

## MODERNISATION OF PROFESSIONAL EDUCATION FOR FUTURE PRIMARY SCHOOL TEACHERS THROUGH MODERN INFORMATION TECHNOLOGIES

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**Abstract:** The article examines the problem of using information technologies in the educational and professional training of future primary school teachers. The authors found that the integration of digital resources into the educational process can effectively solve didactic tasks. It provides opportunities for virtual travel and improves the accessibility and efficiency of education. The application of information technologies contributes to enhancing the educational process. They prepare future teachers to function within the information society and promote the development of critical thinking and creativity among students. The new approach puts the teacher at the center of the educational process. This approach takes into account the professional competencies and personal interests of educators to promote the improvement of methodological, organizational, and technological support for personalized learning. The paper investigated the possibilities of using information technologies in the educational process to train future primary school teachers. The methodology included a systematic approach and general theoretical scientific methods. They include analysis, synthesis, and systematization of the research material on the role of digital technologies in the training of future primary school teachers. The research methodology employed two indicators to assess the psychological and emotional qualities of students, namely: assessment of communication skills; analysis of cultural and value orientations. The research results showed a high level of discomfort related to the current educational system. Nearly half of the respondents experience psychological and emotional stress due to the existing teaching format. In addition, as a result of the program implementation, it was found that the configuration model of student-centered learning applied to distance learning had a significant impact on students. The statistical analysis of the chi-square indices of overall conformity ( $\chi^2 = 0.36...1$ ) indicates a high conformity of the data set.

**Keywords:** Electronic resources, Virtual laboratories, STEM education, IT in pedagogy, Professional training

### 1 Introduction

Nowadays, in the context of the gradual digital transformation of society, the use of modern technologies is becoming a necessary component of the educational process (Nazaretsky et al., 2022). In Ukraine, one of the key strategies for education development is the integration of digital technologies to improve the quality of the educational process, as well as to ensure accessibility and effectiveness of learning. It also helps to prepare future professionals for successful functioning in a digital society. All these factors make the study relevant (Lai et al., 2022).

In the digital era, it is vital to make appropriate changes to the education system, focusing on training future professionals to use modern digital tools competently in their professional activities (Kruszewska et al., 2022). This necessitates the introduction of digital methods and tools into the educational process, which will contribute to a better understanding and perception of educational material. The transition to distance learning is one of the most critical challenges in today's environment, as it raises many questions for teachers, such as:

- How to ensure effective interaction with students remotely?
- How do we optimize the online learning process?
- Which tools to use for high-quality lessons and grading? (Hennessy et al., 2022).

These challenges create an urgent need to integrate digital technologies into the educational process for effective learning and to achieve positive results during the training process. The relevance of modern information technologies in the professional education of primary school teachers lies in the need to adapt the educational process to the requirements of modern society and technological development.

Using IT can improve learning, provide access to innovative methods, and increase student motivation. These are key factors

in shaping quality education and the readiness of future teachers for the challenges of our time (Xue & Wang, 2022).

The article aims to analyze and reveal the impact of modern information technologies on the process of training future teachers. It also defines their role in teachers' education and promotes the effective implementation of such technologies into the educational process.

The main trends in applying information technologies in the educational process include:

- the virtualization of learning and the use of online resources;
- the development of interactive teaching methods through electronic platforms;
- the use of virtual reality in curricula.

### 2 Literature Review

The United States has seen an increase in the use of information technologies within the educational process. This includes the active utilization of online platforms for learning and cooperation, the development of distance learning, the use of e-textbooks and interactive whiteboards, and the growing interest in programming and STEM education. STEM education, consisting of Science, Technology, Engineering, and Mathematics, is defined by several key features that contribute to the deep development of students. It is an integrated approach that combines science and math subjects. STEM promotes the interaction between science, technology, engineering, and mathematics, unlocking the enormous potential of this union. STEM education emphasizes solving real-world issues through critical thinking and practical skills (Lander et al., 2022). It helps students develop not only theoretical knowledge but also the ability to apply it on a practical level.

STEM education encourages students to work in a team that reflects the real conditions in the professional environment. Such cooperation and communication skills are essential in the modern world. Active use of technology in the STEM learning process is equally important. Modern technologies, virtual tools, and programming help develop information competencies and prepare students for the challenges of the contemporary world. Another essential element is an emphasis on practical skills. STEM education focuses on the practical use of theoretical knowledge through experiments, projects, and real-world problem-solving, which forms a deep understanding of the content (Chiang et al., 2022).

