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ARTIFICIAL INTELLIGENCE IN EDUCATION: IMPACT, APPLICATIONS AND FUTURE PROSPECTS

Abstract

The article explores the use of artificial intelligence (AI) technologies in education, providing examples from Kazakhstan and abroad, and discussing their potential and prospects in this field. It outlines a strategy model for implementing AI in higher education, including planning, implementation, and evaluation of effectiveness. The study highlights positive trends in the adoption of AI in Kazakhstani universities, supported by the Republic's interest and successful integration of advanced technologies in higher education. A survey conducted among teachers of "Informatics" and "Mathematics-Informatics" programs at Zhetysu University named after I. Zhansugurov assessed the use of AI in education and identified factors hindering its application. The research substantiated the stages of integrating AI elements into the training of computer science teachers, demonstrating improvements in education quality and student motivation for learning and scientific research.

Keywords: artificial intelligence; automation; educational process; digital technologies; algorithms.

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БІЛІМ БЕРУ ПРОЦЕСІНДЕГІ ЖАСАНДЫ ИНТЕЛЛЕКТ: ӘСЕРІ, ҚОЛДАНЫЛУЫ ЖӘНЕ БОЛАШАҚ ПЕРСПЕКТИВАЛАРЫ

Аңдатпа

Мақалада білім беруде жасанды интеллект (АІ) технологияларын қолдану, Қазақстаннан және шетелден мысалдар келтіру, олардың осы саладағы әлеуеті мен перспективаларын талқылау қарастырылған. Онда жоғары оқу орындарында жасанды интеллектті енгізудің стратегиялық моделі, оның ішінде жоспарлау, енгізу және тиімділікті бағалау көрсетілген. Зерттеу барысында республиканың қызығушылығы мен жоғары білім берудегі озық технологиялардың сәтті интеграциялануының арқасында қазақстандық жоғары оқу орындарында жасанды интеллектті енгізудің оң тенденциялары атап өтілді. І. Жансүгіров атындағы Жетісу университетінің "Информатика" және "Математика-Информатика" бағдарламаларының оқытушылары арасында жүргізілген сауалнама АІ-дің білім беруде қолданылуын бағалап, оны қолдануға кедергі келтіретін факторларды анықтады. Зерттеу информатика мұғалімдерін даярлауға жасанды интеллект элементтерін енгізу кезеңдерін негіздеді, білім беру сапасының жақсарғанын және оқушылардың оқуға және ғылыми зерттеулерге деген ынтасын көрсетті.

Түйін сөздер: жасанды интеллект; автоматтандыру; оқу процесі; сандық технологиялар; алгоритмдер.

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ИСКУССТВЕННЫЙ ИНТЕЛЛЕКТ В ОБРАЗОВАНИИ: ВЛИЯНИЕ, ОБЛАСТЬ ПРИМЕНЕНИЯ И ПЕРСПЕКТИВЫ НА БУДУЩЕЕ

Аннотация

В статье исследуется использование технологий искусственного интеллекта (ИИ) в образовании, приводятся примеры из Казахстана и из-за рубежа, а также обсуждается их потенциал и перспективы в этой области. В ней описывается стратегическая модель внедрения ИИ в высшее образование, включая планирование, внедрение и оценку эффективности. В исследовании подчеркиваются положительные тенденции во внедрении искусственного интеллекта в казахстанских университетах,

подкрепленные интересом Республики и успешной интеграцией передовых технологий в высшее образование. Опрос, проведенный среди преподавателей программ "Информатика" и "Математика-информатика" в Жетысуском университете имени И. Жансугурова, дал оценку использованию искусственного интеллекта в образовании и выявил факторы, препятствующие его применению. Исследование обосновало этапы интеграции элементов искусственного интеллекта в подготовку учителей информатики, продемонстрировав улучшение качества образования и мотивации учащихся к учебе и научным исследованиям.

Ключевые слова: искусственный интеллект; автоматизация; образовательный процесс; цифровые технологии; алгоритмы.

