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Prospective teachers' knowledge and proficiency in modern information and educational technologies

Radoslava Topalska
(Department of Management of education and special pedagogy, South-West University "Neofit Rilski", 66 Ivan Myhailov Str., 2700 Blagoevgrad, Bulgaria)

ABSTRACT

Prospective teachers have à positive attitude towards the use of technology in education and a good knowledge of the field, but face challenges in its practical integration. The main difficulties include insufficient preparation, lack of methodological support and internal barriers such as insecurity and insufficient skills. This paper presents a study conducted at the beginning of two consecutive academic years (2023/2024 and 2024/2025) involving 600 students (398 bachelors and 202 masters) from education majors. The main objective is to assess their information technology skills as well as their attitudes towards its application in the learning process.

KEYWORDS - information technology, future teachers, modern technologies, teachers training, technology.

1. INTRODUCTION

In today's world of rapidly evolving technologies, the role of teachers is transforming, requiring not only pedagogical skills but also the ability to effectively integrate information and communication technologies into the educational process. Both the teachers and the demands on their competencies are changing [1]. Future teachers need to be prepared to integrate information and communication technologies (ICT) into their future teaching and learning practices [2, 3].

Teachers need to be able to create effective learning and teaching environments by selecting technological materials appropriate to their expertise in the field and the pedagogical method they will use in their classes, i.e. they need to be able to combine technological, pedagogical and content knowledge [4]. Internet technologies enrich educational practices by creating dynamic and engaging learning environments, which is essential for preparing future labour market professionals for work in the digital age [5]. This suggests that the mere experience of activities involving the use of technology can foster positive technology-related beliefs [6].

Integrating ICT into teacher in-service training programs continues to be a challenge worldwide [7]. This necessitates that teacher educators continually analyze their current opportunities and needs and, when necessary, access professional learning in response to rapidly changing educational environments and opportunities presented by emerging technological innovations [8]. Educational programs and technology must be integrated to enable future teachers to acquire the necessary pedagogical skills and strategies [9]. With increased access to the Internet and demands on nontraditional teacher education programs, it is important that administrators in higher education understand the ways in which they can help teacher educators use instructional technology [10]. As a result, many frameworks seek to understand the idea of integrating technology into teacher preparation programs [11].

When teachers are continuously educated about changing information technologies in pre-service and in-service training to improve their abilities to use technology effectively, it helps improve their perceptions and facilitates the integration of technology into education [12]. Training, modeling, and mentoring should be part of the teacher education curriculum so that university teachers, teacher educators, and preservice teachers have the knowledge base and skill level to integrate technology into their teaching practice [13]. Institutions of teacher training should offer education that emphasizes the importance of 21st century skills and provide opportunities for future teachers to develop skills such as collaboration, creativity, communication, problem solving, critical thinking, and the use of technology [9]. Digital literacy defines not only effectiveness in the use of new technical tools and the development of electronic resources for educational purposes, but also communication in a virtual learning environment, which is an essential element of e-learning and a factor in its effectiveness [1].

Computer technologies have become an essential aspect of modern life. The fact that information can now be transferred at the touch of a button has posed new challenges for education [14]. In this context, it is crucial that prospective teachers are aware of the innovations they can use with the developing technology, that they know what equipment they can use, and that they have enough knowledge to use all of this [4].

Teacher trainers play an important role in preparing student teachers to integrate technology into their classrooms. In addition to being teachers themselves, teacher educators serve as role models for their students in teaching with technology, as well as in fostering students' technology literacy [15]. However, the Department of Education has not suggested nor provided guidance on how to use the computer and other technologies to ensure a competent level of technology literacy. Arguments for investing in and building information technology (IT) infrastructures may have displaced ideas about the usability of traditional teacher pedagogy; little attention was paid to authentic teacher learning in the early days of the IT movement [16].

Traditionally, teacher education providers select individual ICT courses or modules, which are often located at the beginning of students' qualification programme. Over the years, various frameworks, models and skills have been developed to guide teacher educators in their efforts to build digital capabilities in their students that will support them to use new and emerging technologies in their future classrooms [8].