Finally, STEM fosters creativity. The curricula emphasize creativity and innovative thinking, which are key competencies for future success in STEM fields. The goals of STEM education are often achieved through various software tools. Some popular programs and tools include Scratch and Scratch Jr - for learning the basics of programming, especially in younger age groups. In today's world, technology is transforming our environment and revolutionizing the education system. Virtualization of learning and various online resources are becoming an integral part of the educational process, bringing a new level of flexibility and accessibility (Shamir-Inbal & Blau, 2022).

Virtualization of learning opens up endless possibilities for students. Virtual lectures that use video and audio materials provide effective education at a distance, making learning more accessible and convenient. Virtual laboratories allow you to conduct experiments and research in an interactive virtual environment. LEGO Mindstorms, Arduino, and Raspberry Pi help to learn electronics and programming, providing a hands-on approach to learning. Tinkercad helps to create 3D models and experiment with electronics, improving students' creative and research skills (Ibrokhimovich & Mirzaxolmatovna, 2022; Mirzaxolmatovna et al., 2022). Virtual tours help to expand

horizons by allowing you to virtually travel to places, visit countries, and immerse yourself in historical events.

Online resources also play a key role in the modernization of education. E-textbooks, interactive exercises, and virtual collaboration platforms such as Google Classroom and Microsoft Teams provide students with access to learning material anytime and anywhere. They give teachers and students a convenient tool for sharing information and communicating (Akour & Alenezi, 2022; Kotiash et al., 2022). These technologies not only make education more flexible but also open up new opportunities for students to learn. Virtualization of learning and online resources are becoming not only methods but also the key to effective and innovative learning in the modern world. Electronic platforms for learning and cooperation help to create dynamic and interactive learning. They increase the effectiveness of training future primary school teachers (Fernández-Batanero et al., 2022; González-Pérez & Ramírez-Montoya, 2022).

Virtual reality creates an immersive environment that increases learner engagement and activity. Students can conduct virtual experiments or interact with virtual objects, making learning more practical and dynamic (Adam & Metljak, 2022; Mansurjonovich, 2022). It is possible to “visit” places or events that are physically far away, expanding the geographical coverage of learning opportunities. Virtual reality allows students to customize the learning process to the needs of each person, creating an individualized approach. Virtual scenarios can be used to teach students in immersive environments that may be difficult to recreate in the real world (Chen et al., 2022). Virtual reality in education opens up great opportunities to improve the learning process and prepare students for the challenges of the modern world. The use of interactive whiteboards and screen projectors is a modern approach to organizing learning, where traditional whiteboards are replaced by a screen that responds to touch (Yoon & Kim, 2022; Zhang, 2022). They create an interactive environment where the teacher and students can interact with the content in real-time. Projectors and interactive whiteboards are actively changing the traditional approach to learning, making it more attractive and open to new opportunities for teacher-student interaction.

The development of communication skills through video conferencing is a relevant and essential aspect of the modern world (Martínez-Borreguero et al., 2022). Video conferencing provides an opportunity to see the opponent, which adds an important visual element to communication. They can observe body language and facial expressions, which helps to understand emotions and intonations more effectively. The ability to interact with each other via video conferencing provides flexibility and convenience, allowing participants to communicate without being physically present. This format facilitates communication over long distances, enabling global communication and collaboration (Martínez-Borreguero et al., 2022).

Videoconferencing in educational projects allows students to learn new disciplines and interact with teachers or other students, even if they are located at a distance. Video conferencing is becoming an effective tool for holding remote meetings and business negotiations while maintaining personal contact. Developing communication skills through video conferencing is an essential element of modern communication, especially in the context of the growing importance of remote work and study. The specific features of each discipline determine the specifics of using information technology (IT) in content-based training. In particular, it includes the use of virtual math laboratories for research and experiments or using software to create graphs and visualize mathematical concepts (Bowman et al., 2022). Such technologies contribute to an interactive and effective language skills acquisition process, allowing students to improve their skills in an engaging and stimulating environment. Such trends aim to prepare students for the digital economy and develop key skills for a successful career (Sabdash & Lysko, 2023).

