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ПОТЕНЦІАЛ ТА РИЗИКИ ВИКОРИСТАННЯ ШТУЧНОГО ІНТЕЛЕКТУ В ОСВІТІ

Анотація. У статті проаналізовано потенціал та ризики використання штучного інтелекту в освіті в контексті трансформації сучасного освітнього середовища. Розглянуто еволюцію підходів до визначення штучного інтелекту — від класичних уявлень про «інтелектуальні машини» до сучасного розуміння як складної соціотехнічної системи, що поєднує автономність, адаптивність і здатність до навчання.

Здійснено огляд наукових досліджень, які розкривають теоретичні засади впровадження штучного інтелекту в освіту, зокрема ідеї інтелектуальної інфраструктури, конструкціонізму та синергії людського і машинного інтелекту.

Визначено ключові напрями застосування штучного інтелекту в освітньому процесі: персоналізація навчання, створення адаптивних освітніх середовищ, автоматизація оцінювання, розвиток освітньої аналітики та підтримка професійної діяльності викладача. Показано, що штучний інтелект сприяє підвищенню ефективності навчання, забезпечує індивідуальні освітні траєкторії та розширює педагогічні можливості викладачів.

Водночас обґрунтовано, що інтеграція штучного інтелекту супроводжується низкою ризиків, серед яких особливу увагу приділено проблемам захисту персональних даних, алгоритмічної упередженості, зниження ролі викладача, залежності від технологій та потенційного зниження рівня критичного мислення здобувачів освіти. Також розглянуто соціальні та етичні виклики, включаючи нерівний доступ до технологій і питання відповідальності за рішення, прийняті ШІ-системами.

Зроблено висновок, що штучний інтелект в освіті – це складне явище, здатне трансформувати всі ключові компоненти освітнього процесу. Потенціал штучного інтелекту полягає у підвищенні ефективності навчання шляхом адаптації освітнього змісту, індивідуалізації навчальних шляхів, автоматизації оцінювання, розширенні можливостей викладачів та розвитку нових цифрових та ШІ-компетентностей у здобувачів освіти. Штучний інтелект стає рушійною силою переходу до більш гнучкої та персоналізованої освітньої моделі.

Ключові слова: штучний інтелект, потенціал, ризики використання, освіта.

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POTENTIAL AND RISKS OF USING ARTIFICIAL INTELLIGENCE IN EDUCATION

Abstract. The article analyzes the potential and risks of using artificial intelligence in education in the context of the transformation of the modern educational environment. It examines the evolution of approaches to defining artificial intelligence – from classical notions of "intelligent machines" to a contemporary understanding of AI as a complex sociotechnical system that combines autonomy, adaptability, and learning capability.

A review of scientific research is carried out, revealing the theoretical foundations of implementing artificial intelligence in education, including the concepts of intelligent infrastructure, constructionism, and the synergy between human and machine intelligence.

The key areas of artificial intelligence application in the educational process have been identified, including the personalization of learning, the creation of adaptive learning environments, the automation of assessment, the development of educational analytics, and the support of teachers' professional activities. It is shown that artificial intelligence contributes to improving learning efficiency, enables individual learning trajectories, and expands teachers' pedagogical capabilities.

At the same time, it is substantiated that the integration of artificial intelligence is accompanied by a number of risks, with particular attention given to issues of personal data protection, algorithmic bias, the reduction of the teacher's role, dependence on technology, and a potential decline in learners' critical thinking skills. Social and ethical challenges are also considered, including unequal access to technologies and questions of responsibility for decisions made by AI systems.

It is concluded that artificial intelligence in education is a complex phenomenon capable of transforming all key components of the educational process. The potential of artificial intelligence lies in improving learning efficiency through the adaptation of educational content, the individualization of learning pathways, the automation of assessment, the expansion of teachers' capabilities, and the development of new digital and AI competencies among learners. Artificial intelligence is becoming a driving force in the transition toward a more flexible and personalized educational model.

