

Holubok Valeriia. Chapter V. Artificial intelligence in education: applications, benefits, and challenges. Штучний інтелект в освіті. Частина 1 : монографія / [авт. колектив]; за ред. Яцишин А. – Київ: ІЦО НАПН України, 2025. – С. 70-79. ISBN 978-617-8330-53-8

CHAPTER V. ARTIFICIAL INTELLIGENCE IN EDUCATION: APPLICATIONS, BENEFITS, AND CHALLENGES

DOI: 10.33407/lib.NAES.id/747998

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Abstract. The article provides a comprehensive overview of the advantages, disadvantages, and potential risks associated with the implementation of artificial intelligence (AI). It examines the influence of AI on the educational process and highlights the importance of maintaining a balance between the benefits and possible downsides of this innovative technology. The use of AI in education is analyzed from various perspectives, including individualized learning, the development of personalized curricula, and the application of virtual simulators that facilitate hands-on experience and quicker adaptation to modern challenges. Additionally, the article addresses concerns such as data privacy, technological dependency, and inequality of access, which pose significant risks in the context of AI-enhanced learning. Moreover, it explores the impact of AI on the organization of academic research, considering both its transformative potential and the ethical or practical issues it raises. The findings point to AI's revolutionary capacity in the scientific field while also stressing the importance of addressing the ethical dilemmas that arise. Overall, the article reflects on the current state of AI in education and offers valuable recommendations for its responsible and effective implementation.

Keywords: artificial intelligence, data privacy, opportunities, advantages and disadvantages, risks, customized learning

Introduction. Artificial Intelligence (AI) is a field of computer science that focuses on the development of algorithms, software, and systems capable of performing tasks that

traditionally require human intelligence. These include learning, problem-solving, decision-making, and adapting to new circumstances [1].

In view of the rapid technological advancement, many countries, including Ukraine, have initiated the integration of artificial intelligence into key areas of public life, including the education sector. In December 2020, the Cabinet of Ministers of Ukraine adopted the Concept for the Development of Artificial Intelligence in Ukraine until 2030, which provides, inter alia, for the implementation of AI technologies in education, the economy, public administration, cybersecurity, defence, and other spheres. The principal objective of this policy document is to ensure Ukraine's long-term competitiveness in the global market through the effective and responsible deployment of AI technologies [2].

Despite the significant potential of artificial intelligence, the initial reaction within certain educational systems was characterized by restrictions or outright bans on its use. However, over time, it has become evident that such an approach is inadequate. Instead, it is essential to strike a balance between needs and the tools to meet them, between innovation and tradition, and between technological solutions and the context of their application.

Analysis of Literature and Problem Statement. The issue of artificial intelligence (AI) in education can be considered from three perspectives: education about AI, education with AI, and education for a world with AI. In this paper, we will focus on the second aspect — education with the use of artificial intelligence.

Research Results. The methods of using AI in the educational field encompass: individualized learning; automation of assessment and feedback; modeling and simulation of situations, etc.

Individualized Learning. AI has great potential in education, particularly in terms of personalized learning. By adapting materials to the learner's knowledge level, pace, and interests, AI creates customized learning programs. This helps improve learning effectiveness as students receive materials that meet their specific needs. It is worth highlighting the use of AI to develop personalized curricula for future educators (see

Fig. 1). AI algorithms can assess students' strengths and weaknesses, and based on this, offer learning resources most suited to their needs, which ultimately improves the quality of learning and the development of professional skills.



Fig1. How Teachers Use Artificial Intelligence in Their Work (December 2023, the Ministry of Education and Science of Ukraine surveyed teachers for how they use artificial intelligence in their work) [3].

Automation of Assessment and Feedback. The automation of assessment and feedback through AI is one of the most promising directions in education. AI can automatically assess tests, exams, assignments, and other tasks. For open-ended questions, AI uses natural language processing (NLP) algorithms. Interactive platforms for assessment can track student progress in real-time and immediately provide recommendations or corrections. Platforms can be adapted to the learner's level, automatically adjusting the complexity of tasks based on the results of previous tests. This allows for adaptive learning and improving the assessment process over time, considering the learner's mistakes or common knowledge gaps.