Main provisions

The article examines the use of artificial intelligence (AI) technologies in education, with some examples highlighting their potential and prospects. It proposes a strategic model for implementing AI in higher education, focusing on planning, execution, and evaluation. The study identifies positive trends in Kazakhstani universities, supported by national initiatives to integrate advanced technologies. A survey at Zhetysu University assessed AI usage in education and pinpointed challenges limiting its adoption. The research demonstrates that incorporating AI in teacher training enhances education quality and boosts student motivation for learning and research.

Introduction

The creation and development of artificial intelligence (AI) is a complex and multifaceted process motivated by various factors. Artificial intelligence has enormous potential to solve problems that human intelligence cannot always handle. This may include analyzing large volumes of data, optimizing manufacturing processes, weather forecasting, developing new drugs, and much more. V. Nabiev (2010) [1] defines artificial intelligence as the ability of a computer or a controlled device to perform tasks similar to human actions. The author emphasizes that we are talking about cognitive processes such as reasoning, meaning formation, generalization and learning based on accumulated experience. S. Russell and P. Norvig (2003) [2] interprets artificial intelligence as machine or computational intelligence that covers a variety of applications, including learning and performing tasks such as playing chess, proving theorems, writing poetry, and diagnosing diseases. According to N. Nilsson (2014) [3], artificial intelligence is an algorithmic system capable of simulating human intelligence. The relevance of the research is due to the growing need to modernize educational processes in response to digital transformation. Currently, it is extremely important to offer an education that meets the needs of both students and professionals. In order to improve its educational system, Kazakhstan is actively introducing digital technologies, such as artificial intelligence, into the educational processes of universities.

AI can significantly increase the efficiency and productivity of various fields of activity, such as industry, transport, healthcare, education and business. Students are very active and quickly adapt to new realities. In Hong Kong, an initiative was launched in which a course called "Fundamentals of Artificial Intelligence" was organized for university students. This pilot project aims to raise public awareness about the basics of AI. The program is focused not only on transferring knowledge about the key principles of technology, but also on preparing students for productive interaction with AI in the context of accelerated digital transformation [4]. Artificial Intelligence (AI) has revolutionized education by enabling personalized learning and creating intelligent learning environments using technologies like machine learning, deep learning, and natural language processing [5]. These advancements adapt education to individual needs, reshaping the role of educators. However, successful AI integration requires more than advanced technologies. Studies highlight a lack of connection between AI methods and educational theories, which limits effectiveness [6]. For AI to achieve meaningful results, it must align with pedagogical principles and address learner-specific needs [7]. In summary, while AI offers transformative potential, its success depends on bridging the gap between technology and education theory.

Having studied the works in the field of artificial intelligence, the advantages and disadvantages of AI were revealed (Table 1).

Table 1. The pros and cons of artificial intelligence in education

Aspect	Advantages	Disadvantages
Personalization	<ul style="list-style-type: none"> - Tailored learning approaches for each student. - Adaptation of educational materials to the student's knowledge level and learning pace. 	<ul style="list-style-type: none"> - May limit the development of collaborative skills. - Risk of students becoming overly reliant on automation.
Learning Environments	<ul style="list-style-type: none"> - Use of intelligent technologies like neural networks to create interactive platforms. - Accelerated access to knowledge. 	<ul style="list-style-type: none"> - High costs of development and implementation. - Need for technical support and regular updates.
Efficiency	<ul style="list-style-type: none"> - Automation of routine tasks such as grading. - Reduced workload for teachers, allowing focus on creative tasks. 	<ul style="list-style-type: none"> - Challenges in ensuring objectivity in automated assessments. - Insufficient accuracy in analyzing complex cognitive processes.
Teacher's Role	<ul style="list-style-type: none"> - Enables focus on analytical and creative aspects of teaching. - Supports decision-making through AI tools. 	<ul style="list-style-type: none"> - Risk of diminishing the teacher's role. - Difficulties in adapting teachers to new technologies.
Ethical Aspects	<ul style="list-style-type: none"> - Transparent use of technologies. - Potential for protecting student data when properly configured. 	<ul style="list-style-type: none"> - Issues with data privacy and usage. - Lack of clear standards for AI implementation.
Theoretical Basis	<ul style="list-style-type: none"> - Potential to integrate learning theories (e.g., situational learning) to enhance educational program quality. 	<ul style="list-style-type: none"> - Limited research connecting AI methods with educational theories. - Rare use of learning theories in designing educational systems.