In Europe, there is a very high level of use of information technologies in educational institutions. The trends include:

- The widespread use of online learning platforms.
- The development of electronic resources and e-books.
- The active use of interactive technologies in teaching primary school students.

Virtual laboratories and video conferencing are widespread forms of such classes to support the learning process (Antonietti et al., 2023). Additionally, there is a tendency to develop partnerships with tech companies to prepare students for the demands of the modern digital environment.

### 3 Methods

The research methodology is based on applying a systematic approach and general theoretical scientific methods. They include analysis, synthesis, and systematization of the research material. The research methodology was created to consider the impact of information technology on the training of future primary school teachers (Mogas et al., 2022). The study of the effectiveness of primary school teachers' training was carried out among the 3rd year students of Drohobych State Pedagogical University, named after Ivan Franko. The sample was selected based on educational background and the availability of a large technical support base. Students from the Departments of Elementary School Education and Fine Arts took part in the experiment. A total of 15 respondents were interviewed: 8 women and 7 men, with an average age of 19.2 years (SD=3; range 19-23 years). The majority of the participants had already experienced higher education. However, only 2 out of 30 people entered the third year of their studies after graduating from a pedagogical college with a secondary special education. The initial survey helped to identify key transformations in the student-centered learning process. The third-year students answered three questions to identify changes in the educational sphere. The survey provided information on the needs and aspirations of students regarding interactive learning in Ukraine. The respondents answered the following questions:

Question 1. Which aspects of existing education need to be adjusted?

Question 2. What are the benefits of moving to a new approach towards university education?

Question 3. How confident are you in implementing changes at your university?

Question 4. Please specify the measures that have already been taken to transform the education system.

Question 5. Please indicate possible difficulties that may arise during the implementation of changes.

The assessment was based on a Likert scale ranging from 1 to 5, which included five answer options with two extremes and one neutral option. Instead of the categories of “strongly agree” or “strongly disagree”, the scores were given in numbers from 1 to 5 for better clarification of the answers.

The obtained results were interpreted using the Gleicher's Formula for Managing Change,

$$R = (D \times B \times V \times F) > C, \quad (1)$$

where: R - readiness for changes,

D - unhappiness with the way things are going now,

B - anticipated benefits from the changes,

V - vision of the future,

F - real opportunities for implementing changes,

C - the price or resistance to changes.

According to this formula, readiness for change (R) is defined as the product of dissatisfaction (D), anticipated benefits (B), the vision of the future (V), and realistic possibilities for implementing change (F), and this product is compared to the cost of resistance (C).

It is necessary to specify the numerical values for each formula component (D, B, V, F, C) before determining the readiness for change using this formula. If the product (DxBxVxF) exceeds C, then the readiness for change is considered sufficient.

Please note that specific values and interpretations can be determined based on the specific data and context of the study (Table 1).

Table 1. Sample characteristics (N=15)

Gender %	Number of people	%
Men	7	33,3
Women	8	66,7
Age<19	9	60
20-22	3	20
> 22	3	20
Specialty General secondary education	14	93,3
Specialized secondary education	1	6,7

Notes: F means the first concrete steps that can be taken to achieve the vision; C means the cost of changes.

The refined equation includes the maximum amount of factors. This indicator is intended to reflect the main criteria for overcoming resistance to change and success in achieving goals. Every organization should identify the source of dissatisfaction, formulate a plan, and act on small changes.

The study focused on analyzing the implementation of student-centered learning during 2021-2022. Among the studied aspects were student motivation, teacher knowledge, choice of teaching methods, assessment in student-centered learning, and the use of information technology to improve the quality of education. The study included online phases using e-mail, online questionnaires, and Google Forms tests to collect data. Communication skills and cultural and value orientations were assessed using appropriate tests. The results of the study allowed us to develop and implement the program in the group. The sample group monitored the implementation of the planned motivational and informational activities during the first semester.

The motivational factor of student-centered learning was determined by practice-oriented weekly preparation for professional activities.

The informational factor included measures to reengineer the distance education system, aimed at digitalization and coherence of learning processes using the Teams and MOODLE platforms. The program was implemented by teachers, information technology specialists, and the authors of this study.

