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ARTIFICIAL INTELLIGENCE IN THE EDUCATION SECTOR OF KAZAKHSTAN: OPPORTUNITIES AND PROSPECTS

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Abstract. This article examines the potential for implementing artificial intelligence (AI) technologies in the education system of Kazakhstan. It focuses on how AI can contribute to the individualization of learning, improve the quality of education in remote regions, support teachers, and develop digital literacy among students. Key areas of AI use are analyzed, such as the automation of routine tasks, the creation of personalized educational programs, distance learning, and the development of educational materials in the Kazakh language. It also discusses the challenges associated with the use of AI and predicts its long-term effects on the development of the country's educational system.

Keywords. Artificial intelligence, education, Kazakhstan, personalized learning, digital literacy, automation, distance learning, educational technologies, AI tutors, data analysis, educational materials in Kazakh.

Introduction. Modern technologies are rapidly changing all spheres of life, including education. The introduction of artificial intelligence (AI) opens up new horizons for increasing the efficiency of educational processes, improving accessibility of education and creating personalized learning programs.

In Kazakhstan, where the educational system faces challenges such as inequality of access between urban and rural regions, a shortage of qualified teachers and the need to train personnel for high-tech industries, AI can become a key tool for solving these problems.

AI technologies have the potential to transform learning, from automating routine tasks such as checking assignments to creating smart educational platforms that adapt to the needs of each student. This article explores the opportunities that AI provides for the educational system of Kazakhstan, analyzes the prospects for its application in schools and universities, and discusses the challenges facing the implementation of these technologies.

"By 2029, the number of products using artificial intelligence should increase 5-fold. Accordingly, the share of educational programs or disciplines on artificial intelligence should increase. We need qualified specialists in this field. At the same time, it is important to take into

account the capabilities and needs of domestic companies as much as possible, which will create a multiplier effect on the economy as a whole," Olzhas Bektenov noted [1].

According to the survey results, currently 31% of financial market participants use AI in their activities to one degree or another. The highest level of AI use is observed among second-tier banks – 60%. At the same time, 45% of respondents noted that they plan to use AI in 2024.

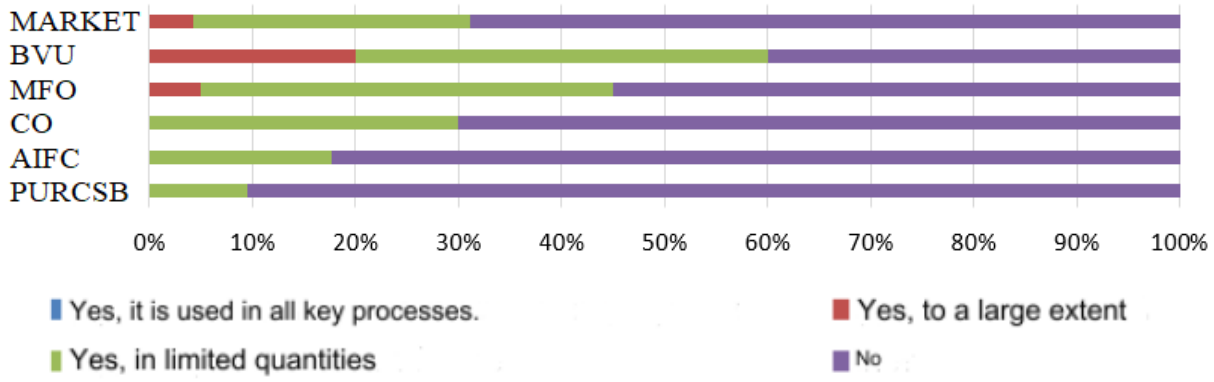

Figure 1 - Use of AI in the activities of financial organizations

Experts note that AI is the most significant technology trend in the modern world. According to Crunchbase research, investments in AI startups in 2023 will reach almost $50 billion, which is 9% more than the previous year.