As can be seen from the table, after analyzing all the identified advantages and disadvantages, it was found that the use of AI in education leads to significant achievements, optimal results in improving the efficiency of the educational process, although there are limitations in subject-social relations in the educational process.

Research methodology

During the research following stages were conducted.

1. Planning. Research objectives have been established, which include analyzing the impact of artificial intelligence on the educational process, as well as formulating key issues related to the integration, benefits, and challenges of using AI. The literature review served as the basis for a theoretical analysis.

2. Data collection. Surveys were conducted among 50 teachers and 30 students of Zhetysu University from various specializations, including informatics, mathematics-informatics. The survey focused on the criteria such as academic performance, learning satisfaction, administrative efficiency.

3. Implementation Analysis. The analysis of tools based on artificial intelligence, including adaptive learning platforms, virtual assistants and automated assessment systems, was executed in order to assess their effectiveness in the educational environment.

4. Evaluation. The data was handled using statistical methods to actuate changes in academic performance, process effectiveness, and satisfaction levels. The key metrics were improved grades, reduced time spent on administrative tasks, and student satisfaction.

5. Recommendations. Practical advice is formulated aimed at improving the effectiveness of the introduction of artificial intelligence, overcoming emerging obstacles and coordinating the use of technology with educational principles.

In addition, research works and analyzes of foreign scientists related to artificial intelligence were used as the main source of information. In February 2024, the Minister of Science and Higher

Education of the Republic of Kazakhstan declared by way of social media the introduce of training specialists in the field of artificial intelligence in cooperation with foreign universities. As part of this initiative, 14 Kazakhstani universities will begin to launch courses on AI from Google. These steps underline the desire of national higher education to meet global trends and develop modern technologies. As an example, at Nazarbayev University the Institute of Intellectual Systems and Artificial Intelligence (ISSAI) was stabled September 2019 with the goal of being a driving force for research and innovation in the digital sphere in Kazakhstan in the field of artificial intelligence research. Projects using AI was developed in ISSAI in 2024 such as One model to Rule them All: A Universal Transformer for Biometric Matching, Kazakh Language Emotional Text-to-Speech, Kazakh Sentiment Analysis Dataset of Reviews and Attitudes. Moreover, adaptive educational platforms such as Coursera and EdX were used that analyzed the progress of students and offered individual educational trajectories. Then, software systems like IBM Watson and Microsoft Azure AI was used to automate administration tasks grading system, scheduling and student record management. AI-Farabi Kazakh National University develops and implements educational programs focused on AI, including training in intelligent tutoring system. Eurasian National University named after L.N. Gumilyova has programs related to AI and aimed at training specialists in this field. Korkyt Ata Kyzylorda State University initiated the creation of the Faculty of Artificial Intelligence in cooperation with SeoulTech [8].

Various artificial intelligence (AI) systems are actively used in foreign educational institutions to enhance the quality of education and optimize the learning process. For example, submitted in 2023, artificial intelligence controls auditors in 84 regions of Russia during the Unified State Exam; AI allows you to stop attempts to pass exams by cheating. Neural networks analyze students' gestures, facial expressions, and eye contact to identify suspicious behavior. Schools and universities in the United States use AI-based chatbots to evaluate students, automating the process of checking and providing feedback to students. Newtown High School in Australia uses the artificial intelligence-based Maths Pathway platform to teach mathematics. The system is based on the needs of an individual student. The system adapts the material to the needs of individual students, increasing the effectiveness of learning. So, we can consider that artificial intelligence in higher education is becoming increasingly important, both globally and in the context of Kazakhstan.

Results of the study

The scientific novelty of this study lies in the comprehensive analysis of the use of artificial intelligence (AI) in the educational process. The research systematically examined motivational aspects and levels of engagement among educators and students, providing insights into AI's role in education and offering practical recommendations for improving teaching and learning processes. The study was conducted at Zhetysu University named after I. Zhansugurov and aimed to determine the extent to which AI technologies are applied in education.

