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Influence of information technologies on the process of forming competences of future teachers

Influencia de las tecnologías de la información en el proceso de formación de competencias de los futuros profesores

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Abstract

The purpose of the study presented in this article is to examine the impact of information technology on the process of developing future teachers' competences and on teaching biology. Based on the data collected during interviews with 27 future biology teachers who used IT in their studies, five categories of IT impact on competence development were identified, namely: improving access to information, expanding learning opportunities, increasing the effectiveness of research activities, developing communication skills, ensuring continuous self-education; and three main categories of IT impact on students, namely: improving the quality of students' research competences, developing skills in analysing,

reasoning, modelling, and solving.

Keywords: research activity, research competence, teaching, learning, biology.

Resumen

El objetivo del estudio presentado en este artícul1o es examinar el impacto de las tecnologías de la información en el proceso de desarrollo de las competencias de los futuros profesores y en la enseñanza de la biología. A partir de los datos recogidos durante las entrevistas con 27 futuros profesores de biología que utilizaron las TI en sus estudios, se identificaron cinco categorías de impacto de las TI en el desarrollo de competencias, a saber: mejorar el acceso a la información, ampliar las oportunidades de aprendizaje, aumentar la eficacia de las actividades de investigación, desarrollar habilidades de comunicación, garantizar la autoformación continua; y tres categorías principales de impacto de las TI en los estudiantes, a saber: mejorar la calidad de las competencias de investigación de los estudiantes, desarrollar habilidades de análisis, razonamiento, modelización y resolución.

Palabras clave: actividad investigadora, competencia investigadora, enseñanza, aprendizaje, biología.

1. Introduction

Information technologies have had a significant impact on various aspects of education, including the formation of competences for future teachers. These technologies have revolutionized teaching and learning methods, providing new tools and resources for teachers to enhance their skills and knowledge. One trend that has emerged is the shift towards digital and online platforms for instructional delivery. Teachers can now access a vast amount of educational resources, videos, interactive simulations, and online courses to enhance their subject knowledge and teaching techniques. This allows them to stay updated with current practices and engage their students in more interactive and personalized ways.

The use of technology can facilitate collaboration and communication among educators. Online platforms and social media groups provide avenues for teachers to connect with their peers, share ideas, and collaborate on projects or lesson plans. This allows them to benefit from the collective knowledge and experiences of other educators, fostering a culture of continuous professional development. Technology also enables teachers to implement various teaching strategies and personalized learning approaches. They can use learning management systems and educational apps to create individualized learning paths for their students, tailor instruction to their needs, and track their progress. This helps in fostering a student-centred approach to education and ensures that each student's unique needs are met.

Furthermore, information technologies provide opportunities for teachers to engage in lifelong learning. Online courses, webinars, and virtual conferences allow them to expand their knowledge base and acquire new skills without the constraints of time and geographical location. This continuous professional development ensures that teachers stay up-to-date with the latest research and best practices in education. Looking ahead, the prospects for the influence of information technologies on the formation of teacher competences are promising. However, it is important to note that the successful integration of information technologies in teacher education requires proper training and support. Information technologies have already had a significant influence on the process of forming the competences of future teachers. They have facilitated access to resources, encouraged collaboration among educators, enabled personalized learning, and promoted lifelong learning. The future prospects for the impact of information technologies on teacher competence formation are promising, with advancements in technology offering even more transformative possibilities for teacher education.

2. Literature review

In the realities of scientific and technological progress, future teachers have a strong incentive to integrate IT as a pedagogical tool into their teaching practice (Borysova, Zadorina, Kotiash & Bukoros, 2023). However, despite such institutional incentives, an analysis of related studies found that only 11% of teachers demonstrate high engagement with the use of these technologies in their teaching practice (Zeng & Li, 2023). Admittedly, there are a number of obstacles to the integration of IT into education in general and the subject of biology in particular. In this context, Tsoli (2023) emphasises the lack of conviction of future teachers about the educational contribution of using IT in the classroom. In general, in the absence of experience with the use of IT in education, teachers are still reluctant to invest time allocated to the school curriculum in IT activities (Khorolskyi, 2023). Similarly, Stamelos & Adamopoulou (2023) are convinced of the importance of didactic integration of IT in education but highlight the risk that this integration is incomplete due to the lack of funding for education systems by governments.