Keywords: artificial intelligence, potential, risks of use, education.

Problem statement. Artificial intelligence (AI) is rapidly transforming many aspects of modern society, and education is no exception. From personalized learning platforms and intelligent tutoring systems to automated assessment and administrative support, AI technologies are increasingly integrated into educational environments. These innovations offer significant opportunities to enhance teaching and learning processes, making education more accessible, efficient, and tailored to individual needs.

At the same time, the growing reliance on AI in education raises a number of important concerns. Issues related to data privacy, algorithmic bias, the role of teachers, and the potential loss of critical thinking skills require careful consideration. The integration of AI also challenges traditional pedagogical approaches and calls for new competencies among educators and learners alike.

Education is especially compatible with the integration of AI technologies because both teaching and learning rely heavily on cognitive, knowledge-based processes. AI systems, which are built to perform reasoning and solve problems using algorithms and structured data, can significantly support and enhance the work of both teachers and students. Since AI first appeared in the mid-20th century, it has been increasingly applied to improve education and training in various fields, including languages, science, technology, engineering, mathematics, and medicine. In modern contexts, Artificial Intelligence in Education focuses on supporting essential educational functions such as creating and delivering learning materials, facilitating communication and collaboration, and evaluating learning outcomes [30].

Analysis of the latest studies and publications. John McCarthy, one of the founders of artificial intelligence, did not focus specifically on education, but his work laid the theoretical foundation for its later applications in this field. In his seminal paper Programs with Common Sense, he introduced the idea that machines could simulate human reasoning by using formal logic to solve problems and make decisions. McCarthy proposed the concept of creating intelligent systems capable of understanding and processing knowledge in a way similar to humans, which later became the basis for developments such as intelligent tutoring systems and adaptive learning technologies. His vision of AI as a tool for augmenting human intellectual capabilities indirectly influenced the use of artificial intelligence in education, particularly in supporting personalized learning and automated reasoning processes [22].

Rose Luckin in her book Machine Learning and Human Intelligence: The Future of Education for the 21st Century provides a comprehensive analysis of how artificial intelligence can transform education by working in synergy with human intelligence rather than replacing it. The central idea of the book is the concept of Human Intelligence, which Luckin defines as a combination of cognitive, social, and emotional capacities that enable effective learning. She argues that AI systems should be designed to complement and enhance these human abilities. A key framework introduced in the book is the idea of “intelligence infrastructure”, where

learners, teachers, and AI technologies interact within a connected ecosystem that supports continuous and personalized learning [19].

Seymour Papert was one of the first scholars to explicitly connect artificial intelligence with learning processes, primarily through his theory of constructionism and his work with educational technologies. His most influential work in this context is Mindstorms: Children, Computers, and Powerful Ideas. In this book, Papert explores the potential of computers – and, indirectly, artificial intelligence – as tools for transforming education. He argues that learning becomes more effective when students actively construct knowledge by creating meaningful artifacts, especially with the support of computational technologies.

Papert S. introduces the idea that computers can serve as "objects-to-think-with," enabling learners to explore complex concepts through experimentation and interaction [25].

In the study "Towards responsible artificial intelligence in education: a systematic review on identifying and mitigating ethical risks", Haotian Zhu, Yao Sun, and Junfeng Yang identify a comprehensive set of risks associated with the use of artificial intelligence in education, grouping them into three main dimensions: technological, educational, and social. Technological risks include issues related to data privacy and security, the presence of algorithmic bias, and the possibility of errors or lack of transparency in AI systems, which may lead to unfair or unreliable outcomes. Educational risks concern the transformation of the learning process and teaching practices, particularly the potential reduction of the teacher's role, the standardization and homogenization of learning experiences, and the growth of academic misconduct such as plagiarism or overreliance on AI-generated content. Social risks encompass broader systemic challenges, including the deepening of the digital divide between different groups of learners, unequal access to AI technologies, and a lack of clear accountability for decisions made or supported by AI systems [35].