To gather data, a survey was carried out among 50 educators and 30 students from various specializations, including informatics, mathematics-informatics. The survey, created using Google Forms, incorporated both closed and open-ended questions, yielding quantitative and qualitative data for analysis. Among the educators, 35 were female and 15 were male, with an average age of 40 years and teaching experience ranging from 1 to over 20 years. The students, aged between 18 and 25, included 18 females and 12 males, representing different specializations: 12 from informatics, 10 from mathematics-informatics, and 8 from other related fields. The diversity among respondents ensures a broad perspective on the integration and impact of AI technologies in educational practices.

The survey aimed to evaluate the impact of artificial intelligence (AI) in education by addressing three key questions: whether AI improves academic performance, enhances administrative efficiency, and increases learning satisfaction. The teachers' pie chart illustrates educators' responses to three key questions about AI's role in education. The first question asked, "Have you observed improvements in students' academic performance due to AI technologies?" with 40 out of 50 teachers (80%) agreeing that AI significantly enhances learning outcomes. The second question, "Has the use of AI

technologies reduced the time spent on administrative tasks such as grading, scheduling, and resource management?" received 45 affirmative responses (90%), showcasing the operational efficiency of AI. Finally, "In your opinion, has AI enhanced student engagement and overall satisfaction in the learning experience?" resulted in 35 out of 50 teachers (70%) agreeing, reflecting AI's role in creating interactive and personalized learning environments (Fig 1).

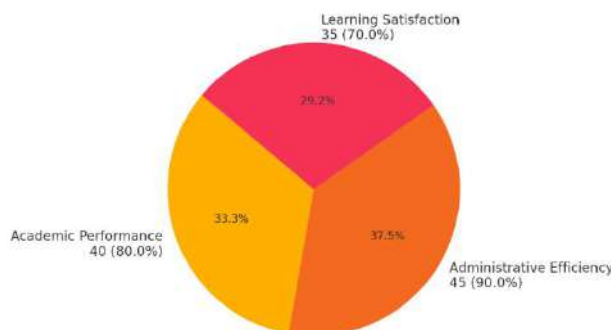


Fig 1. Teacher's detailed Perception of AI impact

The students' pie chart (Fig. 2) visualizes their perceptions based on similar questions. For the first question, "Do you feel that AI tools have helped you achieve better academic outcomes through personalized learning or adaptive technologies?" 25 out of 30 students (83%) agreed. The second question, "Have AI systems in your institution streamlined processes such as class scheduling, resource access, or communication?" was supported by 20 students (67%). Lastly, for the question, "Do you find learning with AI tools more engaging and satisfying compared to traditional methods?" 18 students (60%) agreed, indicating moderate satisfaction with AI's impact on their educational experience.

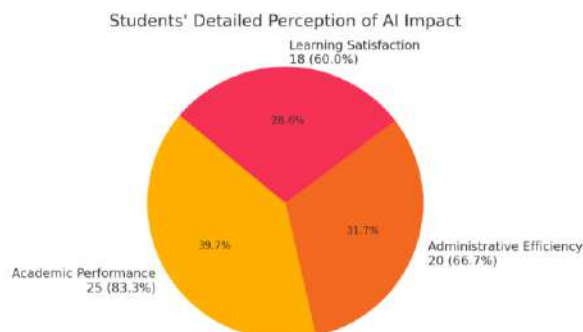


Fig 2. Student's Detailed Perception of AI impact

These pie charts provide a detailed breakdown of how AI is perceived by both educators and students, showcasing its strengths in academics and efficiency, while also identifying areas for improvement in student satisfaction.

Based on the survey results, several recommendations can be made to enhance the impact of artificial intelligence (AI) in education. First, comprehensive training programs for educators and workshops for students should be implemented to ensure both groups can effectively utilize AI tools. Improving the user experience of AI systems by integrating gamification and interactive features can address the relatively lower satisfaction levels reported by students. AI's potential for adaptive learning should be further leveraged to personalize educational pathways, addressing individual needs and boosting academic outcomes. Efforts should also focus on providing affordable and scalable AI solutions to reduce disparities in access, especially in rural or underfunded areas, while ensuring robust data privacy and ethical use policies to build trust. AI tools that support collaborative learning, such as group project platforms and real-time feedback systems, should be prioritized to foster

teamwork and interpersonal skills. Aligning AI applications with established pedagogical theories, such as constructivism, will enhance teaching strategies and student engagement. Finally, implementing a continuous feedback loop will allow educators and students to share their experiences, enabling ongoing improvement and adaptation of AI technologies to meet evolving educational needs. By addressing these aspects, AI can become a transformative tool that supports effective teaching and meaningful learning experiences. So, a strategy model that is aimed on introducing artificial intelligence in universities has been presented. As a result, this strategy will contribute to the development of an understanding of the features of AI and its tools.