Information competence is an integrative professional-personal quality of the future primary teacher, determining its readiness and ability to search for the necessary information from various sources and to process it through research methods [17]. A globally competent personality is oriented towards common human democratic values, open to intercultural dialogue, characterized by global critical thinking and proficient in modern information and communication technologies [18]. Innovative use of ICT is defined as the use of ICT applications that support educational goals based on the needs of today's knowledge society [19]. ICT integration is influenced by the complex of student teachers' constructivist beliefs about teaching, teaching self-efficacy, computing attitudes in education, and their computing self-efficacy [2]. It is believed that the integration of technology into the educational process by prospective teachers is mostly related to the teaching staff who train them. The fact that preservice teachers observe their own teachers using technology in education is a factor that encourages them to use technology in the future [3].

The collaborative design experience and its focus on conceptual understanding influenced preservice teachers' beliefs about a different type of technology than the one they were working on [6]. Another valuable role of technology is to increase teachers' effectiveness in organizing and presenting lessons. Lesson organization is facilitated by teachers being able to load lesson elements in advance (e.g., PowerPoints, videos, images, letters, words, etc.) and outlines guiding the flow of the lesson into the computer. As technology continues to be used at an ever-increasing pace and becomes increasingly important in K-12 education, the next decade will undoubtedly offer unprecedented opportunities for research findings to serve as the basis for improving teaching and learning practices. To achieve this goal, we encourage researchers to reduce efforts to prove the "effectiveness" of technology by focusing on conducting rigorous and relevant mixed-methods research to clarify which technology applications work to facilitate learning, in what ways, in what contexts, for whom, and why [20].

In recent years, there has been an increasing amount of new studies on preservice teachers' use of technology and their competencies in this area. However, the innovative use of technology in education has lagged behind expectations. Research on pre-service teachers' use of technology is expanding, but it is still much less than that on elementary or secondary teachers' teaching and learning with technology. Most of these studies focus on student teachers' qualifications to use technology to both teach and learn without discussing the implications for teacher educators. According to the studies, in order to integrate technology into education, educators must first be able to use it themselves and understand how it works [15]. In this regard, research findings show a significant correlation between technology literacy and the integration of pedagogical practices [16].

Prospective teachers have positive perceptions of technology use, with results indicating that those in different undergraduate programs have similar perceptions of technologies [12]. Despite this positive attitude, studies reveal that teachers' self-confidence predicts future computer use in education, both directly and indirectly, through its impact on attitudes toward computers in education and self-perceived computer skills [2].

In this context, the use of the concept of information competence in science is necessary for the systematic characterization of personality development indicators, and the formation of it should be considered in the context of activity [17]. However, future teachers believe that teacher educators do not sufficiently demonstrate technology integration behaviors in their lessons. They also state that they have a somewhat authentic experience

of using technology in education [3]. Pre-service teachers have critical perceptions related to technology integration such as effective use of technology, incorporating technology into the curriculum, increasing engagement, and visualizing instructional content. At the same time, they identify multiple external and internal barriers that prevent the integration of technology, such as lack of knowledge and ability [21].

However, the prospective teachers feel confident in their technological knowledge, which is in line with the current technological age. Their knowledge of e-learning concepts and their ability to select technology to support their learning strategies remains weak [22]. Yurt highlights the importance of future teacher careers to include 21st century skills such as information and technology literacy, critical thinking, problem solving, entrepreneurship, innovation, and social responsibility [9]. In addition, the influence of contextual factors on technology integration processes and on the evaluation of perceived self-efficacy in digital competencies [23]. University tutors should assess and advise undergraduate student teachers on the effective use of technology. Although they have begun to incorporate technology into their curricula, they see it more as a responsibility for students than for themselves [13].

Teachers' observation of technology reveals how they respond to it, how they connect it to their teaching, and how it supports their vision of teaching and learning [14]. In this context, self-assessment plays a crucial role for both teachers and students. A teacher who does not feel competent will not be able to teach effectively [4]. Previous studies have identified numerous barriers and factors that influence the integration of ICT in teacher preparation programs [7]. More recent research has called for a rethinking of the outcomes of teacher education programmes, suggesting that the focus on digital skills should be extended to include wider models of digital competence [8]. However, preservice teachers believe they have sufficient knowledge of technology and are willing to use technology and pedagogy to deliver content. The preservice elementary teachers have satisfactory skills to integrate technology into their teaching practice [11].

