



The Role of AI Agents in Personalising the Educational Process and Improving the Quality of Education

Oleksandr Khodorkovskyi

CEO, <https://orcid.org/0009-0007-4242-3625>

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***Abstract.** The study aims to determine the role of intelligent agents in personalizing the educational process and improving the quality of education. The **purpose** of the article is to analyze the advantages, challenges, and barriers to introducing artificial intelligence in the educational sphere and to develop recommendations for its integration into the modern educational system.*

***Methods:** To achieve this goal, content analysis, comparative analysis of scientific approaches to introducing artificial intelligence in the educational process, and systematization of modern educational innovations were used.*

***Results:** The study found that intelligent agents help to adapt educational content to the needs of each student, increasing motivation and quality of learning. In particular, integrating virtual tutors and automating routine tasks significantly reduces teachers' workload, allowing them to focus on the creative aspects of their work. In addition, the introduction of artificial intelligence technologies is effective in creating interactive learning environments that stimulate the development of students' critical thinking and creativity. At the same time, key barriers have been identified:*



high financial costs, technical difficulties, ethical challenges, and insufficient training of teachers in the use of new technologies. The recommendations developed include creating national strategies to support artificial intelligence, modernization of infrastructure, specialized training for teachers, and implementing grant programs.

Conclusions: *The findings confirm artificial intelligence's significant potential to improve the quality of education. At the same time, technical, financial, and organizational challenges must be considered to ensure the effective integration of technology into the educational process. Further research should be devoted to analyzing the long-term impact of artificial intelligence on students' critical thinking and cognitive abilities and the motivational aspects of pedagogical activity in the context of automated educational processes.*

Keywords: *personalization of learning, artificial intelligent agents, innovative technologies, education automation, ethical challenges, teacher motivation.*

Роль інтелектуальних агентів у персоналізації освітнього процесу та підвищенні якості освіти

Ходорковський Олександр Анатолійович

CEO, <https://orcid.org/0009-0007-4242-3625>

Анотація. *Дослідження спрямоване на визначення ролі інтелектуальних агентів у персоналізації освітнього процесу та підвищенні якості освіти.*

Метою статті є аналіз переваг, викликів та бар'єрів упровадження штучного інтелекту в освітню сферу, а також розроблення рекомендацій щодо його інтеграції в сучасну освітню систему.

Методи: для досягнення поставленої мети використано методи контент-аналізу, порівняльного аналізу наукових підходів до впровадження



штучного інтелекту в освітній процес, а також систематизації сучасних інновацій у сфері освіти.

Результати: дослідження виявило, що інтелектуальні агенти сприяють адаптації освітнього контенту до потреб кожного здобувача освіти, підвищуючи мотивацію та якість навчання. Зокрема, інтеграція віртуальних репетиторів та автоматизація рутинних завдань значно знижують навантаження на викладачів, дозволяючи їм зосередитися на творчих аспектах роботи. Крім того, впровадження технологій штучного інтелекту показало ефективність у створенні інтерактивних освітніх середовищ, які стимулюють розвиток критичного мислення і творчих здібностей здобувачів освіти. Водночас виявлено ключові бар'єри: високі фінансові витрати, технічні труднощі, етичні виклики та недостатня підготовка педагогів до використання нових технологій. Розроблені рекомендації включають створення національних стратегій підтримки штучного інтелекту, модернізацію інфраструктури, спеціалізовані тренінги для викладачів та впровадження грантових програм.

Висновки: отримані результати підтверджують значний потенціал штучного інтелекту в підвищенні якості освіти. Водночас для забезпечення ефективної інтеграції технологій в освітній процес необхідно враховувати технічні, фінансові та організаційні виклики. Подальші дослідження мають бути присвячені аналізу довгострокового впливу штучного інтелекту на розвиток критичного мислення та когнітивних здібностей здобувачів освіти, а також мотиваційних аспектів педагогічної діяльності в умовах автоматизації освітніх процесів.

Ключові слова: персоналізація навчання, інтелектуальні агенти, інноваційні технології, автоматизація освіти, етичні виклики, мотивація викладачів.



Problem statement. Innovations in education are central to modern society, which is actively changing under the influence of digital transformation. The use of artificial intelligence in the educational process is of particular interest, as its personalization capabilities can significantly improve the quality of education. Intelligent agents can adapt educational content to each student's individual needs and abilities, creating conditions for more effective knowledge acquisition and competence development [1, p. 650; 2].