The final stage included an analysis of the changes that occurred during the implementation of the educational and professional program within the first semester. A comparison of psychological and emotional states between the experimental group and a control group of third-year students was also conducted. The control group included 10 students of the Institute of Pedagogy and Psychology, while both groups (control and experimental) studied under the same curriculum. Compliance with the criteria defined earlier was based on statistical data and analysis tools, such as correlation coefficient criteria and Pearson's chi-square method.

#### 4 Results

The first stage results received the maximum number of single responses among 3rd-year students. In general, criterion D received the lowest score, indicating that dissatisfaction with the current situation is less pronounced among students than other criteria. The majority of students recognized only one criterion as vital to them - high academic performance.

When comparing the perspectives of educational transformation and student-centered learning, given 10 repeats, it showed the least degree of variation. It is evidence of a certain consensus among students on the prospects of educational transformation that is focused on their needs and learning:

D = 3 unsatisfied with the current situation;  
B = 14 anticipated benefits from the changes;  
V = 14 vision of the future;  
F = 13 success factors;  
C = 10 the price of changes.

According to Gleicher's Formula for Managing Change, the readiness for changes according to Formula 1 has been:  
 $R=(3 \times 14 \times 14 \times 13) > 10$   
 $R=20532 > 10$

Thus, the readiness for changes in this case is high (20532). It indicates that, altogether, unhappiness with the current state, anticipated benefits from the changes, vision of the future, and success factors exceed the costs of changes. This may indicate a favorable background for implementing changes in the education system based on the mentioned factors (Figures 1, 2).