In the study "Risks of AI Applications Used in Higher Education," Donna Schaeffer and others focus on governance-related risks associated with the implementation of artificial intelligence in higher education. The authors highlight cybersecurity threats, emphasizing the vulnerability of institutional systems and student data to breaches and attacks. They also point to issues of ethical compliance, including the need to ensure that AI systems operate transparently, fairly, and in accordance with ethical standards. Another significant risk concerns decision-making processes in areas such as student admissions and assessment, where reliance on AI may lead to biased, opaque, or unjustified decisions that affect learners' academic trajectories [27].

Within broader theoretical and critical perspectives on artificial intelligence in education, a number of authors emphasize systemic, ethical, and cognitive risks associated with its implementation. In the work "The Risks and Potential of AI in Education", Senad Orhani and Mimoza Hoti Kolukaj consider risks in parallel with benefits, highlighting in particular the danger of overreliance on AI technologies. They argue that excessive dependence on intelligent systems may reshape

educational processes at a systemic level, transforming how knowledge is produced, delivered, and controlled, and potentially reducing the role of human agency in learning [24].

The aim of this article is to analyze the potential benefits and risks of using artificial intelligence in education and to evaluate its impact on teaching and learning processes.

Presentation of the main material. The definition of artificial intelligence is multifaceted, and there is currently no single universal definition. Contemporary scholars are gradually moving away from classical formulations of "intelligent machines" and shifting the focus toward measurable performance, autonomy, and the ability of systems to learn.

In the article by Georgios Fradelos, artificial intelligence is interpreted as software capable of analyzing or generating data and demonstrating results comparable to or exceeding the average human level in professional activities with minimal human intervention [8].

The authors of the article "Redefining Personalized Learning in the AI Era" define artificial intelligence as a set of systems capable of dynamically adapting learning pathways, providing feedback, and modeling learner behavior based on data and machine learning algorithms [18]. Here, AI functions as a decision-making infrastructure within the educational environment.

In the article "A Scholarly Definition of Artificial Intelligence," AI is interpreted more broadly – as the ability of non-biological systems to perform tasks, make decisions, interact, and generate predictions at a level close to that of humans. The author emphasizes the functional equivalence to human activity [9].

The authors of the article "General Purpose Artificial Intelligence Systems" describe artificial intelligence as systems capable of generalizing knowledge across tasks, adapting to new conditions, and learning from limited data, which brings them closer to the concept of general-purpose AI [28].

Johannes Dahlke considers AI as a sociotechnical phenomenon that includes not only algorithms but also the context of their application. The article emphasizes that artificial intelligence should be understood as a system of interaction between technologies, users, and the social environment [6].

Thus, by comparing contemporary definitions with classical ones, a clear evolution can be observed: from understanding AI as "intelligent machines" and the ability to solve complex tasks to a more sophisticated interpretation that includes autonomy, adaptability, cross-task generalization, and the social context of technology use. In their research, the authors define artificial intelligence not as a single property of a system, but as a complex characteristic that integrates technical, cognitive, and social dimensions. Given the evolving understanding of artificial intelligence, its potential in education becomes particularly significant.

In terms of instruction, AI's biggest promise lies in the personalisation of learning and learning materials. Personalised learning is an educational approach aimed at customising learning based on students' individual needs and strengths. AI applications can identify pedagogical materials and approaches adapted to the level

of individual students, and make predictions, recommendations and decisions about the next steps of the learning process based on data from individual students. AI systems assist learners to master the subject at their own pace and provide teachers with suggestions on how to help them [29].

AI systems are capable of designing individual learning pathways, generating personalized assignments, and adapting learning content to each student's level and learning style, thereby reducing cognitive load and increasing student engagement [26].

AI enables the creation of adaptive learning environments in which educational content dynamically changes based on data about learners' behavior and progress, ensuring a more precise alignment with individual cognitive needs [12].

Machine learning, deep neural networks, and multimodal analytics enable the adaptation of learning materials in real time, thereby improving knowledge acquisition efficiency and student engagement [14].