Intelligent agents (IAs) are software systems that use machine learning algorithms, neural networks, and data processing to perform tasks related to analysis, decision-making, and process automation in various fields, including education. In the educational process, such agents can be virtual tutors, automatic assessment systems, or platforms for creating personalized learning paths [3, p. 530-531; 4].

The modern education system faces numerous challenges, including mass enrolment, multi-level composition of student groups, insufficient qualified teachers, and the need to ensure access to quality education for different socio-economic groups. In this context, the introduction of AI agents is a tool for optimizing the educational process and as a means of solving global educational problems.

The relevance of studying the role of artificial intelligence in personalizing learning is also driven by the rapid development of technologies that provide new opportunities for analyzing large amounts of data, automating routine processes, and creating interactive learning environments. This opens up prospects for a deeper understanding of the impact of artificial intelligence on the quality of education and its role in shaping the educational space of the future. The key aspects of this topic are to study the role of artificial intelligence in developing an individual approach to learning and ensuring access to education and identify the challenges and risks associated with



introducing these technologies. Thus, studying this topic is extremely important for the scientific community, educational institutions, and society.

Analysis of the latest research and publications. Personalization of the educational process with the help of artificial intelligence is one of the key areas of modern pedagogical research. In particular, O. Papach, O. Horohorodankina, and G. Rizak [5, p. 5] study the possibilities of a differentiated approach to learning by adapting educational content to the individual needs of higher education students but do not sufficiently reveal the aspects of the long-term impact of such technologies on the quality of learning and the role of the teacher.

The problem of technical barriers and financial constraints is also widely studied. L. Bashkirova, O. Gruzevskiy, and Y. Tyravska [6, p. 1029] analyze the combination of artificial intelligence and virtual reality, which, despite its high potential in medical education, has significant financial problems that hinder its large-scale application. Similarly, S. Sichkar and I. Denysiuk [7, p. 352] consider the technical difficulties of introducing artificial intelligence into educational institutions, including the need to adapt the infrastructure and high costs. It is worth noting that these studies do not sufficiently consider possible strategies for overcoming such barriers.

Ethical challenges and the problem of training teachers to work with innovative technologies are other vital research areas. V. Motorina, G. Rizak, and I. Nebelenchuk [8, p. 944] point to the need to regulate the privacy of data of higher education students, but the study does not offer clear recommendations on the legal regulation of such aspects. L. Ilychuk [9, p. 240] focuses on the lack of training of teachers in the use of artificial intelligence, which limits the effectiveness of these technologies. Similar attention is paid to this topic by J. Kim, H. Lee, and Y. Cho [10, p. 6071], who emphasize the importance of integrating the collaboration of teachers and artificial intelligence into pedagogical practice. At the same time, the works of scientists do not consider motivating teachers to use the latest technologies.



Integrating innovations into the educational process is also the subject of numerous studies. D. Kalko, T. Sichko, and I. Senyk [11, p. 666] analyze methods of optimizing the educational process, including automation of routine tasks, but do not consider the impact of such innovations on the development of critical thinking of higher education students. The study of prospects and development strategies is also an important area. T. Tardaskina [12, p. 94] focuses on the digital transformation of education, while A. Klačnja-Milićević and M. Ivanović [13, p. 6715] consider the sustainability of personalised learning systems. However, neither study sufficiently addresses the problems of integrating these innovations into the traditional education system. O. Grachev [14, p. 823] provides a global overview of the role of artificial intelligence in social and economic systems, including education, but leaves out specific challenges at the local level.

I. Nepomniashcha [15, p. 966] studies the impact of interactive technologies on the involvement of higher education students in online learning, emphasizing their importance for improving educational outcomes. Y. Luchko [16, p. 1364] analyses the use of artificial intelligence in higher education research, focusing on its potential for data optimization. M. Ilić and his co-authors [17, p. 14907] provide an overview of intelligent technologies in e-learning, but the question of their long-term impact on the educational system remains open.

Thus, existing research largely highlights artificial intelligence's potential for personalizing the educational process but insufficiently covers its introduction into mass education, its long-term impact on the quality of learning, and the training problems for its use.

Identification of previously unsolved parts of the overall problem Despite significant progress in using artificial intelligence in education, some problems remain unresolved. One is making such technologies accessible to a wide range of educational institutions. High financial costs and limited resources make introducing artificial



intelligence into mass education challenging, especially in regions with insufficient infrastructure.