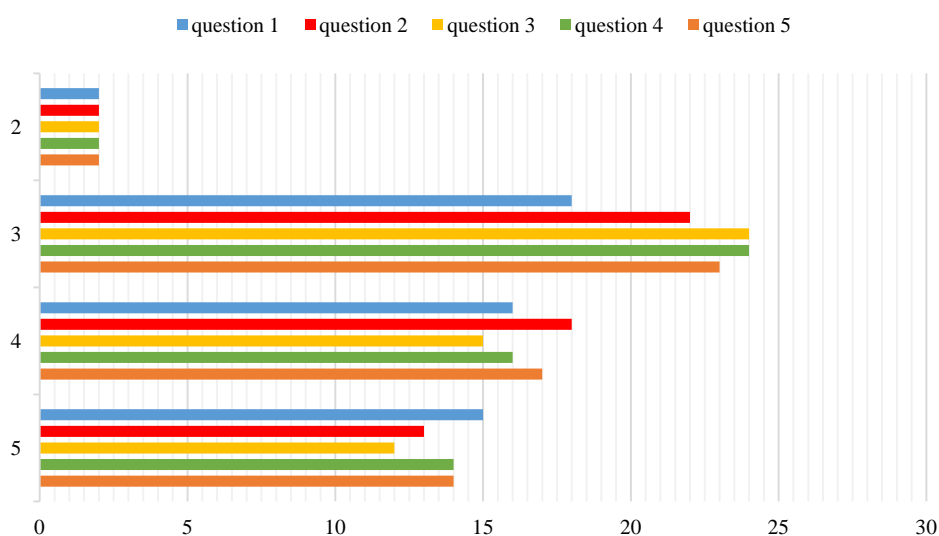
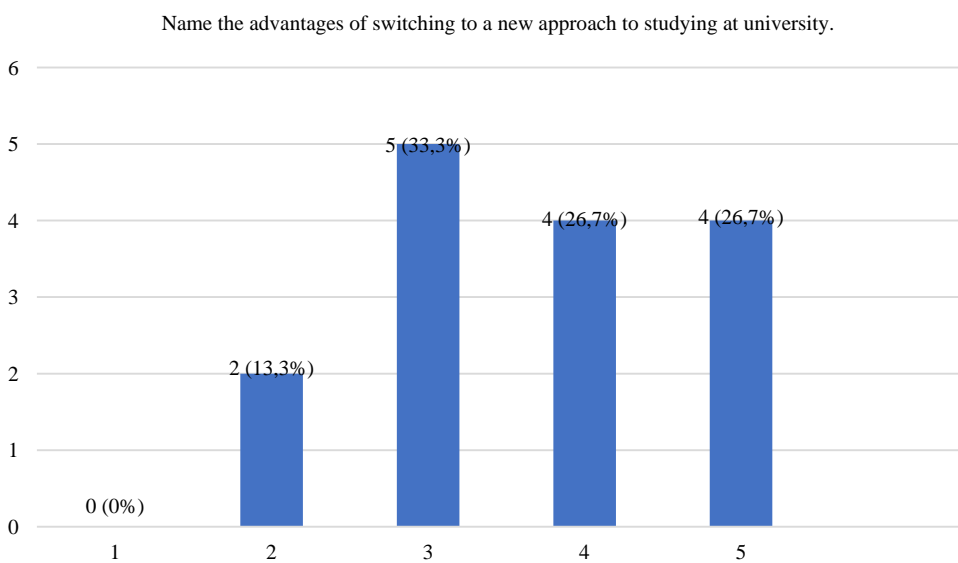
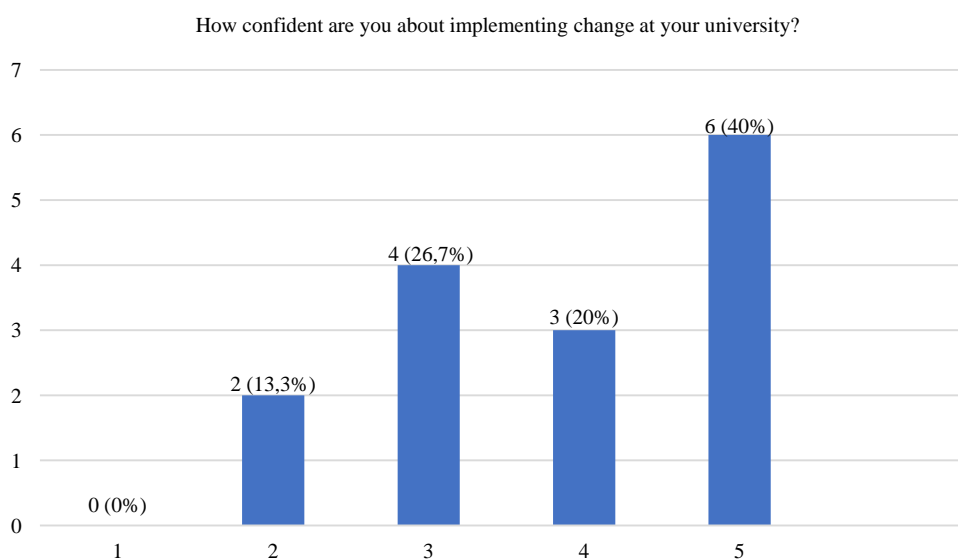
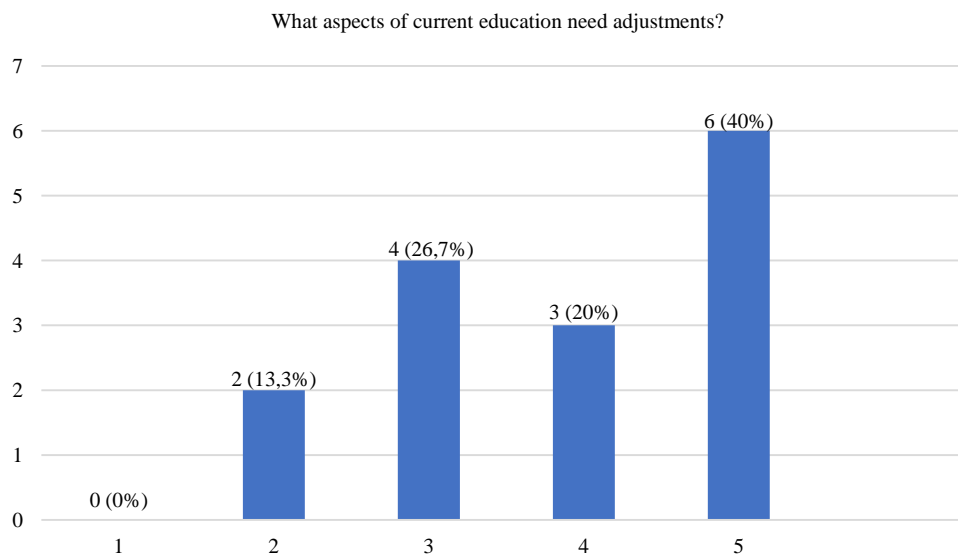