Thus, despite the existence of many factors that hinder the integration of IT into education in Ukraine, we are witnessing strong involvement and increased motivation of most teachers towards this type of educational tool (Melnyk, 2022).

Thus, the interest in using IT in pedagogical practice can be explained by the positive impact of IT on both teaching and learning.

To this end, a qualitative study was conducted among student interns of future biology teachers who use IT in the classroom. Their opinions on the impact of these technologies on teaching and learning biology in the Ukrainian educational context were collected and analysed. Thus, the working questions focus mainly on the concept of IT in education, namely: What is the impact of IT on teaching practice? What is the impact of IT on the process of forming the competences of future teachers? Does IT affect the development of students' abilities to experiment, analyse, reason, model, and solve problems? What are the consequences of using IT on students' learning behaviour? To answer the working questions, IT is considered as "the only technologies that are mainly based on computers (hardware and software) that allow processing and storing information, microelectronics, telecommunications, networks in particular, that allow the exchange and transmission of information" (Maciej, 2023).

The use of IT in education in general, and in the teaching of science subjects in particular, offers several avenues of exploitation (Ali Iliyasu & Daramola, 2023). In fact, research shows that there are a number of technologies that allow educators and students to manipulate data in a variety of ways. Spreadsheets for arithmetic, computers, and various tools allow users to work with more and more complex categories (Zahorodna et al., 2022). Multimedia software makes it possible to build student learning by combining units of measurement, dynamic motion, sound, and graphic design. For example, specialised software such as formal computing systems (Computer Algebra System (CAS) and Dynamic Geometry Systems (DGS)) help students improve their skills and understanding of algebra and geometry. They provide students with the ability to manipulate, make assumptions, and measure shapes, leading to improved learning (Tsekhmister et al., 2022). In addition, IT can serve as a focal point that encourages and facilitates collaboration and interaction between learners. Networking of students, facilitated by IT, promotes scientific discussions in the classroom (Dobrovolska et al., 2023). However, in order to ensure the effectiveness of the technological tool and to obtain good learning outcomes, Pieshev et al. (2022) notes that the limitations of the technological tool should be considered when designing educational resources. Furthermore, according to Tsekhmister, Konovalova & Tsekhmister (2022), IT can facilitate access to knowledge through assessment of learning outcomes. They support the pedagogy of constructivism, which allows learners to explore and understand subject concepts. After comparing the use of three pedagogical approaches (traditional, cooperative, and cooperative with ICT) in medical education, Tsekhmister, Chalyi & Chalyy (2009) concluded that the achievements and attitudes of students who had undergone cooperative

education with ICT were significantly better than those of students who had been taught using traditional or cooperative methods without the use of ICT.

In this context, modern learning activities are profoundly transformed by the availability of technological tools. In fact, these technologies can develop skills of experimentation and critical thinking (Garvasiuk et al., 2023). In addition, it is a fact that through problem-solving, situation modelling, and progressive demonstration learning, future teachers can demonstrate to students the relevance of scientific activities, teach them to identify a problem and test it with examples, guess the outcome, develop a solution, monitor the results and evaluate their relevance to the problem under study (Namestiuk, 2022). Over the past two decades, the literature on the use of IT in education has found that the use of information and communication technologies in combination with pedagogical methods helps to improve and expand the pedagogical process (Lavina et al., 2020).

For their part, referring to the anthropological approach to learning, Lebid et al. (2023) believe that understanding the impact of software use on teaching and learning cannot be done by separating content from practice. In addition, based on the instrumental approach, Moshinski, Pozniakovska, Mikluha & Voitko (2021) consider the object of learning and the way of learning as being dependent on the artefacts used for it. Otherwise, the artefacts (software) influence not only the teaching practices but also the content being taught.

