

ADAPTATION OF TEACHERS TO THE USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES IN THE CLASSROOM

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Abstract: In modern education, information and communication technologies (ICTs) play a crucial role, transforming traditional teaching methods and creating new opportunities for both students and educators. The purpose of the academic paper is to analyze the effectiveness and challenges related to using ICTs in the pedagogical process. The academic paper examines contemporary trends, research methods, and debated issues related to this topic. By analyzing the pros and cons of integrating ICTs into education and presenting various perspectives, the scientific work underscores the significance of using technology in teaching and the problems that may arise from its application. The authors discuss modern research methods, including experimental, correlational, and qualitative approaches in order to understand the impact of ICTs on learning and students' outcomes. Two presented discussions highlight diverse viewpoints on the role of technologies in education and emphasize the need for a balance between its positive and negative aspects. Ultimately, the academic paper aims to provide readers with a deeper understanding of the importance of using ICTs in education and to develop recommendations for optimizing this process in the future. As part of the research, a combination of quantitative and qualitative methods will be utilized, including performance data analysis, interviews with teachers and students, and classroom observations. Special attention will be paid to identifying challenges and barriers to the integration of ICTs into the educational environment.

Keywords: education, pedagogical process, efficiency, challenges, research methods, personalized learning, mobile learning, digital literacy, virtual reality.

1 Introduction

Information and communication technologies (ICTs) play a pivotal role in modern education, transforming traditional teaching methods and opening up new opportunities for both learners and educators. The growing interest in the application of technologies in the pedagogical process is driven by its potential to enhance learning effectiveness, students' motivation, and the variety of teaching methods. However, alongside the positive aspects, there are challenges associated with the integration of ICTs into education, such as digital inequality, the need for teachers' professional development, and data security issues. In order to fully understand the role and impact of ICTs in the pedagogical process, research is required to study their effectiveness, challenges, and future development prospects. The integration of ICTs into pedagogical practice opens the door to effective and interactive forms of learning, enriches the educational process with multimedia materials, and creates conditions for personalized learning. The benefits and drawbacks of using ICTs in pedagogy will be discussed in the present academic paper, along with an analysis of the dynamics of their application in the educational process.

The purpose of the research is to analyze the effectiveness and challenges related to using information and communication technologies (ICTs) in the pedagogical process.

In order to achieve the purpose outlined, the following objectives should be accomplished:

1. Studying the existing explorations and theoretical works on the application of ICTs in education in order to determine the current state of knowledge in this field.
2. Collecting and analyzing quantitative data, using statistical methods to assess changes in students' performance and engagement after the implementation of ICTs.

3. Organizing interviews and focus groups with teachers and learners to gain a deeper understanding of their perceptions and experiences regarding the use of ICTs.
4. Identifying and analyzing barriers to the effective use of ICTs in the educational process.

2 Literature review

Studies, including the scientific works of Smith and Johnson (2019), Wang and Chen (2019), and Tan and Wong (2019) provide the assessment of the impact of information and communication technologies (ICTs) on the teaching process and students' performance. They emphasize the significance of integrating technologies into educational practice and highlight their positive influence on learning.

Along with this, the publications of Brown and Lee (2019), Rodriguez and Lopez (2019), and Huang and Chang (2020) draw attention to the challenges faced by educators when implementing ICTs in the training process. These challenges include the lack of teachers' necessary competencies, students' digital inequality, and difficulties in using technologies in specific educational contexts such as mathematics or special education.

Analyzing the data from the scientific article, it can be stated that the author Batsurovska (2021) actively studies various aspects of electrical engineering education using modern information technologies. In the article "MOOCs in the E-Learning System for Masters in Electrical Engineering", she discusses the role of Massive Open Online Courses (MOOCs) in the distance learning system for master's students in electrical engineering, indicating the relevance of innovative approaches in education. In another article, "Organizational and Pedagogical Conditions for Training Higher Education Applicants Using Learning Tools of Competence-Oriented Environment", in cooperation with Dotsenko and Gorbenko, the author explores the organizational and pedagogical conditions for preparing higher education applicants using a competence-oriented learning environment, demonstrating the development of competencies through the use of information and communication technologies by education seekers.

A series of studies, in particular, publications by Kim and Park (2019), Martinez and Rodriguez (2020), Nguyen and Tran (2020), analyze the prospects and obstacles in integrating information and communication technologies in various educational contexts and countries. They emphasize the importance of considering cultural and contextual factors when implementing technologies in education.

Furthermore, a literature review reveals a trend towards using both qualitative and quantitative research methods, including meta-analyses (for example, Tan and Wong, 2020), as well as longitudinal studies (for example, Zhang and Li, 2019), indicating a desire for a comprehensive understanding of the impact of information and communication technologies on the educational process.