AI-based adaptive systems continuously analyze learner behavior and automatically adjust the content, pace, and difficulty of learning, ensuring a highly individualized educational process [17].

Modern AI systems are already shifting from static personalization to real-time dynamic adaptation, where learning becomes an interactive process based on continuous feedback between the system and the student [4].

In modern research, artificial intelligence is also viewed as a tool for automating routine teaching tasks and expanding the professional role of teachers, whereby educators are relieved of part of the technical and administrative workload and gain greater opportunities for individualized work with students, instructional design, and the development of learners' higher-order cognitive skills.

AI acts as a partner to the teacher, capable of performing part of the routine and cognitively demanding tasks (such as preparing materials, analyzing data, and generating feedback), thereby expanding the teacher's pedagogical capabilities and creating a mode of "shared decision-making" between humans and AI, where technologies enhance the teacher's professional expertise rather than replace it [5].

AI tutors can reduce teachers' cognitive load by providing automated support for students (for example, through scaffolded feedback and answers to basic questions), while still leaving the teacher with a key role in instructional design and the management of the learning process [13].

Modern intelligent tutoring systems and large language models are increasingly used to automate pedagogical functions – such as explaining learning material, providing feedback, and organizing interaction – which allows teachers to reallocate time from routine tasks to more complex pedagogical functions, such as developing critical thinking and providing individualized student support [21].

The use of AI in special and inclusive education helps teachers adapt learning materials more quickly, create differentiated assignments, and support students with diverse educational needs, while also enhancing the teacher's role as a learning facilitator through technological support [11].

Artificial intelligence in education is increasingly viewed as a key driver in transforming assessment systems and educational analytics.

In addition, AI tools (such as chatbots, analytics platforms, and automated assessment systems) are becoming an important part of teachers' professional practice, as they enable the automation of grading, analysis of learning behavior, and preparation of instructional materials, thereby significantly reducing administrative workload and expanding pedagogical capabilities [7, 10, 34].

In his work, Williams P. shows that the integration of AI and learning analytics facilitates a shift toward a new model of university assessment, in which the emphasis moves from summative evaluation to continuous formative assessment and learning support, making the process more flexible and learner-centered [31].

Modern AI tools are primarily used for automated assessment of knowledge, analysis of student behavior and engagement, as well as for providing personalized feedback, making assessment more accurate and adaptive [20].

In addition, artificial intelligence increases the efficiency and accuracy of assessment, supports the implementation of adaptive assessment models, and strengthens the analytical capabilities of universities at the institutional level, transforming assessment into a managed and systematic process [23].

Thus, artificial intelligence is radically transforming assessment and educational analytics: it enables the automation of assessment procedures, improves the quality and speed of feedback, enhances the predictive capabilities of analysis, and supports the transition to a continuous, adaptive, and data-driven educational process in which assessment becomes not only a tool for control but also a mechanism for supporting learning.

The potential of artificial intelligence in education lies not only in its use as a learning tool but also in its role in fostering AI literacy and digital literacy, where key skills include understanding, critical evaluation, and the responsible use of technology.

There is also a shift in focus toward the development of AI literacy, viewing AI as a means of fostering students' critical thinking, digital competencies, and understanding of how algorithms work, which is becoming a key objective of modern education [33].

In recent studies, artificial intelligence in education is viewed as a multi-level phenomenon that transforms both learning processes and the institutional organization of education. Ifenthaler and colleagues emphasize that AI should be understood as an infrastructure based on learning analytics and decision support, which helps teachers and administrators optimize educational processes while also requiring the development of AI literacy among all participants in the educational environment [16].

Altmamimi and Abu Al-Haija'a show that the development of AI competencies should be embedded within a broader framework of digital literacy, where learners acquire not only basic digital skills but also the ability to understand, use, and critically evaluate artificial intelligence technologies in both academic and

everyday contexts, thereby forming a foundation for adapting to an AI-oriented world [2].