Figure 1. Information about the needs and aspirations of students concerning interactive learning in Ukraine



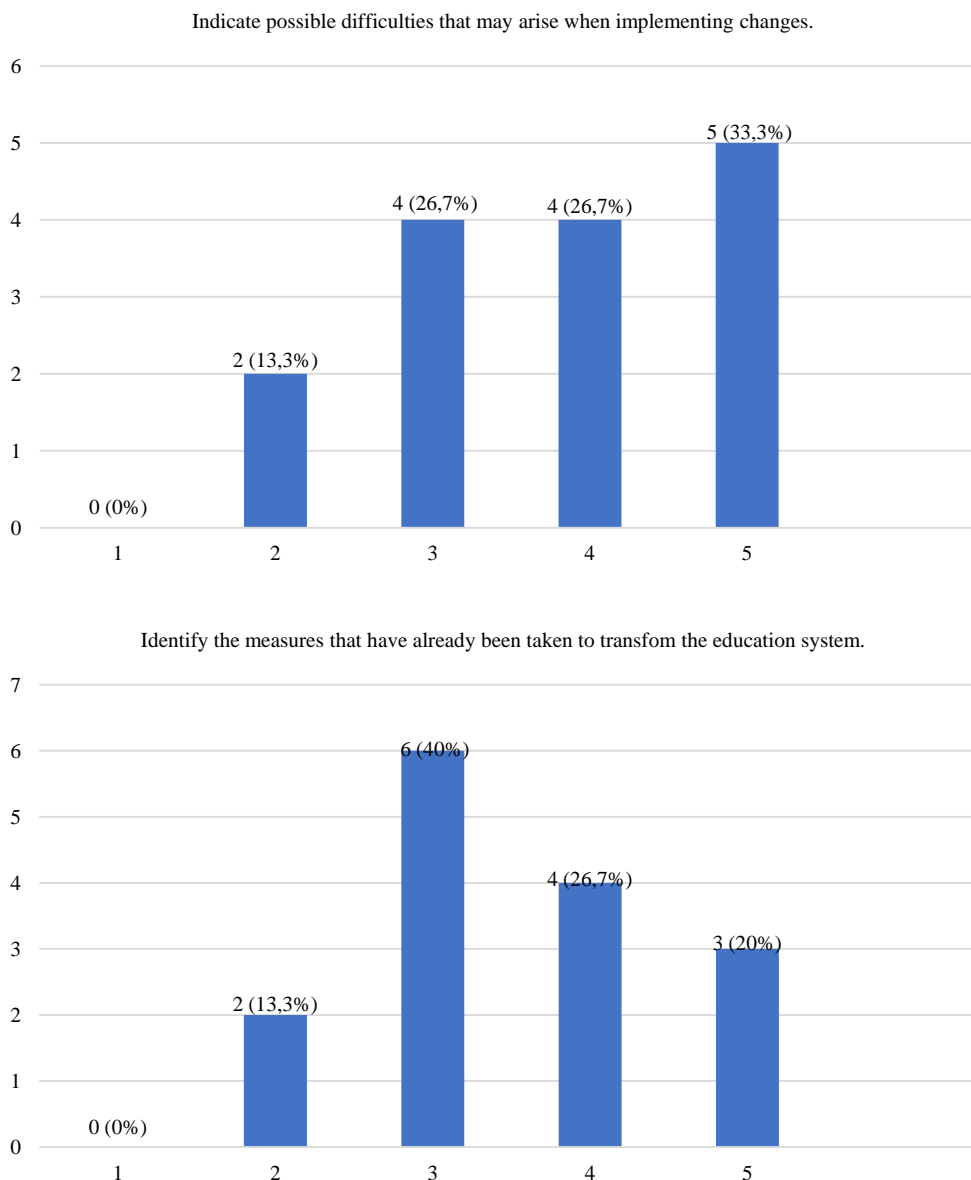


Figure 2. Survey results on the needs and aspirations of students concerning interactive learning in Ukraine

Survey results on the needs and aspirations of students concerning interactive learning in Ukraine are presented in the following table.

The chart below presents the results of the survey on different aspects of education system transformation.

*Question 1 (Identify measures for transformation):*

The answers range from 2 to 5, indicating different levels of awareness or recognition of the actions taken to transform the education system.