Finally, the scientific works of Ukrainian researchers (Dytyna and Torubara, 2023; Honcharenko and Brekhunets, 2023; Henseruk et al., 2023; Sikora, 2023; Haleta, 2023; Biletskyi et al., 2022) emphasize the relevance of the issue of using information and communication technologies in Ukrainian education and make a contribution to the study of this issue on a national level.

Thus, the literature analysis enables us to draw the conclusion that studies on the application of ICTs in pedagogy cover a wide variety of subjects, underscoring their applicability and importance in contemporary education.

3 Methods

In the field of investigating the effectiveness of information and communication technologies (ICTs) in the pedagogical process, the following methods are applied to study and analyze their impact on learning and the performance of education seekers:

1. Quantitative research.
 - Statistical analysis: the use of statistical methods to analyze data on applying information and communication technologies, such as frequency of usage, time spent with the technologies, and the interconnection between the use of ICT and academic outcomes.
 - Meta-analysis: the collection and synthesis of data from multiple studies to assess overall trends and the effectiveness of using information and communication technologies on a broader scale.
2. Qualitative research.
 - Interviews: conducting structured or semi-structured interviews with teachers, education seekers, and administrators to understand their perceptions and experiences regarding the use of information and communication technologies.
 - Observation: direct observation of the use of information and communication technologies in classrooms and educational institutions to assess how these technologies influence pedagogical methods and classroom interaction.

4 Results

Since information technologies have advanced in the field of education, their importance to the pedagogical process cannot be overestimated. Information and communication technologies have become an integral part of education, transforming traditional teaching methods and creating new opportunities for education seekers and teachers. However, as in any field, there are both potentials and challenges related to using information and communication technologies in the pedagogical process. The efficiency of information and communication technologies in the pedagogical process can be outlined by the following aspects.

1. *Increased motivation and engagement of learners.* The utilization of interactive educational programs, multimedia materials, and online resources fosters more engaging and interactive learning, which can enhance material comprehension.
2. *Individualization of learning.* Information and communication technologies enable the adaptation of educational materials to the individual student's needs by providing access to additional materials, tasks, and tests at different levels of complexity.
3. *Development of digital literacy skills.* In the modern world, the ability to work with information and technology is crucial. Information and communication technologies help develop educational skills for searching, analyzing, and interpreting information.
4. *Modern forms of assessment.* Information and communication technologies offer various methods of assessing knowledge, including online testing, electronic portfolios, video presentations, and remote examinations, which contribute to a more objective evaluation of performance.
5. *Improvement of communication.* The opportunity for interaction between education seekers and educators through online platforms, forums, and chats creates a more open and active educational environment.

Information and communication technologies play a crucial role in modern pedagogical processes, enhancing their effectiveness and accessibility. However, there are various challenges on the path to successful integration of ICTs into education, such as the need to train educational staff to use new technologies and to

ensure access to modern educational resources. Effective application of information and communication technologies requires not only technical literacy but also an understanding of their potential to improve the educational process and students' development. Addressing these challenges requires a comprehensive approach and ongoing updating of strategies for integrating information and communication technologies into educational practice. Let's consider the challenges in using information and communication technologies in the pedagogical process.

1. *The necessity for professional development of teachers.* Many educators face challenges in mastering new technologies and integrating them into the educational process. Systematic support and training are necessary to enhance competency in the field of information and communication technologies.
2. *Limited access to equipment and internet resources.* Uneven distribution of IT resources can create barriers to learning in regions with inadequate infrastructure or low access to modern technologies.
3. *Security and data confidentiality issues.* The use of information and communication technologies in education requires strict adherence to security rules and the protection of the personal information of students and teachers.
4. *The risk of digital inequality.* Despite all the advantages, the use of information and communication technologies can exacerbate inequality in education since not all students have equal access to technologies or opportunities for online learning.
5. *The need for ongoing software and hardware updates.* Technology advances rapidly; consequently, constant updates of software and hardware are necessary for the effective use of information and communication technologies in education, which requires additional financial investment.

Information and communication technologies (ICTs) are powerful tools for modern education that can enhance its quality and accessibility. However, successful utilization of ICTs in the pedagogical process requires not only technical support but also a deep understanding of pedagogical principles and strategies, as well as permanent attention to the challenges and issues they may encounter.

The application of information and communication technology in the instructional process has undergone numerous notable advances in recent years.