At the first stage of interpreting AI to Universities, it is good to make a quantitative and qualitative approaches. So, quantitative describes how we will reach a goal whereas qualitative shows which goal we will reach.

Of course, to enter an AI to an educational structure it is necessary to teach one person to distribute knowledge of using an AI to other teachers for having a good experience. Moreover, for achieving the goal an infrastructure should be ready to use, such as hardware and software.

The top companies using an AI system are presented in Table 2.

Table 2. Top development companies using AI in education

Name	Use
University of Texas (Austin, Texas, USA)	System which has online lessons related to STEM (Science Technology Engineering Mathematics) assures students with efficient lessons in a science area. In addition, generates recommendations for every student in the class by their work.
Century (London, UK)	The system makes teachers life easier because it gives a personalized plan of work with some recommendations after passing related exams. Then tutors can control all their work, what they have done.
Third Space Learning (London, Great Britain)	The goal of the system is to unite teachers from all over the world to have an abroad practice and interpret it on their lessons.
Netex Learning (La Coruna, Spain)	The programs that are used for these purposes can be used to create personalized curricula, send multimedia messages, conduct video conferences and visualize student opportunities.
Carnegie Learning (Pittsburgh, Pennsylvania, USA)	The system that is used an AI technology make an individual plan for each student and exam can be assessed in a real time.
ALEX - Assessment and Learning in Knowledge Spaces (Irvine, California, USA)	The platform for training in specific area with adaptive technologies allows you to determine the level of readiness of a student in a given period of time. As a result, a personal learning path is formed, and the transition to a new stage is carried out after successful assimilation of the material passed.
Brainly (Krakow, Poland)	This social network employs artificial intelligence to handle information security and content management in order to guarantee interaction among university students.

In general, the main usage of AI will lie in automating learning processes, requiring a thorough reconsideration of existing training techniques. For the development of a deeper understanding of the effects of AI on learning processes, the creation of a model that will set the implementation of technologies became vital.



Figure 1. Introduction of an artificial intelligence to universities

In order to introduce an AI it is necessary to make a plan which consists of five stages.

1. Making a plan – firstly, it is necessary to make a plan, have stages of work. It saves time and helps to achieve a goal.

2. Design and Explanation – Aims to organize the structure and identifying functional requirements.

3. Development and debugging – checking for errors and debugging them if needed.

4. Testing – comparing the software with the requirements from the design stage. It aims to check similarity and functionality.

5. Observation and technical service – helping for users at manufacturing the system.

There are some criteria that help to assess a performance of using an AI in Kazakhstan:

- Making better an educational trial: Related to a complex topics, AI is available to make an understanding of those topics easier so that it is clear to anyone at different levels.

- Increasing the accessibility of education: During the COVID-19 for some regions it was hard to get an access to knowledge. However, by AI algorithms it is going to be easy to reach for students from various regions of Kazakhstan.

- Streamline administrative processes: AI can help automate a number of administrative tasks, such as managing class schedules, selecting curricula, assessing students, and even managing university budgets.

- Research and Development: Institutions can use AI for research purposes in various fields, including medicine, engineering, social sciences and others. This can promote scientific progress and innovation.

- Training: The use of AI in education allows students to acquire the skills needed to work in areas related to the development and application of artificial intelligence technologies.

Evaluating effectiveness depends on how properly institutes incorporate AI into their educational and administrative works. But it is vital to conduct some advantages and disadvantages of using AI in universities.