Another critical issue is the adaptation of educational institutions to work with new technologies. The lack of technical support and trained specialists to support artificial intelligence systems are becoming serious barriers that require a comprehensive approach to overcome them. A critical issue is the training of teachers in the use of innovative technologies. Teachers' lack of sufficient knowledge and skills in working with artificial intelligence can significantly reduce the effectiveness of these technologies. Professional development programs are needed to help teachers adapt to the new learning environment. Also, the impact of automating routine tasks on the development of cognitive abilities of higher education students remains poorly understood. Integrating artificial intelligence into the educational process should consider not only technical advantages but also long-term consequences for the development of students' critical thinking and creativity. The above aspects form the basis for further research and the proposal of solutions to integrate artificial intelligence into educational practice effectively.

Formulation of the article's objectives. The article aims to study the role of intelligent agents in personalizing the educational process and improving the quality of education. It also aims to develop practical recommendations for their integration into the modern educational system.

To achieve this goal, the following tasks were formulated:

1) To analyze scientific and methodological approaches to the use of artificial intelligence in the educational process. The aim is to study existing methods of integrating artificial intelligence into education, in particular, to adapt educational materials to the individual needs of higher education students, which will allow the identification of the strengths and weaknesses of such approaches;



2) To explore the key challenges and barriers to introducing artificial intelligence in education. Particular attention will be paid to the analysis of technical, financial, ethical, and organizational problems that complicate the introduction of artificial intelligence in educational institutions, which will allow the formulation of reasonable proposals for their solution;

3) Develop recommendations for integrating artificial intelligence into the modern educational process. Based on the analysis, practical solutions, including teacher training, infrastructure adaptation, and technology accessibility, will be proposed to improve the efficiency of using artificial intelligence in education.

The objectives provide a comprehensive approach to studying the topic, focusing on both theoretical aspects and practical implementation. This will significantly contribute to the development of modern pedagogy and provide an innovative approach to improving the quality of education.

Summary of the main research material. Intelligent agents play an essential role in creating conditions for personalized learning. These technologies ensure the adaptation of educational content to the individual needs of each student, which can significantly improve the efficiency of the educational process. For example, artificial intelligence systems analyze data on a student's results, learning style, and progress and then create an individual learning plan.

The integration of artificial intelligence into education is based on methods of adapting learning materials to the individual needs of higher education students. The first approach involves the use of machine learning algorithms. For example, learning personalization systems analyze a student's progress and offer materials that meet their needs and level of knowledge. Research confirms that such systems improve learning effectiveness, but their use is limited by the need for significant data for analysis and high implementation costs [1, p. 639-640].



The second approach involves virtual tutors that provide real-time support to higher education students. These systems explain complex concepts through interactive modules and adapt learning materials based on the student's performance [2]. Despite the benefits associated with the availability of information, virtual tutors face technical integration challenges and limitations in terms of software quality.

The third approach focuses on automating routine tasks such as grading, creating curricula, and managing administrative processes. Automation allows for the reduction teachers' workload and facilitates concentration on creative and pedagogical aspects of work [3, p. 530-531; 18]. At the same time, the risk of bias in algorithms remains a significant challenge to the effectiveness of these solutions. For a detailed understanding of the strengths and weaknesses of the analyzed approaches, Table 1 is presented.

Table 1

Advantages and limitations of scientific and methodological approaches to integrating artificial intelligence into the educational process

Scientific and methodological approach	Main advantages	Restrictions
Adaptation of training materials	Individualization of the educational process in accordance with the needs of the student	The need to collect and analyze large amounts of personal data
	Increasing the level of motivation and engagement of students	High development and implementation costs
Virtual tutors	The ability to get help in real time	Dependence on stable internet access and software quality
	Expanding access to learning regardless of geographic location	Limitations in complex interactive tasks
Automation of routine tasks	Reducing the workload of teachers	Possibility of algorithmic bias in the assessment.
	Optimising the management of educational processes	Lack of transparency in the functioning of automated systems

Source: compiled by the authors based on data from [1; 2; 3; 18].



OpenAI technologies offer new perspectives for interactive learning, particularly through integrating artificial intelligence into the meta-universe [19]. This allows for creating virtual environments that increase the engagement of higher education students and make it possible to adapt the educational process to their individual needs. For example, virtual learning spaces provide access to interactive resources regardless of geographical location, which is an important step toward democratizing education. Scientific and methodological approaches to using artificial intelligence in education demonstrate a high potential for improving the quality of learning and optimizing educational processes. At the same time, significant costs, technical barriers, and ethical challenges remain key constraints.

