quality assurance system must be supplemented with indicators of institutional readiness for AI, which can serve as a tool for the university's internal self-assessment and continuous improvement.

CONCLUSION. Thus, AI is becoming a strategic factor in the digital transformation of education, requiring further in-depth study and the development of a legislative framework. AI significantly increases the efficiency of educational and research activities by automating the search for, analysis of, and processing of information. The use of intelligent educational systems enables personalised learning and contributes to improving the quality of the educational process. The adoption of generative artificial intelligence is transforming the professional work of educators and researchers.

At the same time, demands regarding academic integrity, information security, and the ethical use of digital technologies are increasing. Addressing this requires the establishment of an appropriate regulatory framework.

The effective integration of AI into education requires systematic cooperation between educational institutions, government bodies, technology developers, and employers. Such cooperation will contribute to the development of a sustainable digital educational environment capable of responding flexibly to technological changes and the evolving needs of the labour market. Particular attention should also be paid to continuously improving the digital competencies of both educators and students. Therefore, the creation of an intelligent digital ecosystem integrating AI, big data, cloud computing, and analytical platforms is important for the future development of education. Prospects for further research lie in developing quantitative models to assess the effectiveness of AI implementation, examining the impact of generative models on research quality, and analysing the long-term socio-economic consequences of the digital transformation of the educational environment.

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AUTHOR INFORMATION:

Жумагулова Алина Бакытжановна - кандидат юридических наук, генеральный директор Независимого агентства аккредитации и рейтинга (IAAR), Астана, Казахстан. E-mail: iaar@iaar.kz

Яновская Ольга Алексеевна – д.э.н., профессор, PhD, советник генерального директора Независимого агентства аккредитации и рейтинга (HAAP/IAAR), Астана, Казахстан.

Жұмағұлова Алина Бақытжанқызы - заң ғылымдарының кандидаты, бас директор, Аккредиттеу және рейтинг тәуелсіз агенттігі (IAAR), Астана, Қазақста. E-mail: iaar@iaar.kz

Яновская Ольга Алексеевна – э.ғ.д., профессор, PhD, Аккредиттеу және рейтингтің тәуелсіз агенттігі (IAAR) бас директорының кеңесшісі, Астана, Казахстан.

Zhumagulova Alina - Candidate of Juridical Sciences, General Director, Independent Agency for Accreditation and Rating (IAAR), Astana, Kazakhstan. E-mail: iaar@iaar.kz

Yanovskaya Olga – Dr. Sci. (Econ.), Professor, PhD, Advisor to the General Director, Independent Agency for Accreditation and Rating (IAAR), Astana, Kazakhstan.