According to experts [9], there are nine areas where it is considered to use an artificial intelligence:

1. Automated method for grading.

2. Reviewing lectures from time to time.

3. Feedback mechanism for educators.

4. Utilization of virtual assistants by educators.

5. Directing mental processing in light of supercomputers.

6. Individual instructions based on the interests of students.

7. Adaptive learning.

8. Collection and personalization of information taken from an AI system.

9. Monitoring violations during tests and exams online.

Here are several ways AI can be applied in universities:

1. Individual Learning: Implement AI-driven learning management systems (LMS) that provide personalized recommendations, adaptive learning paths, and customized content based on individual student needs, learning styles, and performance metrics.

2. Virtual Teaching Assistants: Develop AI-powered virtual assistants or chatbots to assist students and faculty with inquiries, course enrollment, scheduling, and academic support services. These assistants can provide instant responses and guidance, improving accessibility and efficiency.

3. Predictive Analytics: identifying at-risk students, forecasting student outcomes.

4. Smart Classrooms: Equip classrooms with AI-enabled technologies such as smart whiteboards, facial recognition systems, and voice recognition software to enhance engagement, interactivity, and collaboration among students and instructors. [10]

5. Automated Grading and Feedback: Use AI-powered grading systems to automate the grading process for assignments, quizzes, and exams. Additionally, AI algorithms can provide instant feedback to students, identify common misconceptions, and offer suggestions for improvement.

6. Research and Data Analysis: Leverage AI tools and techniques for data mining, pattern recognition, and predictive modeling to support research initiatives across various disciplines. AI can help researchers analyze large datasets, discover insights, and accelerate the pace of discovery.

7. **Administrative Efficiency:** Implement AI-driven administrative systems for tasks such as admissions management, student enrollment, course scheduling, resource allocation, and financial planning. AI can streamline processes, reduce administrative burdens, and optimize resource utilization.

8. **Virtual Laboratories:** Develop virtual laboratories and simulations powered by AI to provide students with hands-on learning experiences in STEM fields and other disciplines. Virtual labs can enhance accessibility, safety, and scalability while allowing students to explore and experiment in a controlled environment. [11]

9. **Natural Language Processing (NLP):** Utilize NLP technologies to analyze and extract insights from academic literature, research papers, and scholarly publications. NLP gives an opportunity to search for needed information, summarize content, and generate citations.

10. **Student Support Services:** virtual assistances for students in different spheres.

When integrating AI into universities, it's essential to prioritize ethical considerations, data privacy, transparency, and equity to ensure responsible AI adoption and promote positive outcomes for students, faculty, and the university community as a whole. Collaboration among stakeholders, ongoing training, and evaluation of AI initiatives are critical for successful implementation and continuous improvement.

Experts suggest that in the future, artificial intelligence will likely be able to reproduce the information visually in the forms of illustrations and infographics in the background, while the teacher is explaining the educational material, thereby acting as a virtual teaching assistant. Instead of standardized materials for classes an AI generated modern data to present the class. These materials will be available to each student with an ability of editing and managing them. All data got by artificial intelligence will be automatically saved in the lesson archive and can be available for students whenever.

Discussion

The results of this study demonstrate that artificial intelligence is playing an increasingly important role in enhancing educational processes. AI tools facilitate more personalized, efficient, and adaptive learning, addressing diverse student needs while supporting educators through automation and real-time feedback.

These findings are consistent with existing academic research, which highlights both the educational benefits of AI and the necessity of careful consideration of ethical and practical issues, including data protection and the evolving role of teachers.

Future studies should investigate the long-term impact of AI on student motivation, learner autonomy, and the quality of teacher-student interaction. Moreover, the development of ethical frameworks and the professional preparation of educators will be crucial for the responsible integration of AI into educational settings.

In conclusion, while artificial intelligence offers considerable opportunities, its effective implementation depends on well-designed, research-informed strategies that uphold educational quality and human-centered values.

Conclusion

Today, an Artificial Intelligence technology has a positive effect on an educational sphere. It makes possible for teachers to free their time by having an automated grading system, personalization of the program related to various topics, giving feedbacks and comments, analyzing dynamics of the progress of students' knowledge so that teachers have an opportunity of better collaborating with students. In the Republic of Kazakhstan, there is a positive tendency in the use of AI in universities, which is confirmed by the interest of the republic and numerous successful examples of the use of progressive technologies in various of higher education. It leads to a development in the quality of education and an increase in students' motivation to gain knowledge and making a research.

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