Studies measuring the impact of IT integration in education have concluded that these technologies have a positive impact on motivation Garvasiuk & Namestiuk (2023), and research competence plays an important role for future teachers. In the context of STEM education, for example, future teachers learn how to organise students' research activities during biology lessons. Research is important in the development of biology teachers' subject competences (Tsekhmister et al., 2021). Teacher training is carried out using research tasks.

3. Methodology

Qualitative studies aim to explore in-depth understanding and generate insights by examining the experiences, perspectives, and behaviours of participants. Unlike quantitative studies, where larger sample sizes are often required for statistical significance, qualitative research emphasizes the richness of data obtained from a smaller number of participants. A small sample size allows for deep engagement and detailed analysis of individual cases, ultimately providing a comprehensive understanding of the research questions.

In this particular study, focusing on the use of IT in teaching practice, the sample size of 27 is sufficient to achieve saturation, which means that data collection and analysis continue until no new insights or information emerge. Saturation is a critical criterion in qualitative research, as it indicates that the researcher has gathered enough data to develop a comprehensive understanding of the phenomenon under investigation. Given the exploratory nature of this study, a sample size of 27 is expected to yield a rich and diverse range of experiences, perspectives, and practices related to the active use of IT in teaching.

The selection of participants in this study is based on the criterion of active use of IT in their teaching practice. This criterion ensures that the participants have relevant experience and insights related to the research focus. The assessment of this criterion can be conducted through a combination of methods, including self-reported data and observational evidence.

To assess the active use of IT, participants can be initially screened using a survey or questionnaire that asks about their involvement with IT in their teaching practice (e.g., frequency of use, types of technology

utilized, specific tasks performed). This self-reported data can help identify potential participants who are actively engaged with IT.

Furthermore, to validate the self-reported data and ensure the authenticity of the criteria, additional evidence can be gathered through observations or documentation (e.g., lesson plans, student assignments, recorded teaching sessions). This would provide a more objective assessment of the participants' active use of IT and increase the reliability of the selection process.

In summary, the sample size of 27 trainee students, teachers, and future teachers is justified for this qualitative study based on the depth of inquiry needed and the principle of saturation. The criterion of active use of IT in teaching practice ensures that participants have relevant experiences, insights, and practices. This criterion can be assessed through a combination of self-reported data and supporting evidence gathered from observations or documentation.

In order to answer the research questions, a qualitative approach was used. Regular meetings and discussions among the coding team to address any coding-related questions or ambiguities were also conducted. This allowed for the refinement and clarification of coding guidelines throughout the analysis process. Thus, a survey was conducted among 27 trainee students, teachers, and future teachers from 14 schools in Ukraine. The sample size of 27 trainee students, teachers, and future teachers is justified based on two main factors: the qualitative nature of the study and the criterion of active use of IT in teaching practice.

The focus group was selected based on the criterion of active use of IT in their teaching practice. In addition, the participants were selected based on whether they had completed their pedagogical practice in a public or private institution (Table 1).

Table 1.
Gender distribution of participants and type of institution

Gender	State institution	Private institution	Total value
Men	11	4	15
Women	10	2	12
Total value	21	6	27

Table: authors' own development

The interviews were semi-structured using a questionnaire consisting of parts related to the use of IT and limitations on the way of integrating IT into the subject of biology, the impact of information technology on the process of forming the competencies of future teachers, on behaviour, and the development of creative thinking. Data collection was completed between January and June 2023, and the duration of each interview ranged from 45 minutes to one hour.

Ethical considerations were met in the research. All participants were given clear detailed information about the purpose, procedures, potential risks and benefits, and any compensation involved in the study.

To ensure the reliability and validity of our analysis, several measures were taken. First, we followed a standardised coding scheme and methodology. This involved developing a coding manual with clear definitions and guidelines for each category and subcategory. All coders underwent extensive training in using this coding manual to ensure consistency in coding.