2. IMPLEMENTATION OF THE STUDY

The present study was conducted at the beginning of two consecutive academic years 2023/2024 and 2024/2025 with the participation of 600 students (398 Bachelors and 202 Masters students respectively) of pedagogical majors in the first semester, just before the start of their training. They received a paper questionnaire but had the opportunity to check their answers on a computer.

The purpose of this study is to assess the level of information technology proficiency of students in teacher education programs at the beginning of their studies, and to analyze the factors that influence these skills. In addition, the study aims to identify the needs for additional training and preparation in information technology that could assist both prospective and current teachers in the effective integration of technology into the educational process.

Among the tasks identified are: a theoretical review of the literature, an empirical study of the students' (first-year) skills in applying information technology, a comparative analysis of the results between bachelor's and master's students, identification of gaps in the students' preparation and the need for additional training, and an investigation of the differences between the students' self-assessment of their information technology competences and their actual test scores.

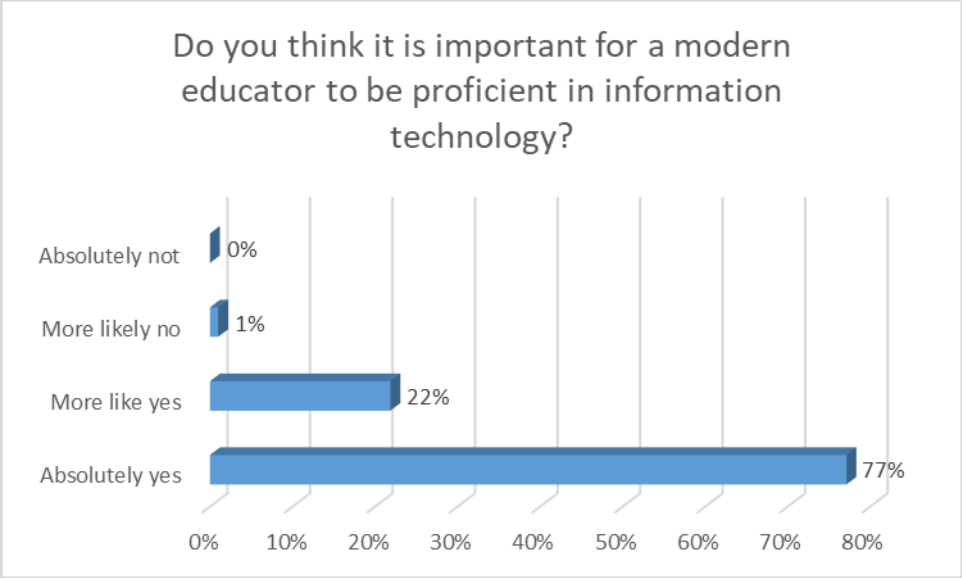

Figure 1.

Fig. 1 presents the results obtained on the question on the competence of the modern teacher in the field of information technology. Here, 77% of respondents answer "Absolutely yes", indicating strong support for the need for teachers to have technology competencies. 22% answer "More likely yes", meaning that, although with some reservations, they also see the importance of implementatiton of technology in educational practice. Only 1% answer "More likely no" and 0% choose "Absolutely not," indicating that almost no students think technology skills are not essential for teachers.

The combined results clearly show that the large survey majority (99%) of respondents consider information technology proficiency to be important or even mandatory for today's teachers. This highlights the increasing role of technology in the educational process and the need for its integration into learning process.