Modeling and Simulating Situations. This allows effective preparation for solving real-world problems, developing critical thinking, adaptability, and other important skills. Business students can practice management, decision-making under competition, financial crises, or market changes. Medical students can simulate diagnostics and patient treatment in virtual clinics, where AI models various symptoms and patient responses to treatment. Using AI to simulate combat or operational situations allows military and law enforcement agencies to train in conditions that closely resemble real-life scenarios. AI

can develop scenarios where participants must respond to various types of threats or life-threatening situations. By creating interactive games, students can quickly, effectively, and easily memorize and rehearse material. AI can adjust the learning situation based on the learner's progress, changing scenarios in real-time. By modeling various event outcomes, the learner learns to assess the consequences of their decisions and choose the most effective path.

Advantages of Using AI in Education include:

1. Increased Engagement and Motivation of Learners.

AI systems can add game elements, visualizations, and interactive exercises to the curriculum to make learning more engaging and motivating for students. This increases the concentration and engagement period in studying the material. In a study conducted under the SparxMaths project in the United Kingdom, students who used an adaptive learning tool for one hour per week showed an 18% improvement in their predicted GCSE mathematics scores [4].

2. Support for Learners with Special Needs.

AI systems can provide additional support for learners who require assistance by identifying students at risk of falling behind and providing timely intervention. They can also determine and adapt tasks to the most effective learning type for such students. Due to this feature, students will not feel excluded, improving their psychological state. A study published on arXiv demonstrated that the use of the AI assistant Syntea at IU International University of Applied Sciences allowed students to reduce their study time by an average of 27% in the third month of usage [5].

3. Integration with Big Data.

The use of large amounts of data in education through AI can significantly improve decision-making processes, curriculum optimization, and prediction of student success. AI analyzes vast amounts of data to detect patterns and trends, enabling teachers, administrators, and educational institutions to better understand students' needs and take appropriate actions. In 2021, the University of Southern California (USC) implemented a

learning analytics system that analyzed student data, including grades, attendance, and demographic information. This allowed instructors to predict students at risk of academic failure before final testing. Those identified as at risk received personalized support, which significantly improved their academic performance and reduced dropout rates. [6].

4. Improvement of Research through AI.

AI can accelerate research activities in educational institutions by automating many aspects of research, such as searching for relevant literature, analyzing large volumes of scientific data, and detecting new patterns and connections between various aspects. One company, IBM Watson, collaborates with various universities and research institutions to automate the search for scientific publications and data classification. For example, in collaboration with medical researchers, IBM Watson helped search and analyze data from over 80 million medical articles, significantly speeding up the process of identifying new treatment methods for specific diseases [7].

Disadvantages and Limitations of Using AI in Education:

1. Dependence on Technology.

AI requires stable technological infrastructure. In countries with limited resources, as well as in educational institutions that lack access to high-tech tools, AI may not work or fail to deliver the desired result. According to UNESCO, in African countries, about 40% of schools lack the necessary technological infrastructure to use AI in the educational process (UNESCO Global Education Monitoring Report, 2020) [8].

2. Technical Failures and Errors.

AI systems can be vulnerable to technical malfunctions. This may lead to incorrect student assessments or data loss. A study conducted by Mohammed University found instances of incorrect assessments due to errors in automated testing systems, raising concerns among educators [9].

3. Uncertainty in Regulation.

There is a lack of a clear regulatory framework for the use of AI in the educational process, which may lead to its uncontrolled or opaque application. The European

Commission states that many countries still lack clear policies on integrating AI into education, which creates risks for both students and teachers [10].

4. Lack of Emotional Intelligence.

According to a study, students taught by instructors had a higher level of emotional support, which contributed to their learning process and overall development [11].

There are also significant threats associated with the use of AI in education.

Today, privacy issues have become especially relevant. Artificial intelligence requires access to a large amount of personal data from students and teachers, including information about academic performance, individual learning characteristics, and behavioral traits. In the case of inadequate protection, this data could be vulnerable to leaks or unauthorized access. This raises serious concerns in society and necessitates the implementation of clear ethical standards and legal guarantees to protect personal information. Additionally, there is an increased risk of cyber threats, which could lead to data breaches if AI systems are misused [12].

Another key issue of modern artificial intelligence is the spread of incorrect or fabricated information, which is referred to as “hallucinations” in Western Europe. While AI can instantly respond to queries, these responses often lack depth. In cases of complex or specialized questions, AI systems such as ChatGPT frequently fail to provide precise information, and instead, they begin to generate information, combining real and fabricated facts [13].