Overall, the combination of rigorous coding protocols and triangulation methods helped ensuring the reliability and validity of our analysis. The limitations encountered were addressed through manual

adaptations and additional tools to mitigate any potential biases introduced by the software.

According to experts, any qualitative analysis can undergo various forms of thematization. In addition, this method of analysis is considered universal, as it can be applied deductively - starting from predefined themes - or inductively - using corpora to generate themes.

In order to remain consistent with its aims and issues, our research used a thematic analysis, which allowed us to move relevant topics to the beginning, while introducing new topics, which increased representativeness in the context of the problem under study.

Additionally, NVivo was used for easy classification, ordering, and recording of data. The data analysis procedure consisted of two main phases: preparation, which mainly involved transcription of the data, and coding, categorisation into themes, and interpretation of the data. Although the data was linear and ordered, there was often a feedback loop between data and analysis.

The interview instrument used in this study was a semi-structured interview guide, designed to explore participants' experiences, perspectives, and practices related to the use of IT in teaching. The interview guide included open-ended questions that allowed for in-depth discussions and the elicitation of rich, detailed responses from the participants. The interviews were conducted in person and lasted approximately 45-60 minutes each.

Data analysis procedures for this study involved a thematic analysis approach, which allowed for the identification of key themes, patterns, and insights within the data. The analysis process began with the transcription of the interview recordings, followed by the coding of the data to identify relevant themes and categories. The coding team consisted of multiple researchers who independently coded the data and then compared their findings to ensure consistency and reliability. Discrepancies were resolved through discussion and consensus among the coding team members.

The software used for data analysis in this study was NVivo, qualitative data analysis software that facilitates the organization, coding, and analysis of large datasets. NVivo helped streamline the data analysis process by providing tools for coding, categorizing, and visualizing the data. The software allowed for the systematic exploration of the data and the identification of key themes and patterns that emerged from the interviews. Additionally, NVivo facilitated the generation of reports and visualizations that supported the interpretation and presentation of the study findings.

In addition, although the value of the score is not of paramount importance in quality analysis, it is sometimes important to have an overall picture of the data and to draw conclusions about the research topic. Therefore, descriptive matrices (tables) have been created to provide an overview of the data from the corpus and their relationships between categories and subcategories. To confirm the data, excerpts from the interviews are included in the paper.

4. Results and Discussion

In this section, we are interested in presenting and analysing the responses of the surveyed future teachers from a scientific point of view. The statements of the survey participants show that IT is important for teachers in the process of preparing for classes. By analysing these statements, we have classified the benefits of IT in improving the teaching process in three ways: expanding the scope of attention, improving course content, diversity of teaching strategies and achieving learning objectives through the use of IT, and the ability to adapt learning to the level and pace of students (Table 2).

Table 2.
The impact of it on pedagogical activity

Effect	Participants	Percentage ratio %
IT improves the school curriculum, making it more interesting, engaging, and useful.	22	81%
IT offers great opportunities for a variety of learning strategies.	18	67%
IT supports the achievement of curriculum objectives by adapting learning to the level and pace of each student.	16	59%

Table: authors' own development

According to Table 2, the majority of the surveyed participants (81%) say that IT makes classes richer, more interesting, more challenging, etc., as one of the future teachers noted:

"After starting to use the STEM programme, my biology lessons have undergone positive changes. They have become more interesting, dynamic, interactive, and understandable. Indeed, my lessons are more stimulating and make my students want to follow them."

However, most participants pointed out the importance of the variety of specialised software and resources available on the Internet, and they also emphasised the need to have the skills to design their own digital resources. Thus, when working with IT, future teachers primarily develop technical and scientific competencies. In this regard, the participant, sharing his previous testimony, clarifies that:

"In general, it is difficult to find out about online digital resources that are well suited to the subject of biology. We use different software and simulators that allow us to develop digital resources adapted to the level of our students. Some topics present difficulties both in terms of teaching and learning. But with the use of software like STEM, we have the opportunity to develop lessons that are easy to understand."