*Question 2 (Specify difficulties in implementation):*

Responses range from 2 to 5, reflecting different opinions on potential challenges or problems in implementing changes in the education system.

*Question 3 (Name the benefits of the new approach):*

The answers range from 2 to 5, reflecting different perceptions of the benefits of the transition to a new approach to university education.

*Question 4 (Confidence in implementing changes):*

The answers range from 2 to 5, demonstrating the range of respondents' confidence levels in implementing changes in their respective universities.

*Question 5 (Aspects that need to be adjusted in the current educational system):*

The answers range from 2 to 5, indicating different opinions on which aspects of the current education system need to be adjusted.

Overall, the table reflects the diversity of respondents' opinions on various aspects of the education system. They include implemented measures, potential difficulties, perceived benefits, confidence in implementation, and areas that need to be adjusted.

The results of the statistical analysis of the chi-square indices of overall compliance ( $\chi^2 = 0.36 \dots 1$ ) indicate a high consistency of the data set.

## 5 Discussion

Information technologies in the professional education of future primary school teachers face several problems and challenges.

Unequal access to technical means and the Internet creates inequalities among students and limits their opportunities for learning through IT. Currently, not all teachers have sufficient qualifications and skills to use information technologies in the educational process effectively. Therefore, the issue of ensuring data privacy and security arises, especially when using online platforms and sharing information. The reliance on technical means can lead to problems in the case of technical failures or unforeseen circumstances. In some locations, there are limited opportunities for effective virtual communication and interaction between students and teachers. It is important to identify fair methods for assessing and tracking students' progress within the virtual learning environment.

The expenses for purchasing and maintaining hardware and software can be a burdensome factor for educational institutions. Therefore, there is a need to adapt to new technologies and their use in the educational process. The ways to solve these problems may include:

- Training of teachers in using IT.
- Development of more accessible technical tools.
- Coordinated strategies for introducing technologies into education.

In this article, we discuss the key aspects of using modern information technologies in the training of future primary school teachers. Integration of these technologies into the educational process is vital for the formation of competent and technologically-educated teachers who can meet the challenges of modern education. First of all, it is essential to emphasize the fact that the integration of information technologies into pedagogical education is a critical element in improving the quality of education. By using these technologies, we create interactive and innovative learning environments, promoting the development of creativity and pedagogical skills of future teachers.

The implementation of the above model helps to improve the interaction between teachers and students, promoting their active partnership. However, along with the great potential of information technologies, there are challenges to their implementation. It is necessary to adapt curricula and teaching methods to the digital era, which requires both time and resources. The issue of accessible and reliable technical facilities needs to be addressed. However, if handled correctly, these challenges can be turned into opportunities to develop more flexible and innovative teaching methods.

Information technologies in teachers' training meet modern requirements for education. These technologies help to develop critical thinking, creativity, and adaptability, which are key competencies of teachers in the contemporary information environment. Such technologies help teachers not only to teach but also to innovate and promote students' progress actively. In conclusion, it should be noted that the prospects for introducing information technologies in teacher education are very promising. The introduction of new technologies can improve the quality of education, making it more accessible and personalized. New technologies research and implementations should be considered as a strategic direction for further educational process development.

Therefore, the application of modern information technologies in the training of future primary school teachers has a significant potential for changes in education, improvement of education quality, and formation of highly qualified teachers ready for modern challenges.

## 6 Conclusions

In conclusion, we can emphasize that the use of information technologies in the professional education of future primary school teachers is a necessary element of modern pedagogical practice. The introduction of these technologies allows the creation of an innovative and effective learning environment,

expands the possibilities of teacher training, and contributes to their readiness for the challenges of the modern learning environment.

In particular, the article examines the impact of information technology on primary school teacher training and determines the relevance of using IT in education, as well as its role in the development of professional competencies. The paper also emphasizes the challenges and issues that arise while implementing such technologies and indicates how to solve them.

Finally, we should also note the need for further research and training programs aimed at optimizing the use of information technologies in preparing future teachers, in particular those that address the specifics of the educational process in primary school. Such an approach will contribute to the formation of professional educators capable of meeting modern requirements.

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**Primary Paper Section: A****Secondary Paper Section: AM, IN**