



USE OF ARTIFICIAL INTELLIGENCE IN PERSONALIZED EDUCATION

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Abstract: This article analyzes the theoretical foundations and practical possibilities of using artificial intelligence technologies in the personalized learning process. The study examines the issues of forming an individual learning trajectory through adaptive learning systems, smart tutoring platforms, and educational analytics. The influence of artificial intelligence on the effectiveness of education, its pedagogical advantages, and ethical and technological problems are also highlighted. The results show that personalized education based on artificial intelligence is an important tool for optimizing the educational process and increasing the level of student learning.

Keywords: personalized education, artificial intelligence, adaptive learning, smart tutoring systems, educational analytics.

The education system of the 21st century is fundamentally transformed by globalization, digitalization, and the rapid development of information technologies. The process of acquiring knowledge in modern society requires a transition from the traditional model of education to a personality-oriented, flexible, and individual-based model. From this point of view, the concept of personalized education is recognized as a relevant pedagogical approach. This approach implies the organization of the educational process, taking into account the level of knowledge, the pace of learning, cognitive characteristics, and interests of each student. The development of digital technologies, especially artificial intelligence (AI) systems, makes it possible to practically effectively implement personalized learning. Adaptive learning platforms based on artificial intelligence analyze student activity in real time, identify individual errors, identify knowledge gaps, and recommend appropriate learning materials. As a result, the educational process will become more effective, interactive, and productive.

The issue of using artificial intelligence in personalized education is also widely studied at the international level. In particular, scientific research is being conducted in the areas of adaptive learning systems, intelligent tutoring programs, data-based assessment models, and learning analytics. However, the pedagogical, psychological, and ethical aspects of these technologies still



require comprehensive scientific analysis. The issue of the integration of personalized learning and artificial intelligence is one of the most actively studied areas at the intersection of pedagogy, educational technologies, and cognitive sciences in recent decades. Research conducted in this area is mainly formed in three main areas: (1) the theoretical foundations of personalized learning, (2) adaptive systems based on artificial intelligence, (3) educational analytics and decision-making processes based on data.

The concept of personalized education is based on the theories of constructivism and socio-constructivism. In particular, the theory of the "zone of proximal development," put forward by Lev Vygotsky, substantiates the need to take into account the level of individual development of the student. According to this theory, the educational process should be organized in the interval between the student's existing level of knowledge and the level of potential development⁵⁶. Jean Piaget's views on the stages of cognitive development also serve as an important methodological basis for determining the trajectory of individual learning⁵⁷. With the development of digital technologies, personalized education has begun to be implemented in practice through adaptive learning systems. The "Intelligent Tutoring Systems" (ITS) model, created as a result of research led by John R. Anderson, made it possible to analyze student responses in real time and provide personalized tasks⁵⁸. Later, Beverly Park Woolf conducted an in-depth analysis of the architecture and pedagogical effectiveness of intelligent tutoring systems based on artificial intelligence⁵⁹. In his opinion, ITS systems significantly increase student performance by forming an individual educational trajectory.

Among modern research on the role of artificial intelligence in education, the work of Wayne Holmes and colleagues is of particular importance. They analyzed the possibilities, risks, and ethical issues of the application of artificial intelligence in education based on a comprehensive approach⁶⁰. While researchers note the high effectiveness of AI systems in the processes of personalized learning, automated assessment, and educational analysis, they also pay attention to the problems of data confidentiality and algorithmic bias. Research conducted by George Siemens and Dragan Gašević in the field of educational analytics substantiates the possibility of developing individual

⁵⁶ Vygotsky, L. S. *Mind in Society*. Cambridge, MA: Harvard University Press, 1978

⁵⁷ Piaget, J. *The Psychology of Intelligence*. London: Routledge, 1950

⁵⁸ Anderson, J. R., Corbett, A. T., Koedinger, K. R. *Intelligent Tutoring Systems*. Science, 1995

⁵⁹ Woolf, B. P. *Building Intelligent Interactive Tutors*. Morgan Kaufmann, 2009

⁶⁰ Holmes, W., Bialik, M., Fadel, C. *Artificial Intelligence in Education*. Boston: Center for Curriculum Redesign, 2019



learning strategies through the analysis of educational data⁶¹. In their opinion, modeling student learning behavior based on big data increases the effectiveness of personalized learning.

In recent years, AI-based adaptive platforms (such as smart learning systems and automated recommendation mechanisms) have been widely used in the global education market. Studies show that adaptive algorithms can increase learning outcomes by 20-30% by accurately assessing the student's level of knowledge and presenting individual learning materials⁶². However, some scientists argue that excessive automation of technologies can reduce the pedagogical role of the teacher⁶³.