In the same vein, IT is seen, for some 59% of the participants surveyed, as a tool to help achieve the goals of the curriculum. In essence, for them, a successful act of teaching requires, first of all, taking into account the skill level of the students and ensuring their achievements. For example, a future teacher of a private secondary school notes that:

"In general, IT helps teachers to adapt learning to the level and pace of each student by designing different lessons, and it is also effective for reviewing the material covered."

In addition, the success of teaching with the use of ICT is noted, as 67% of the teachers surveyed have a positive reaction to ICT. This success is attributed to the fact that IT provides a variety of opportunities to enhance learning strategies. In particular, collaboration and group work between students facilitate the use of these technologies, according to one teacher:

> *"Before starting classes, we encourage students to participate in group work using the virtual experience they have gained. This gives students the opportunity to repeat this experience many times, collaborate with each other, analyse information, hold scientific discussions, and draw conclusions."*

Most of the future teachers surveyed believe that frequent use of software helps students gradually develop their skills in building and experimenting, as well as their ability to think logically. They also emphasise the importance of using IT wisely as part of a well-planned learning process that helps to concretise the

concepts taught. One participant emphasises that:

> *"We use IT devices to clarify, explain, or reinforce understanding of concepts and tasks. However, when it comes to solving them, students do not always realise that experiments are never a substitute for demonstration."*

Based on the participants' views, there is a broad belief in the role that IT can play in enhancing learning. However, they emphasise the need to use these technologies in a reasonable and sensible way, in particular taking into account constraints such as technical problems, lack of time, and classroom management difficulties. It appears that for them, the use of IT should be used in certain pedagogical scenarios, but it should not be considered a substitute for the curriculum.

As mentioned above, the aim of the study was to examine the impact of information technology on the process of developing future teachers' competences. The participants' perceptions and analysis of their comments allowed us to identify five categories of IT impact on competence development, namely: improving access to information, expanding learning opportunities, increasing the effectiveness of research activities, developing communication skills, and ensuring continuous self-education (Table 3).

Table 3.
Five categories of it impact on competence development

Competences	Participants	Percentage ratio %
Improving access to information.	17	63%
Expanding learning opportunities.	14	52%
Improving the efficiency of research activities.	14	52%
Development of communication skills.	7	26%
Ensuring continuous self-education.	7	26%

Table: authors' own development

The first impact cited by seventeen out of twenty-seven participants (63%) was that information technology allows them to access a variety of information quickly and easily from anywhere, enabling them to find, analyse and evaluate new ideas and methods that improve their competencies.

52% say that information technology provides an opportunity to use a variety of online resources, software tools, and computer models to develop competencies in various fields. They can use specialised software to create interactive lessons with multimedia elements that improve their teaching skills.

52% of the participants believe that smart learning systems and intelligent analytical systems can help future teachers to increase the efficiency of research activities, develop the ability to assess students' potential, and identify their weaknesses, which allows them to focus on the development of specific competences. Information technology can also support individualisation of learning by creating personalised curricula and materials. The findings highlight the transformative potential of AI chatbots in education. By prioritizing digital literacy, fostering adaptability, promoting collaboration, supporting research, and addressing equity concerns, educators, policymakers, and curriculum developers can leverage the benefits of AI chatbots to enhance teaching and learning processes.

The limitations identified in the research highlight the importance of providing teacher training in IT, integrating IT in pre-service teacher education, offering in-service professional development, ensuring technical support and resources, and fostering a change in institutional culture. By addressing these

implications, educational institutions can better support the integration of IT into teaching and learning processes, ultimately enhancing the quality of education and preparing students for the digital age.

26% of respondents stated that information technology allows them to communicate and collaborate with each other, both online and offline. This develops their communication skills and promotes their ability to work in a team, which is important for future teachers.

Another 26% believe that information technology allows teachers to keep their knowledge and skills up to date. They can use online courses, webinars, and other electronic resources for professional development and improve their competencies in certain areas.

