THE PEDAGOGICAL ESSENCE AND FUNCTIONS OF INFORMATION TECHNOLOGIES IN THE EDUCATIONAL PROCESS

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Annotation: This article explores the pedagogical essence and functions of information technologies in the educational process. It examines how modern digital tools contribute to enhancing teaching effectiveness, facilitating interactive learning environments, and supporting individualized approaches to education. The study also highlights the role of information technologies in shaping contemporary pedagogical practices and increasing student engagement and motivation.

Keywords: Information technologies, pedagogy, educational process, digital tools, interactive learning, teaching effectiveness, student engagement.

Introduction: The implementation of information and communication technologies (ICT) in the modern education sector has radically transformed the pedagogical environment, directing teaching and learning processes toward a new system. Globally, the resources allocated to education amounted to $227 billion in 2020, and by 2025 this figure is expected to reach $404 billion. This, in itself, indicates the sharply increasing importance of ICT as a social factor in education. The pedagogical essence of information technologies is not limited to technological tools alone; rather, it reflects their role in human education and upbringing, methodological approaches, and practical outcomes. The emergence of pedagogical paradigms such as blended learning, m-learning, and CSCL underlines the potential of information technologies to harness human resources. For instance, research led by Robert Somekh shows that working with interactive whiteboards increases student achievement in mathematics and science by 2.5 months over a two-year period. Statistics: In 2021, the percentage of computers allocated to educational institutions in Kyrgyzstan ranged from 34% to 33%, while the use of ICT at the organizational level reached 54%. These indicators also confirm a similar trend in countries like Uzbekistan – the digital transformation process is accelerating in sectors such as healthcare, education, and public administration. Information technologies, particularly artificial intelligence, are having a profound impact on the global education market. For example, in 2022 the AI market was valued at $2.48 billion, and it is expected to grow to $53.7 billion by 2032. This suggests that new approaches such as automating pedagogical processes, adapting to students' individual needs, and implementing AI-based testing and assessment programs are becoming more feasible. Symbolic statistical data clearly illustrate this: when analyzing secondary education institutions worldwide through successive investigations, it was found that in schools where interactive technologies were tested, learning effectiveness increased by 20–50%. On the other hand, CSCL methods have been proven to be effective in shaping students' social skills. In conclusion, the use of information technologies in education not only facilitates the transmission of knowledge but

also helps students develop critical thinking, creativity, and problem-solving skills. As global macro-trends (according to Forbes, Softline, and UN Reports) suggest, around 5% of global expenditures are planned to be allocated to the education sector by 2025. As a result, conducting strategic research in the field of digital pedagogy remains a relevant task for Uzbek educators and academic researchers. In the future, it is predicted that AI will enable the customization of individual learning plans, enhance the accuracy of real-time pedagogical monitoring and assessment processes, and that digital learning will be automatically managed through collaboration with machine interfaces[1]. If ethically responsible AI algorithms are developed to ensure educational quality, this approach will allow educators to define the main direction of digital tools in the near future. The 21st century is described as the century of the knowledge economy, in which the education system—being the most important foundation of human capital—has undergone a fundamental transformation. In this process, information and communication technologies (ICT) have become recognized not only as auxiliary tools but also as primary pedagogical resources that shape students' thinking, working, collaborative learning, and creativity. The digital transformation observed in the global educational arena, particularly the rapid introduction of tools such as artificial intelligence, big data, IoT (Internet of Things), distance learning platforms, and virtual laboratories, sharply increases the scientific and practical relevance of this topic. Today, Uzbekistan is also not isolated from these global changes. The initiatives put forward by President Shavkat Mirziyoyev to develop the education sector—such as the "Digital Uzbekistan – 2030" strategy and the principle of "New Uzbekistan – an enlightened society"—have led to an increasing number of reforms aimed at integrating ICT into education year by year[2]. Specifically, starting from 2020, computer classrooms connected to the internet network have been gradually established in all general education schools, and a special certification system on ICT competencies for teachers and students has been developed.According to statistical data, only 38% of schools in Uzbekistan had internet access in 2017, whereas by 2023 this figure reached 98%. At the same time, by the end of 2022, more than 8,000 schools had established modern information resource centers. This ensures the innovative development of the educational environment and expands the scope of information technologies' influence.

Among the key regulatory and legal documents adopted in recent years in Uzbekistan, the following stand out: The Presidential Decree dated November 6, 2019, "On the Digitization of the Education System", The Government Decree dated June 23, 2020, "On the Creation of the National Digital Education Platform", The "Concept for the Development of Science and Education until 2030" dated February 28, 2022[3].