At the current stage, the introduction of artificial intelligence in education faces a number of challenges that can be divided into technical, financial, ethical, and organizational. Their systematization is necessary to develop practical recommendations for overcoming these barriers.

The technical infrastructure of educational institutions is one of the key constraints to introducing artificial intelligence, as insufficient computer equipment, low Internet speed, and lack of specialized software hinder this process. Technical requirements for integrating innovative technologies remain high, limiting many educational institutions' ability to effectively use modern solutions [19; 20]. It is also worth noting the difficulty of integrating artificial intelligence into existing educational platforms due to insufficient technology compatibility.

Another significant barrier is the high cost of implementing artificial intelligence. For example, only large educational institutions can afford to purchase and maintain software, train staff, and upgrade infrastructure [8, p. 944]. Lack of funding limits access to these technologies in regional and rural schools, leading to inequality in opportunities for quality education. It is predicted that by 2027, the size of the artificial intelligence market will reach \$407 billion [20].



Ethical aspects of AI implementation include data privacy issues, risks of algorithmic bias, and lack of transparency in decision-making. In 2024, 83% of organizations worldwide identified data privacy as a priority challenge for implementing artificial intelligence [20]. This underscores the need to develop clear ethical standards and policies to protect the privacy and transparency of algorithms. Using personal data in educational processes using artificial intelligence raises significant concerns among higher education students and teachers, underscoring the need for clear data protection standards.

Organizational barriers include insufficient training of teaching staff to work with new technologies and low motivation to use artificial intelligence [9, p. 232]. There is also a need to create a national strategy for introducing artificial intelligence in education that will consider regional peculiarities.

Fig. 1 shows the key challenges of introducing artificial intelligence into education, illustrating the main limitations and possible ways to overcome them.

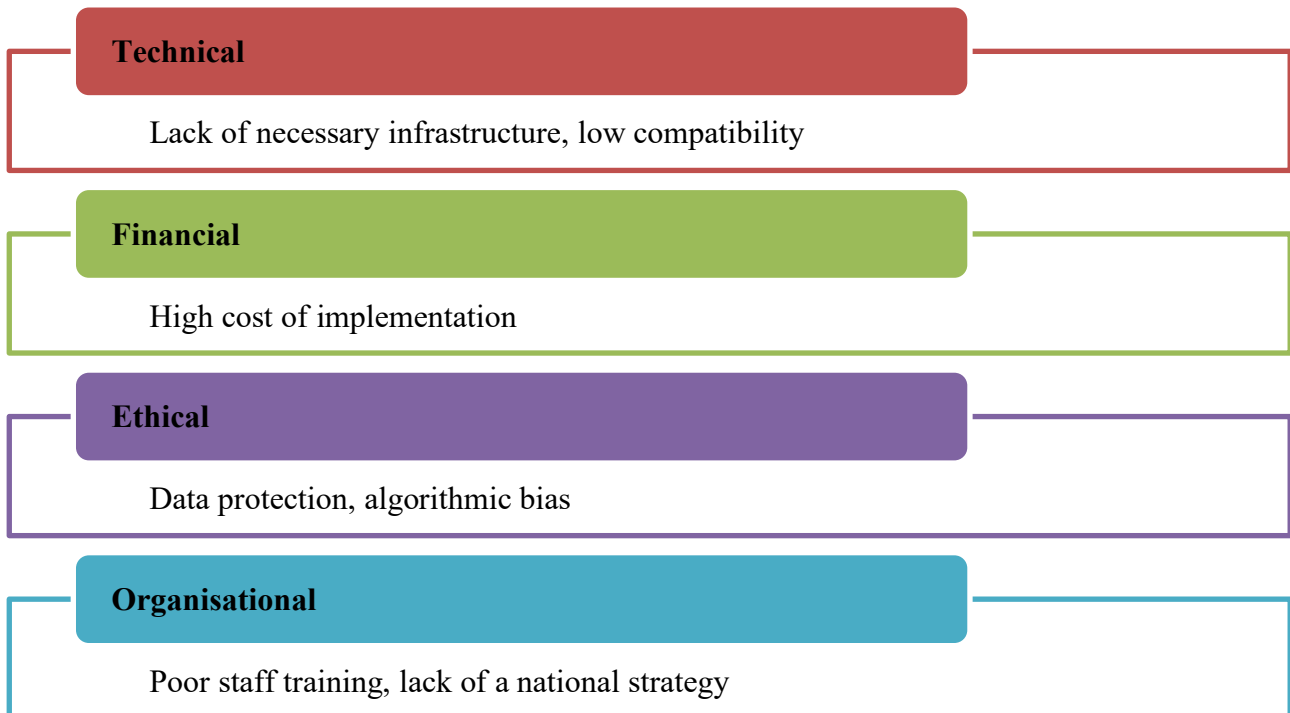




Fig. 1. Key challenges of introducing artificial intelligence into the educational process

Source: compiled by the authors based on data from [6; 7; 8; 9; 10; 13].