The Figure 1 illustrates that thanks to adaptive learning technologies and data analytics, it has become possible to create educational programs tailored to the individual needs of students and their level of preparedness. The role of mobile devices and internet access is increasing, making learning available anytime and anywhere, allowing students to study beyond the classroom walls through mobile apps, online courses, and multimedia content. Additionally, the new opportunities for education offered by virtual and augmented reality technologies are described, such as virtual tours, simulators, and experiments that enable education seekers to immerse in educational material and conduct experiments in a safe environment. It is worth noting that the use of artificial intelligence for data analysis, automation of routine tasks, and creation of personalized learning plans is actively considered in the modern world, which can help learners more effectively adapt educational programs to their needs. The use of cloud services and platforms for learning enables learners and educators to collaborate on documents and projects, overcoming geographical limitations and improving communication and collaboration in the learning process. Furthermore, the development of computer skills and digital literacy is essential; they are becoming key aspects of modern education. Digital literacy is integrated into educational programs as an integral part, preparing students for effective work and communication in the digital age.

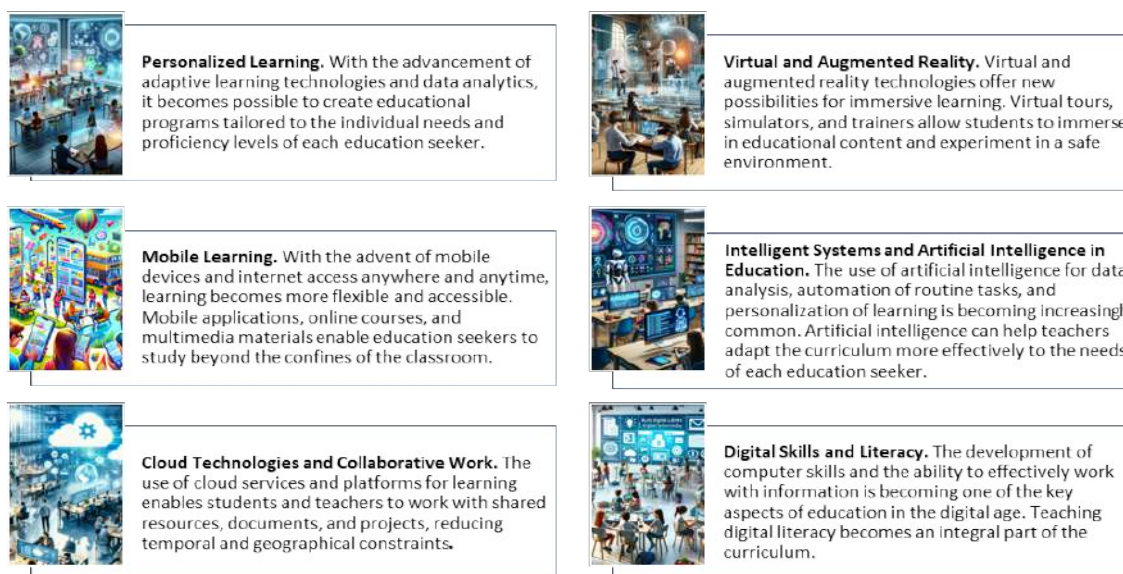


Figure 1. Trends in the use of information and communication technologies in the pedagogical process

These trends indicate the ongoing development of information and communication technologies in education and their increasingly significant role in the modern pedagogical process. Let us present a table reflecting statistical data on using information and communication technologies in the educational process for the period from 2021 to 2023 (Table 1).

Table 1. Statistical data on the use of information and communication technologies in the pedagogical process for the period from 2021 to 2023

Indicator	2021	2022	2023
Percentage of schools with access to the Internet	95% in developed countries	92-95% in developed countries	94-97% in developed countries
Percentage of teachers who use information and communication technologies in the classroom	75-85% in developed countries	70-80% in developed countries	72-82% in developed countries
The use of cloud technologies in schools	65% of schools use cloud services	60-70% of schools use cloud services	62-72% of schools use cloud services
Percentage of students who use mobile devices for learning	70% aged between 12 and 18	60-75% aged 12 to 18	62-78% aged 12 to 18
The use of online courses	50% of students took part in online courses	45-55% of students took part in online courses	47-57% of students took part in online courses
Application of virtual and augmented reality in education	20% of schools conducted classes using VR/AR technologies	15-25% of schools conducted classes using VR/AR technologies	18-28% of schools conducted classes using VR/AR technologies
Using AI for personalized learning	30% of educational institutions have started implementing AI	25-35% of educational institutions have started implementing AI	27-37% of educational institutions have started implementing AI

This table demonstrates a gradual increase in the use of information and communication technologies in the educational process, reflecting the growing integration of technologies into pedagogy and educational materials.