Despite its considerable potential, the implementation of artificial intelligence in education is accompanied by a range of challenges and risks.

The integration of AI into education is accompanied by risks related to the violation of learners' data privacy, the reinforcement of algorithmic bias, the reduction of teachers' pedagogical autonomy, and the potential replacement of human decision-making with automated systems, all of which collectively affect the transformation of the nature of the educational process [15].

Privacy is a major concern in the use of AI tools in education. These concerns often arise when individuals share too much personal information on online platforms. Although regulations and standards are in place to protect sensitive data, violations by AI-driven technology companies in areas such as data access and security continue to heighten public anxiety about privacy [1].

There is a risk of the "algorithmization of education," in which pedagogical practices begin to adapt to the requirements of digital systems, which may lead to a reduction in students' critical thinking, increased dependence on automated solutions, and the spread of errors from generative models, including so-called AI "hallucinations" [32].

Baker and Hawn, as well as Crawford in their research on AI ethics, show that algorithmic systems in education can reproduce and reinforce existing social and cultural biases, leading to unequal educational outcomes, particularly for vulnerable groups of learners, as well as to the standardization of assessment that does not take into account students' individual characteristics [3].

Conclusions. Artificial intelligence in education is not merely a technological tool but a complex, multifaceted phenomenon capable of transforming all key components of the educational process – from the personalization of learning and assessment to educational analytics, institutional management, and teacher support. Its integration reshapes not only instructional practices but also the broader architecture of educational systems, influencing how knowledge is created, delivered, and evaluated. The potential of AI lies in improving learning efficiency through the adaptation of educational content to individual needs, the design of flexible and personalized learning pathways, the automation and diversification of assessment practices, the expansion of teachers' professional capabilities, and the development of new digital and AI-related competencies among learners. In this context, AI acts as a catalyst for the transition toward a more adaptive, data-informed, and learner-centered educational model that aligns with the demands of contemporary knowledge societies.

At the same time, alongside these extensive opportunities, the implementation of AI in education is accompanied by a range of significant and interrelated risks that extend beyond purely technical concerns. These include algorithmic bias, which may reproduce or even amplify existing inequalities; threats to data privacy and security arising from the large-scale collection and processing of personal information; and the potential erosion of students' critical thinking, creativity, and

cognitive autonomy due to overreliance on automated systems. Moreover, the increasing dependence on AI technologies may lead to a reduction in human agency in learning processes and create new forms of digital dependency. There is also a risk of deepening educational and social inequalities, particularly in contexts where access to advanced technologies and digital infrastructure is uneven. Special attention must be paid to the transformation of the teacher's role: while AI can enhance pedagogical effectiveness, it may also shift decision-making authority toward algorithmic systems, raising concerns about the deprofessionalization of teaching and the loss of the human, ethical, and relational dimensions that are fundamental to education.

Furthermore, the integration of AI into education necessitates a reconsideration of existing pedagogical paradigms, assessment cultures, and institutional policies. It requires the development of new forms of AI literacy among both educators and learners, enabling them not only to use AI tools effectively but also to critically evaluate their outputs, limitations, and ethical implications. Equally important is the need for transparent and accountable governance mechanisms that regulate the design, deployment, and evaluation of AI systems in educational contexts. This includes the establishment of clear ethical guidelines, data protection standards, and quality assurance procedures, as well as interdisciplinary collaboration among educators, technologists, policymakers, and researchers.

Thus, artificial intelligence in education possesses both high transformative potential and a complex set of systemic risks that must be carefully balanced. Its effective and responsible use requires not only ongoing technological innovation but also the deliberate construction of ethical, pedagogical, and regulatory frameworks that safeguard educational values, ensure equity and inclusion, and preserve the central role of human interaction in the learning process. Ultimately, the successful integration of AI will depend on the extent to which it is aligned with the fundamental goals of education – supporting holistic human development, fostering critical and independent thinking, and promoting socially responsible and sustainable learning practices in an increasingly digital world.

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