AI-based tools such as ChatGPT have become a revolutionary step in education [2]. They provide students with the opportunity to get answers to questions and explanations of complex topics in real-time. This promotes critical thinking and a deeper understanding of the material and allows students to work independently with the support of technology. Adapting educational institutions and teachers to new technologies is a prerequisite for effectively integrating artificial intelligence into the educational process. This includes training teachers to use the latest tools, developing new teaching methods, and providing access to modern technologies for all students, even those from remote regions. This approach guarantees equal opportunities in the face of technological change.

Integrating artificial intelligence into the educational process is an important step toward modernizing the education system. This goal aims to improve the quality of education and access to modern technologies. In today's world, technological innovations play a key role in shaping knowledge and competencies, so introducing artificial intelligence is becoming both an opportunity and a necessity.

One key condition for successfully integrating artificial intelligence into education is the training of teaching staff. Most teachers do not currently have the necessary skills to work with innovative technologies, including artificial intelligence, which points to the need for specialized training and professional development programs focused on the practical use of technology. Particular attention should be paid to training in using learning platforms adapted to artificial intelligence.

The integration of artificial intelligence requires modernizing the technical base of educational institutions that face technical barriers to introducing innovative



technologies, including underdeveloped infrastructure. It is recommended that an audit of the technical condition of academic institutions is conducted and that centralized support programs be created to upgrade equipment. Particular attention should be paid to ensuring the supply of high-speed Internet, which is critical for operating artificial intelligence systems.

Financing is one of the key barriers to the adoption of artificial intelligence. It is expected that from 2023 to 2030, industries related to such technologies will grow at an average annual rate of 37.3%, which highlights the rapid development of artificial intelligence and its impact on various sectors of the economy [20]. This data confirms the importance of integrating artificial intelligence into the educational process, as training specialists capable of working with the latest technologies are becoming critical to meeting the needs of the labor market. To overcome financial constraints, it is recommended that grant programs be created for educational institutions to support the integration of artificial intelligence. It is also necessary to ensure equal access to such technologies in urban and rural schools through public funding and the involvement of private investors.

Among the successful examples of artificial intelligence integration is the use of virtual tutors, which ensure the adaptation of educational content to the needs of higher education students, promote their engagement, and increase the overall learning effectiveness [3, p. 530-531]. To optimize the use of artificial intelligence, it is recommended that a national strategy be developed that includes a phased plan for introducing technologies, including creating pilot projects in educational institutions of different levels. The proposed recommendations for integrating artificial intelligence into education will help improve the educational process's efficiency by ensuring equal access to modern tools for all participants.

Conclusions. The study's results emphasize the importance of introducing artificial intelligence into the educational process. This allows for a personalized



approach to learning and improves the quality of education. Intelligent agents demonstrate significant potential in creating individual learning paths, automating routine tasks, and supporting teachers, ensuring effective adaptation of educational content to students' needs.

The study also identified key challenges to integrating AI, including technical, financial, ethical, and organizational barriers. The high cost of technology adoption, insufficient technical infrastructure, and poor teacher training pose serious obstacles to the large-scale use of AI in education. Ethical concerns, such as data privacy and algorithmic bias, require the development of clear Standards and policies.

The proposed recommendations for integrating artificial intelligence include specialized training for teachers, modernizing the infrastructure of educational institutions, creating national support strategies, and implementing grant programs. Innovative technologies are important for making education accessible even in remote regions.

Despite the results achieved, the study demonstrates the need for further research on the long-term impact of artificial intelligence on the development of students' critical thinking, cognitive abilities, and creative skills. The issue of teachers' motivation to use the latest technologies and the impact of automation on their professional activities also requires further analysis.

The study's findings confirm the achievement of the set goals while outlining areas for further research that will contribute to the effective integration of artificial intelligence into the educational process and ensure the sustainable development of education.

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