Based on these documents, every educator has become responsible for using digital methodological tools in their work, delivering knowledge through modern platforms, and implementing distance assessment. The relevance of this topic has also increased significantly in the post-pandemic period. Due to COVID-19 in 2020, the shift to distance learning created the necessity for a complete reform of traditional forms of education. This led to the recognition of information technologies not only as auxiliary tools but also as distinctive pedagogical methodologies. As a result, experiences with E-Learning, Learning Management Systems (LMS), Virtual Reality (VR)-based lessons, and interactive software have become widespread. In international practice, information technologies are integrated into all stages of education in Finland, where every student is required to acquire digital literacy starting from the age of five. In China, under the "Smart Education China" program, students' knowledge levels are automatically assessed using artificial intelligence[4]. In the USA, platforms such as Google Classroom, Khan Academy, and edX maintain constant online communication between students and teachers. From this perspective, Uzbekistan also demonstrates positive progress in this direction, with experimental digital schools being established in the Bukhara, Samarkand, Tashkent, and Namangan regions — practical examples of reforms in the field. Another factor

defining the relevance of the topic is the direct connection between the pedagogical functions of information technologies and education. These functions are manifested not only through technical capabilities but also through renewing the approaches in the educational process[5]. For instance, adaptive learning programs tailored to students' levels, gamification elements that make lessons interactive, and virtual libraries encouraging independent learning — all are examples of the modern pedagogical functions of ICT. From this viewpoint, this topic occupies a central place in the ongoing renewal of today's education system. Strengthening the integration between science and education, and fostering innovative thinking and digital competencies among students, serves not only the modernization of curricula but also the enhancement of the intellectual potential of society as a whole.

Literature review: The issue of integrating information and communication technologies (ICT) into the educational process has been extensively covered by numerous foreign researchers, whose scientific works analyze in detail the role of technologies in improving the quality and ensuring the effectiveness of the pedagogical process. In particular, the American scholar Richard E. Mayer, in his work *Multimedia Learning* [6] demonstrated that presenting information through visual and audiovisual materials during the learning process significantly increases the speed and retention of students' knowledge. Mayer's research shows that students' memory and comprehension abilities improve by up to 40% when multimedia tools are used [7]. Statistical data also confirm that the introduction of ICT in education increases learning efficiency by an average of 25-35%. This situation indicates that in pedagogical practice, technologies have become not only auxiliary but also fundamental functions. Additionally, the Australian researcher Helen Crompton, in her scientific work *Educational Technology and Mobile Learning* [8], studied the role of mobile devices and interactive applications in individualizing and personalizing the educational process in modern pedagogical environments. According to Crompton, students allocate 60% more time to independent learning with the help of mobile technologies, which in turn increases their motivation to learn[9]. This expands the functional capabilities of ICT tools in education and creates new platforms to achieve pedagogical goals. Based on statistical analysis, it is predicted that the use of ICT in education will deepen further in the future, particularly through artificial intelligence, machine learning, and virtual reality technologies, adapting the learning process to individual characteristics. For example, by 2024, the growth of online and digital learning platforms worldwide is expected to reach 30%, with the number of learners reaching 1.5 billion [10]. This further increases the importance of information technologies as one of the main tools of the pedagogical process. Researchers emphasize the necessity of developing pedagogical approaches alongside the technological integration in education systems. Richard Mayer notes in his work that the alignment between educational content and technology, user-centered approaches, and the level of interactivity directly affect educational effectiveness. Helen Crompton highlights the importance of adapting the educational process to students with new technologies, as well as the formation of convenient monitoring and assessment mechanisms for teachers. As a result, the scientific analyses of both scholars indicate that the pedagogical essence of information technologies lies not only in enriching the educational process with technological tools but also in fundamentally improving the quality of education, expanding individualized approaches, and increasing students' interest in knowledge. This requires countries to adopt information technologies as a primary strategic direction in shaping their educational policies.

Methodological section: In the methodological section of this article, a multifaceted scientific approach was applied to study the pedagogical essence and functions of information technologies in the educational process. Both qualitative and quantitative research methods were harmoniously employed. In particular, surveys, interviews, and observation methods played a primary role in collecting and analyzing empirical data. Through these methods, precise numerical indicators were obtained regarding students' activities in using ICT tools and their

impact on learning effectiveness. For example, according to statistical data, the introduction of ICT into the educational process was found to help increase students' knowledge levels by an average of 30% (Statista, 2024). Additionally, experimental methods were used to test the influence of multimedia tools on students' cognition during the learning process, and the results confirmed the effectiveness of digitizing the pedagogical process. Using the historical-analytical method, the development of information technologies within the pedagogical system was studied, as well as the changes they brought to the content and methods of education, laying the foundation for comparing trends in global and national contexts. Moreover, forecasting methods, based on research findings, indicate that in the future, the widespread use of artificial intelligence and big data technologies in the educational process will lead to further individualization of learning and create opportunities for significantly enhancing students' abilities. This is expected to fundamentally improve the efficiency of the pedagogical process and contribute to strengthening social equity in education. Thus, the scientific methods employed in the article not only analyzed the practical significance of information technologies in education but also made it possible to identify development prospects for contemporary and future pedagogy.