For the first time, artificial intelligence on the scale of Kazakhstan is mentioned in the Digital Kazakhstan program. It is also found in such strategic documents as the National Development Plan of the Republic of Kazakhstan until 2025 and the Concept of Digital Transformation, Development of the Information and Communication Technologies and Cybersecurity Industry for 2023-2029.

According to the Government Readiness Index for Artificial Intelligence for 2023, conducted by Oxford Insights, Kazakhstan is in 72nd place among 193 countries, and in 3rd place in the regional ranking for South and Central Asia after India and Turkey [2].

According to some international estimates, artificial intelligence will provide 7% of the world's GDP by 2030. And by 2027, the capitalization of the global artificial intelligence market will significantly exceed $400 billion.

The probability of cyberattack combinations is directly proportional to the development of digitalization. That is, the more data is digitalized and processed, the more combinations appear to steal this data. For example, fraudulent schemes with deepfakes of famous athletes and even with the President of the country have recently become popular. Voice phishing is also often used, when the victim is convinced to disclose valuable personal information over the phone or send money using the voice of a loved one, - notes the cybersecurity expert [3].

When using AI tools on a large scale in various areas, there should be rules and regulations for its use, and ethical standards should not be violated. That is why the President recently noted the importance of developing AI in a constructive direction. Special attention should be paid to establishing ethical standards, protecting data and preventing cyber threats in this area [4].

The performance of these simple machine learning algorithms depends heavilyon therepresentationof the data they are given. For example, when logisticregression is used to recommend cesarean delivery, the AI system does not examinethe patient directly. Instead, the doctor tells the system several pieces of relevantinformation, such as the presence or absence of a uterine scar. Each piece ofinformation included in the representation of the patient is known as afeature.Logistic regression learns how each of these features of the patient correlates withvarious outcomes [5].

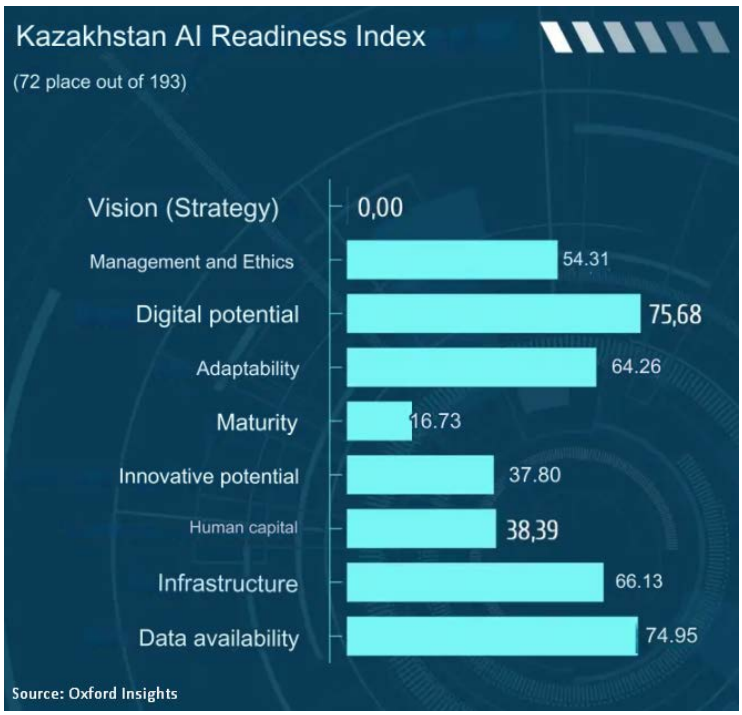

Figure 2 - Kazakhstan's Rating for Readiness to Implement Artificial Intelligence

As Yoshua Bengio and Ian Goodfellow point out in their book Deep Learning, deep neural networks have changed the way AI is trained. They can extract complex hierarchical representations of data, making them particularly powerful for tasks like image classification and speech recognition. CNN (convolutional neural networks) and RNN (recurrent neural networks) architectures have proven effective in real-world applications such as autonomous driving and machine translation. However, despite their success, these networks remain limited by the training data and are unable to move beyond pre-defined scenarios [6].