One of the significant concerns regarding the use of AI in education is the risk of plagiarism in academic writing. AI systems like ChatGPT and other advanced natural language models can generate text that mimics human writing. While this feature is valuable for creating drafts or summarizing research, it raises the possibility of students or researchers using AI-generated content inappropriately, presenting it as their own work.

Plagiarism detection systems, such as Turnitin, have been developed to identify similarities between submitted texts and existing sources. However, AI-generated content, while often original in its structure, may still contain patterns or phrases that resemble

other published materials, leading to false positives or undetected plagiarism. This creates an ethical dilemma for both educational institutions and students. Several studies have pointed to the growing challenges AI poses in combating plagiarism. Research published by the University of Oxford suggests that the integration of AI in academic writing, without proper oversight, could lead to an increase in students relying on AI tools without acknowledging their source, thus contributing to an erosion of academic integrity [14].

Moreover, researchers have warned that AI systems, if not monitored carefully, could produce convincing, yet ultimately plagiarized content. A study published in the *Journal of Educational Technology* reported that approximately 15% of AI-generated content in academic submissions exhibited similarities to existing works [15].

Another major issue is the potential loss of jobs within the educational sector. As AI systems become more sophisticated, many tasks traditionally performed by teachers, administrative staff, and other education professionals could be automated, leading to significant workforce disruptions.

For example, AI can assist in grading, providing feedback, managing course materials, and even offering personalized learning experiences. These capabilities reduce the need for manual intervention in routine educational tasks, potentially displacing administrative and teaching roles. While AI is intended to support educators, not replace them, the long-term effects on employment remain a concern.

Research by the World Economic Forum indicates that automation, including AI in education, could displace up to 40% of existing educational jobs in the coming decades, especially in areas like tutoring, grading, and administrative tasks [16]. Furthermore, a report by McKinsey & Company suggests that certain low-skill positions, such as administrative support and routine teaching assistants, are most at risk of being replaced by AI-driven systems [17].

Future of AI in Education and the Role of Human Educators

AI is expected to further develop personalized learning, making education more adaptive to individual students' needs and capabilities. According to OECD research, AI

will enable dynamic, real-time curriculum adjustment based on a learner's progress, engagement, and areas of difficulty [18].

Furthermore, AI is predicted to improve the efficiency of administrative processes, such as grading, course planning, and student support. It will also enhance accessibility, especially for students with special needs, by providing tools like speech recognition, automated transcription, and adaptive learning environments [19].

However most scholars agree that AI won't be able fully replace the human role in education. While AI excels in analyzing data and automating routine tasks, it lacks emotional intelligence, ethical judgment, and the capacity to foster social interaction—crucial components of the educational process. According to a study by the Brookings Institution, teachers remain essential for mentoring, motivating, and emotionally supporting students, which AI currently cannot replicate [20].

Instead of replacing educators, AI is projected to act as a powerful support tool—assisting teachers in routine tasks and enabling them to focus more on creativity, critical thinking, and interpersonal communication within the classroom. The future of education is therefore seen as a collaborative model in which human educators and AI systems work in tandem to deliver more effective, inclusive, and engaging learning experiences.

Conclusions. One of the primary advantages of using artificial intelligence in education is the opportunity to implement personalized learning. With this technology, it is possible to develop educational programs that take into account the personal needs and knowledge levels of each student, contributing to deeper and more effective material comprehension. Additionally, AI enables the tracking of learning outcomes and the timely identification of students who require additional attention. This significantly eases the workload of teachers and positively impacts the overall education quality. Another important aspect is the creation of simulators for effective knowledge acquisition. Virtual classrooms allow students to gain practical skills in any environment.

However, one of the primary threats is the loss of social communication and interaction, which is an essential part of the learning process. Also, a significant problem

is the protection of data and intellectual property. Financial costs and security measures also require attention and the development of appropriate strategies.

Overall, the implementation of artificial intelligence in the preparation of future professionals opens significant opportunities to enhance the quality of education. However, this requires a balanced and ethical approach. To achieve effective results, it is crucial not only to utilize the advantages of AI but also to be aware of the potential risks and challenges. Special attention should be given not only to the technical aspects of implementation but also to the ethical, socio-cultural, and practical nuances. If the approach is comprehensive and balanced, artificial intelligence will be able to become an effective tool in training qualified educators who can work efficiently in the digital transformation of education.

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