Thus, the analyzed scientific sources show that the use of artificial intelligence in personalized education is a theoretically substantiated direction, and its practical effectiveness is confirmed. At the same time, it requires a comprehensive approach, taking into account pedagogical, ethical, and social factors.

1. Theoretical and Methodological Foundations of Personalized Education

Personalized learning is a pedagogical approach aimed at organizing the educational process in accordance with the individual needs, level of knowledge, pace of learning, and cognitive characteristics of each student. Although this concept is inextricably linked with the concepts of differentiated learning, individual learning, and adaptive learning, it differs from them in terms of scale and technological capabilities. In the traditional education model, students are taught based on the same content and pace. Such an approach does not sufficiently take into account individual differences. Personalized learning involves determining the student's level of mastery, identifying gaps in knowledge, and choosing an appropriate learning strategy. In this process, algorithms based on artificial intelligence act as an important tool. Methodologically, personalized learning is based on the principles of constructivism, a competency-based approach, and informed pedagogical decision-making. In a modern educational environment, the student's learning trajectory must be dynamic and flexible.

2. Adaptive learning systems based on artificial intelligence

Artificial intelligence (AI) technologies occupy a central place in the practical implementation of personalized learning. AI systems analyze student

⁶¹ Siemens, G., Gašević, D. Learning Analytics and Educational Data Mining. EDM Handbook, 2012

⁶² Pane, J. F. et al. Continued Progress: Promising Evidence on Personalized Learning. RAND Corporation, 2015

⁶³ Selwyn, N. Education and Technology: Key Issues and Debates. London: Bloomsbury, 2016



responses, identify errors, assess learning speed, and offer personalized materials.

Intelligent Tutoring Systems (ITS)

Building Intelligent Interactive Tutors states that intelligent tutoring systems consist of a domain model (subject content database), a student model (information about the student's level of knowledge and errors), a pedagogical model (adapted strategies), and interface module components. ITS systems allow for the formation of an individual educational trajectory. For example, when a student answers incorrectly in teaching mathematics or a foreign language, the system automatically provides additional explanations or a simplified task.

Machine learning and adaptive algorithms

Machine learning algorithms predict learners' learning behavior by analyzing large amounts of data. Such systems determine the level of knowledge, assess the probability of success, and provide individual recommendations. For example, adaptive platforms identify topics where students show results below 70% and redirect them to that section. This helps to systematically eliminate gaps in knowledge.

3. Educational Analytics and Data-Based Management

Educational analytics is a direction aimed at increasing the effectiveness of education by collecting, analyzing, and interpreting data generated in the educational process. With the help of AI, the student's level of activity is determined; the time for completing assignments is analyzed; academic success is predicted; an individual development map is formed. As a result, the teacher relies on accurate statistical data when making decisions. This reduces subjective assessment and improves the quality of education.

4. Pedagogical effectiveness of artificial intelligence

Scientific research shows that personalized learning based on AI leads to the following results:

- increase in assimilation indicators;
- Increased motivation of students;
- development of independent learning skills;
- efficient use of time resources.

However, it is advisable to consider AI systems not as a fully autonomous teacher, but as an auxiliary tool of the teacher. The human factor - empathy, socio-emotional support, and moral education - is not fully replaced by artificial systems.

5. Problems and limitations

When using artificial intelligence in personalized education, there are a number of problems, such as data confidentiality and security issues,



algorithmic bias, digital inequality, and the possibility of weakening pedagogical control. Therefore, when implementing AI systems, it is necessary to develop a regulatory framework, ethical norms, and mechanisms for pedagogical monitoring.

6. Prospects for application in the national education system

The processes of digital transformation are accelerating in the education system of Uzbekistan. Electronic platforms, distance learning, and online assessment systems are being gradually implemented. In the development of personalized education, the creation of national content, the development of adaptive platforms in the Uzbek language, and the training of teachers in digital competencies are priority tasks. In the future, it is expected that AI-based educational systems will further improve individual curricula, automated assessment, and competency monitoring.

Conclusion

In conclusion, the use of artificial intelligence in personalized learning is important in taking into account the individual needs of students, adapting the learning process, and increasing the effectiveness of education. Artificial intelligence optimizes the educational process through adaptive learning, automated assessment, and educational analytics. At the same time, when implementing it in the education system, it is necessary to take into account pedagogical goals, ethical principles, and data security issues. Also, the use of artificial intelligence in personalized education is an important tool for optimizing the educational process, taking into account individual needs, and increasing the effectiveness of learning. However, technological innovations should serve pedagogical goals, the human factor and ethical principles should be prioritized.

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