Results: The results of the research conducted in this article show that the integration of information technologies into the educational process has significantly increased pedagogical effectiveness. According to statistical data, the average growth in students' learning speed and knowledge acquisition ranges between 25-35% (UNESCO, 2023). Moreover, it has been proven that interactive lessons conducted using ICT tools are more effective in reinforcing students' knowledge and developing practical skills compared to traditional methods. Based on the data collected during the study, it can be predicted that in the near future, with the widespread implementation of artificial intelligence and virtual reality technologies in the education system, the pedagogical process will become more individualized, leading to new heights in students' mastery levels and overall education quality. Furthermore, through a high degree of adaptation to global education standards and the effective application of pedagogical innovations, achieving social equity, ensuring fairness of educational opportunities, and preparing qualified personnel will be significantly enhanced. Therefore, the comprehensive and systematic integration of information technologies in the educational process is expected to remain a decisive factor in the development of global education.

Discussion: The discussion section of this article focuses primarily on scientific debates regarding the pedagogical essence and functions of information technologies in the educational process. The viewpoint of the American pedagogy expert Richard E. Mayer is particularly significant as the first foreign scholar referenced. While analyzing methodological approaches related to the integration of information technologies into the learning process, he emphasizes that their effectiveness largely depends on how well the educational content and the cognitive abilities of learners are matched (Mayer, Richard E., *Multimedia Learning,* Cambridge University Press, 2009, p. 384). Empirical research conducted by Mayer shows that multimedia tools, by combining information in visual and auditory forms during education, increase learners' ability to receive and retain knowledge by 34%. According to statistical data, the use of information technologies in the United States has enhanced educational efficiency by 25-40% (U.S. Department of Education, 2023). Mayer's approach to the function of information technologies in education enables individualization and interactivity in the learning process, as well as increasing the interactivity of the educational process itself, which significantly improves learners' levels of mastery. On the other hand, German education specialist Katrin Schulz highlights certain problems and limitations in the introduction of information technologies into the pedagogical process. According to her, the widespread use of technologies leads to a one-sided technological basis for pedagogical approaches in education, which may negatively affect the development of learners' critical thinking skills (Schulz, Katrin, *Technology and Education: Critical Perspectives,* Springer, Berlin, 2017, p. 276). Research conducted by Schulz found that

reliance on information technologies, especially in interactive and online education systems, reduces social interaction and group collaboration among learners, thereby weakening the human elements of the educational process. Statistical data shows that the level of social isolation in online education in Germany increased by 18%, which negatively impacted learning efficiency (Federal Statistical Office of Germany, 2022). Schulz also emphasizes that the pedagogical effectiveness of using technologies directly depends on teachers' qualifications and methodological preparation, and technological tools are only effective when adapted appropriately to the pedagogical process. At the same time, current trends and analyses indicate that effective integration of information technologies in education requires harmonizing technological approaches with pedagogical content. In the future, educational platforms created based on artificial intelligence and big data will better adapt to the abilities and needs of individual learners, thereby making the learning process more personalized, interactive, and effective (World Economic Forum, 2024). Additionally, at a global level, the need to ensure digital equity in education and to expand educational opportunities underscores the importance of further in-depth study and optimization of the pedagogical functions of information technologies. Thus, the differences and debates in the views of Mayer and Schulz demonstrate the complexity and developmental potential of scientific reflections on the role and impact of information technologies in education.

Conclusion: This article provides a detailed analysis of the pedagogical essence and functions of information technologies in the educational process. Based on scientific research and statistical data, the role of information technologies in enhancing the effectiveness of education, as well as their importance in ensuring interactivity and individualization in students' learning processes, was revealed. Drawing on the views of foreign scholars such as Richard E. Mayer and Katrin Schulz, the positive and negative aspects of using technologies in education were highlighted, including the significance of the harmony between pedagogical approaches and technology. It was emphasized that in the future, the prospects for further personalizing the educational process and improving its efficiency through the use of artificial intelligence and big data analysis are promising. At the same time, issues of digital equality and expanding opportunities in education remain urgent. Overall, deeper study and practical application of the pedagogical functions of information technologies play a crucial role in improving the quality of the educational process.

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