The next stage of AI development is systems that can learn on their own. Richard Sutton and Andrew Barto's book "Reinforcement Learning: An Introduction" describes the key principles of reinforcement learning. Unlike deep neural networks, which rely on large amounts of data, reinforcement learning algorithms learn through interaction with the environment. This approach allows the system to not just classify or predict, but also make decisions based on long-term strategies. The term dynamic programming (DP) refers to a collection of algorithms that can be used to compute optimal policies given a perfect model of the environment as a Markov decision process (MDP). An example is algorithms like DeepMind's AlphaGo, which can adapt and improve its game strategy without the need for pre-labeled data [7].

Generative models such as generative adversarial networks (GANs) have opened up a new approach to creating synthetic data. In Generative Deep Learning, David Foster details how GANs can create high-quality images, text, and music based on simple models of interactions between two neural networks, a generator and a discriminator. Generative networks are becoming an important part of unsupervised learning systems because they can generate rich data to train other systems or simulate real-world scenarios to test autonomous agents [8]

. While deep neural networks and unsupervised learning systems offer many capabilities, they remain limited in terms of energy consumption and the speed at which they can adapt to new challenges. In the future, neural networks may evolve towards neuromorphic systems that mimic the structure and function of biological neurons. Simon Haykin's Neural Networks and Learning Machines discusses the prospects for bio-inspired architectures that could lead to more efficient and energy-saving systems. These systems will be closer to the human brain in their structure and will be able to learn faster and with less resource expenditure [9]

Neural networks have evolved significantly in recent decades, evolving from simple models inspired by biology to complex systems that power many modern artificial intelligence (AI) applications. With the rise of deep learning, we've seen advances in areas like computer vision, natural language processing, and robotics. However, despite this, deep neural networks remain heavily dependent on pre-labeled data and manual hyperparameter tuning. The advent of self-learning systems like reinforcement learning is ushering in a new era of AI that can adapt and learn from experience.

.***Materials and methods.*** The study used various sources, including scientific articles, analytical reports and examples of practical application of artificial intelligence in education at the international level. The main focus is on studying the experience of implementing AI in the educational systems of other countries, as well as analyzing current trends in the digitalization of education in Kazakhstan.

Materials:

- Analytical reports on the state of education in Kazakhstan provided by the Ministry of Education and Science of the Republic of Kazakhstan and international organizations (UNESCO, World Bank).

- Scientific publications on the use of AI in education, available through the Scopus, Web of Science and Google Scholar databases.

- Reports and studies on the use of AI in educational platforms such as Coursera, Khan Academy, Duolingo and other international projects.

- Kazakhstani educational programs that include elements of digitalization and the integration of AI technologies.

Methods:

- Literature analysis. A comprehensive literature review was conducted to identify current achievements in the field of AI in education and the possibilities of its application in Kazakhstan.

- Comparative analysis. The method allowed us to compare the experience of using AI in education in Kazakhstan and other countries, identifying common problems and successful strategies.

- Surveys and interviews. Surveys were conducted among teachers, students, and education experts in Kazakhstan to identify the level of digital literacy and readiness for the implementation of AI.

- Content analysis of data on current digital initiatives in the educational system of Kazakhstan, including programs aimed at developing IT infrastructure and training specialists in the field of AI.

- These materials and methods allowed us to obtain a comprehensive picture of the possibilities of implementing AI in the educational system of Kazakhstan, as well as to identify key barriers and prospects in this area.