While the responses of the interviewed participants generally indicated that the pedagogical integration of IT in education has a positive impact on the development of knowledge and skills of both students and teachers, it is difficult to judge that the improvement in learning outcomes is solely attributable to this approach to learning.

Unfortunately, IT is not limited to technological tools alone and cannot be an effective teaching method unless it is combined with the planning and use of clearly defined pedagogical scenarios. According to the survey, approximately half of the respondents (48%) claim that learning outcomes have improved due to the introduction of IT. In addition, the majority of respondents frequently used dynamic biology software. This data clearly shows that the secondary school biology curriculum is in particular in need of IT.

According to the above statements of the participants, IT helps to create meaningful learning situations for students. Based on the analysis of the discourses of the interviewed teachers, it seems that the use of IT has a significant impact on students' behaviour. As Table 4 shows, for the majority of respondents (89%), the pedagogical use of IT motivates students and makes them more persistent and more autonomous.

Table 4.
Teachers' perceptions of the impact of it on student motivation

Impact	Participants	Percentage ratio %
IT boosts motivation	24	89%
IT promotes interest in learning	24	89%
IT improves student autonomy	18	67%

Table: authors' own development.

Approximately nine out of ten future teachers (89%) reported that their students were more motivated when the course was taught using computers.

In addition to motivating students during IT classes, a quarter of participants believe that this motivation also continues outside of school, as one participant noted:

"Students are more motivated to achieve and do their homework when the assignments are related to computer-assisted courses."

However, every 10th future teacher believes it is obvious that:

"The motivation of students during the first lessons with the help of IT loses its power when they get used to such learning."

Similarly, nine out of ten participants (89%) said that IT helps students to persevere in their studies:

"The *use of technology provides an opportunity to make several attempts and check their validity, and students are actively involved in the process of finding solutions to the problem."*

According to the study, the use of IT helps to engage students in the learning process and attract their attention. Participants believe that it promotes students' autonomy, as it encourages them to complete tasks offered on the computer.

However, a third of the teachers surveyed do not share this view. They believe that the use of ICT does not ensure student autonomy unless factors such as access to digital resources to help with difficult situations, adaptation to different learning paces, and a self-assessment system that allows students to check their work independently of the teacher are taken into account.

The evidence shows that the majority of respondents say that the pedagogical use of ICT in the classroom has a positive impact on student behaviour, such as motivation, perseverance, and independence. However, about half of them point out that these effects are also not systematic. For the latter, the necessary use of IT should not be reduced to the transformation of the content format, paper to digital, but the successful integration of IT into teaching practice is based on the choice of resources in line with the object and objectives of learning.

Although only 11% of teachers reported using ICT to develop creative skills, we are still convinced of the importance of these skills and draw attention to this fact. According to our research, although only three participants use ICT to develop creativity, their examples show that they believe in the positive impact of these technologies.

The development of creative skills is undoubtedly important, because using IT, future teachers do not just passively use digital resources, but take the initiative to create their own simulations that allow them to make assumptions, participate in the evidence process, and develop design thinking (Dykhnych et al., 2022). Creativity is certainly a complex process, but it is "subjective and contextual" (Pikalova, 2015).

In other words, an achievement is judged as creative in relation to the context in which it is produced.

Most of the participants in the presented work believe that the variety of available specialised interactive digital resources on the Internet contribute to the enrichment of the subject and believe that IT offers many opportunities to diversify strategies through numerous learning situations for students. The results of a study conducted by Tytova & Mereniuk (2022) show that IT facilitates access to pedagogical goals, encourages communication, and promotes creativity.

Undoubtedly, the availability of digital educational resources expands the opportunities for teachers to inspire and create their own educational content. However, the abundance of such resources on the Internet and the lack of an editorial filter require users to evaluate and identify what meets their needs (Markova et al., 2019). Some teachers prefer to develop their own learning resources, taking into account the specifics of their students or their own approach (Yurinova, Byrdina & Dolzhenko, 2022). Others simply adapt digital resources created by other teachers for their students, as Tsankov & Damyanov (2019) emphasise.