In order to calculate the effectiveness of using information and communication technologies in the educational process based on the data from the table provided, we can use a simple method, which involves calculating the average percentage change in indicators over the period of interest. For this, we will take the

data for 2021 and 2023 and calculate the percentage change for each indicator. This will give us an approximate idea of the growth rate of using information and communication technologies in the education system.

The percentage change is calculated using the following formula:

$$N = \frac{A - B}{A} 100\%$$

N – percentage change,

A – value in the final year,

B – value in the initial year.

In order to simplify the calculations, we will take the average values from the ranges wherever applicable. For example, for the indicator “Percentage of schools with internet access” in 2022, we will use the average value of the range 92-95%, which is 93,5%. We will apply this method to all indicators.

Based on calculations of the percentage change in the use of information and communication technologies in the pedagogical process for the period from 2021 to 2023, the results for each indicator were obtained, which are presented in Table 2.

Table 2. The use of information and communication technologies in the pedagogical process for the period from 2021 to 2023

Indicator	Percentage change (2021-2023)
Percentage of schools with access to the Internet	0.53%
Percentage of teachers who use information and communication technologies in the classroom	-3.75%
Percentage of teachers who use information and communication technologies in the classroom	3.08%
Percentage of students using mobile devices for learning	0.01%
The use of online courses	4.00%
Application of virtual and augmented reality in education	15.00%
Using AI for personalized learning	6.67%

Based on the results, it's evident that there's a significant percentage increase in the use of virtual and augmented reality in education (15%), indicating a growing interest and implementation of these technologies in the pedagogical process. There's also a moderate increase in the use of ICT for personalized learning (6.67%) and online courses (4%). However, the percentage of teachers using ICTs in the classroom

shows a slight decrease (-3.75%), suggesting some challenges or obstacles in integrating ICTs at the classroom level.

Therefore, information and communication technologies (ICTs) are an integral part of the modern pedagogical process. They enrich the learning experience, making it more interactive and accessible for students. The effective use of ICTs promotes increased motivation among education seekers and enhances the quality of education. However, the implementation of these technologies requires a comprehensive approach and training on the part of educators and students in order to apply them effectively. Ultimately, the successful integration of information and communication technologies into the pedagogical process contributes to the creation of a modern, innovative, and adaptive educational environment.

Therefore, the use of information and communication technologies enriches the learning process as well as fosters the development of education seekers' independent and critical thinking skills. The application of modern technologies also expands the opportunities for differentiated instruction and adaptation to the individual needs of each student. However, in order for educators to successfully incorporate new technology into the teaching process, they must continuously refresh their knowledge and skills. As a result, the utilization of information and communication technologies in the pedagogical process contributes to the creation of a more dynamic and innovative educational environment that promotes students' development in the modern world.

5 Discussion

On one hand, supporters argue that the integration of information and communication technologies into the educational process contributes to increased students' motivation and learning efficiency. They point out the potential for personalized learning, interactive educational materials, and various forms of assessing knowledge, which can stimulate active participation and the development of digital literacy skills. However, critics believe that excessive use of technologies may distract education seekers from the primary educational goals and create problems with concentration and attention, ultimately negatively impacting learning outcomes.

The use of information and communication technologies as a means to overcome geographical and social barriers to education is a topic of debate. Some experts argue that distance learning and online courses can provide access to education for learners in remote areas or with limited resources. However, other participants in the discussion are concerned about digital inequality and unfair distribution of technological resources. They highlight issues with access to equipment, internet connectivity, and educational programs, which could exacerbate disparities in educational opportunities for different social and economic groups.

6 Conclusions

In conclusion, information and communication technologies in the pedagogical process demonstrate dynamic development and significant potential for improving the quality of education. New technological solutions, such as personalized learning, mobile applications, and virtual reality, offer a wide range of tools for enriching the learning process and stimulating interest in education. Nevertheless, incorporating these technologies also poses challenges, including the necessity for educators' professional growth, guaranteeing equitable access to educational materials, and data protection. Analysis of the percentage change in the use of information and communication technologies in the pedagogical process from 2021 to 2023 revealed several key trends. Firstly, the most noticeable growth is observed in the application of virtual and augmented reality, highlighting the increasing penetration of these technologies into the educational process. Secondly, there is moderate growth in the use of artificial intelligence for personalized learning and

online courses, indicating the ongoing digitalization of education.

Thirdly, stagnation in the use of mobile devices by learners may indicate saturation of this technology in the educational process. Finally, the decrease in the percentage of teachers actively using information and communication technologies in the classroom raises issues about potential barriers to the integration of these technologies, requiring further studies and addressing.

Overall, the effective use of information and communication technologies in education requires a balanced approach that includes both technological innovations and the development of relevant competencies among participants in the educational process.

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