Results and discussion. Data analysis showed that the use of artificial intelligence can significantly improve the quality and accessibility of education in Kazakhstan. The introduction of personalized educational platforms based on AI opens up the possibility of adapting educational material to the needs of each student. An example of the successful implementation of such technologies can be global platforms such as Khan Academy and Coursera, which could be adapted to Kazakhstani conditions, including support for the Kazakh and Russian languages.

One of the key issues identified in the study is the lack of quality educational materials in the Kazakh language. AI, especially in the form of machine translation and automated content creation, can help develop new educational resources. This will speed up the process of adapting international educational programs and make them more accessible to Kazakh-speaking students.

Despite the obvious advantages of AI, there are a number of challenges associated with its implementation in the educational system of Kazakhstan. One of the main barriers is the lack of preparation of teachers and students to use digital tools. Survey results showed that a significant portion of teachers do not feel confident in working with new technologies, and students' digital literacy remains at an average level.

Another important aspect is data ethics and privacy. Collecting and processing large amounts of data using AI raises concerns about the protection of students' and teachers' personal information. For the successful implementation of AI, it is necessary to develop a clear legal and ethical framework that will ensure data security.

Conclusions. The use of AI in Kazakhstan's education system can not only improve access to quality education, but also help the country prepare a new generation of specialists needed for economic growth. However, it is important to consider the need for investment in digital infrastructure, teacher training, and the development of ethical standards for the use of AI in education to ensure its most effective and safe implementation.

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ИСКУССТВЕННЫЙ ИНТЕЛЛЕКТ В СФЕРЕ ОБРАЗОВАНИЯ КАЗАХСТАНА: ВОЗМОЖНОСТИ И ПЕРСПЕКТИВЫ

Аннотация. В статье рассматривается потенциал внедрения технологий искусственного интеллекта (ИИ) в систему образования Казахстана. Основное внимание уделяется тому, как ИИ может способствовать индивидуализации обучения, повышению качества образования в отдаленных регионах, поддержке учителей и развитию цифровой грамотности среди учащихся. Анализируются ключевые направления использования ИИ, такие как автоматизация рутинных задач, создание персонализированных образовательных программ, дистанционное обучение и разработка учебных материалов на казахском языке. Также обсуждаются проблемы, связанные с использованием ИИ, и прогнозируется его долгосрочное влияние на развитие образовательной системы страны.

Ключевые слова: искусственный интеллект, образование, Казахстан, персонализированное обучение, цифровая грамотность, автоматизация, дистанционное обучение, образовательные технологии, ИИ-репетиторы, анализ данных, учебные материалы на казахском языке.

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ҚАЗАҚСТАННЫҢ БІЛІМ БЕРУ САЛАСЫНДАҒЫ ЖАСАНДЫ ИНТЕЛЛЕКТ: МҮМКІНДІКТЕРІ МЕН БОЛАШАҒЫ

Аңдатпа. Мақалада Қазақстанның білім беру жүйесіне жасанды интеллект (AI) технологияларын енгізу әлеуеті қарастырылады. Негізгі назар AI оқытуды жекелендіруге, шалғай аймақтардағы білім сапасын жақсартуға, оқытушыларға қолдау көрсетуге және студенттер арасында цифрлық сауаттылықты дамытуға қалай көмектесетініне аударылады. Күнделікті тапсырмаларды автоматтандыру, дербестендірілген білім беру бағдарламаларын құру, қашықтықтан оқыту және қазақ тілінде оқу материалдарын әзірлеу сияқты AI қолданудың негізгі бағыттары талданады. Сондай-ақ ЖИ-ні қолданумен байланысты проблемалар талқыланып, оның елдің білім беру жүйесінің дамуына ұзақ мерзімді әсері болжанады.

Кілт сөздер: жасанды интеллект, білім, Қазақстан, дербестендірілген оқыту, цифрлық сауаттылық, автоматтандыру, қашықтан оқыту, білім беру технологиялары, AI репетиторлары, мәліметтерді талдау, қазақ тіліндегі оқу материалдары.