Similarly, the analysis of the results shows that using IT as a didactic tool, in a way that is aligned with the objectives, can help develop students' skills, especially in terms of experimentation, modelling, analysis, reasoning, problem-solving, and creativity. These results are in line with the findings of a number of researchers (Voronin, Saienko & Tolchieva, 2020).

The results of this study also show that approximately half of the respondents (48%) stated that the use

of IT plays a major role in developing their pedagogical competences and is a significant contributor to improving educational outcomes and can contribute to higher student achievement. In fact, although it is difficult to say that the improvement of learning outcomes is solely due to the use of IT, the effectiveness of these technologies has been generally confirmed by many studies and experimental data (Frolova, Rogach & Ryabova, 2020).

On the other hand, research suggests that pedagogical integration of IT has a significant impact on improving students' attitudes and feelings towards learning. The issue of the causal relationship between IT use and motivation has been discussed for several years, and research has shown that the pedagogical use of IT encourages students to learn and makes their attitudes more positive (Marienko, Nosenko & Shyshkina, 2020). The results of the presented work also show that the successful use of IT contributes to the development of professional competences and encourages independence. The interactivity and opportunities for collaboration provided by IT allow for active participation in learning. Rudenko's (2022) research has shown that IT provides opportunities for interaction, which leads to motivation and perseverance. Furthermore, the results indicate that these effects are not automatic, and the pedagogical use of IT should be aligned with the learning objective to promote motivation, perseverance, and autonomy. Furthermore, our findings support the research of Zahorodna, Saienko, Tolchieva, Tymoshchuk, Kulinich & Shvets (2022), which indicates that IT alone is not sufficient to increase learner motivation, it also depends on how it is used.

As with any research, this paper also has some limitations. The debate on the effectiveness of IT in education is still ongoing, although there are international studies that cover this issue. However, relevant Ukrainian studies are very rare. Therefore, given the limited number of participants in the experiment, we can strengthen the reliability of the data collected by conducting an exclusive survey of teachers with significant experience in the practice of teaching with the help of IT. We believe that such a study can shed light on a question that still remains open.

5. Conclusions

The main purpose of this study was to investigate the impact of information technology on the process of developing future teachers' competences.

The results show that there is a positive trend of using IT in teaching and learning biology. In the context of this study, three main categories of prospects for the introduction of IT in educational programmes were identified.

The first category relates to the impact of IT on pedagogical practice and the development of professional competences. On the one hand, it includes the integration of IT to improve the quality of the learning process. On the other hand, the use of these technologies allows for the application of various teaching strategies and their adaptation to the needs of each student, their level, and the pace of learning.

The use of IT in pedagogy has a positive impact on learning and student achievement. Students who use this methodology develop skills in experimentation, modelling, analysis, reasoning, problem-solving, and creativity. However, the direct impact of such technologies on academic success is still difficult to prove.

As for the third category, it concerns the impact of IT on students' attitudes towards learning. In fact, the results show that the use of IT has a significant impact on student behaviour. It promotes motivation in students and makes them more persistent and more autonomous.

The results of this study have revealed a rather important topic in the context of Ukrainian education. The topic of introducing IT into educational programmes has always attracted the interest of many researchers

around the world. The study also raised issues that open the way for further research and prospects in this area. Additional analysis could focus on various aspects related to IT integration and its impact on learning. One of potential avenues for further exploration are the longitudinal studies. This could help determine if the initial positive impact persists or changes over time; as well as comparative studies for a better understanding of how IT integration affects learning in diverse contexts. Moreover, examining the impact of teacher training and support programs specifically focused on IT integration could help identify effective strategies to enhance teacher competencies and pedagogical practices in utilising IT tools for improved learning outcomes. By delving deeper into these aspects, researchers can gain a more comprehensive understanding of how IT integration affects learning and identify strategies to optimise its potential benefits.

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