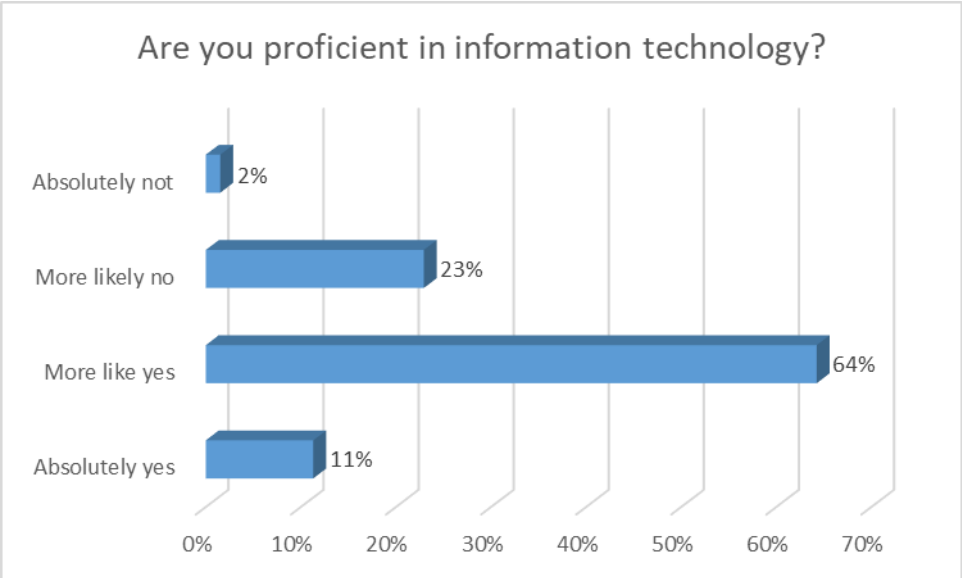

Figure 2.

Fig. 2 presents the responses obtained to the question on students' self-assessment of their proficiency in information technologies. 64% of the respondents answered "More likely yes", indicating that a significant percentage have intermediate knowledge of information technology. 11% indicated the other positive response, "Absolutely yes", indicating a high level of confidence in their skills. 23% answered " More likely not", suggesting some uncertainty or limited technological competence. And 2% choose "Absolutely not," indicating the small percentage of students who are not at all proficient in information technology. This fact indicates the need for

additional training and development of digital skills, especially considering the increasing role of technologies in teachers' professional lives.

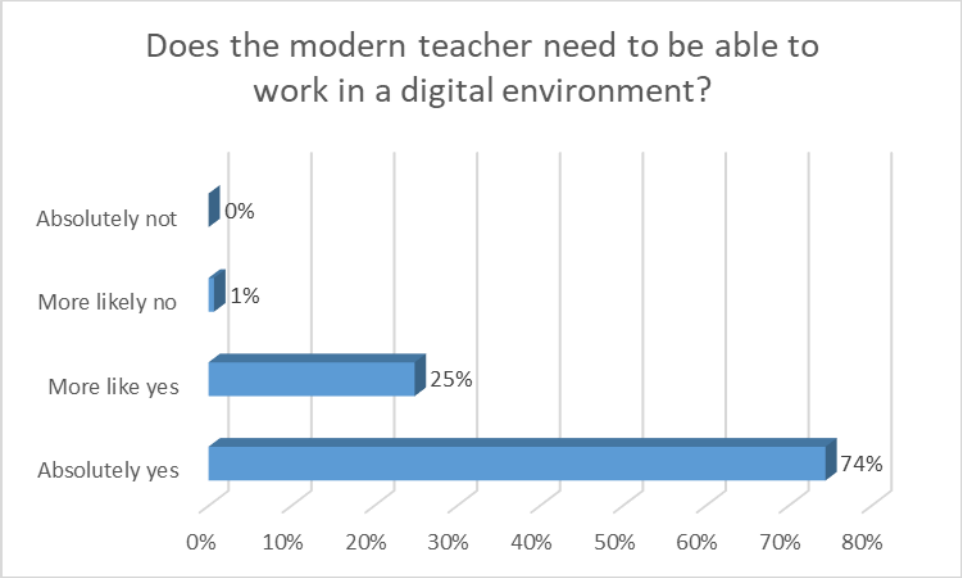

Figure 3.

The next question (Fig. 3) was dedicated to the necessity of working in a digital environment that stands in front of the modern teachers. 74% of participants felt that it was absolutely necessary for modern educators to be able to work in a digital environment, while 25% believed it was rather necessary. Only 1% considered these skills to be unnecessary, and not a single participant chose the option „absolutely not". These results highlight the importance of digital skills in modern education, where technology plays a key role in both teaching and learning. Teachers who can use digital tools effectively are better prepared to engage students and adapt their methods to the variety of classroom needs. The tendency also reflects changes in the education system, which is increasingly integrating technology.

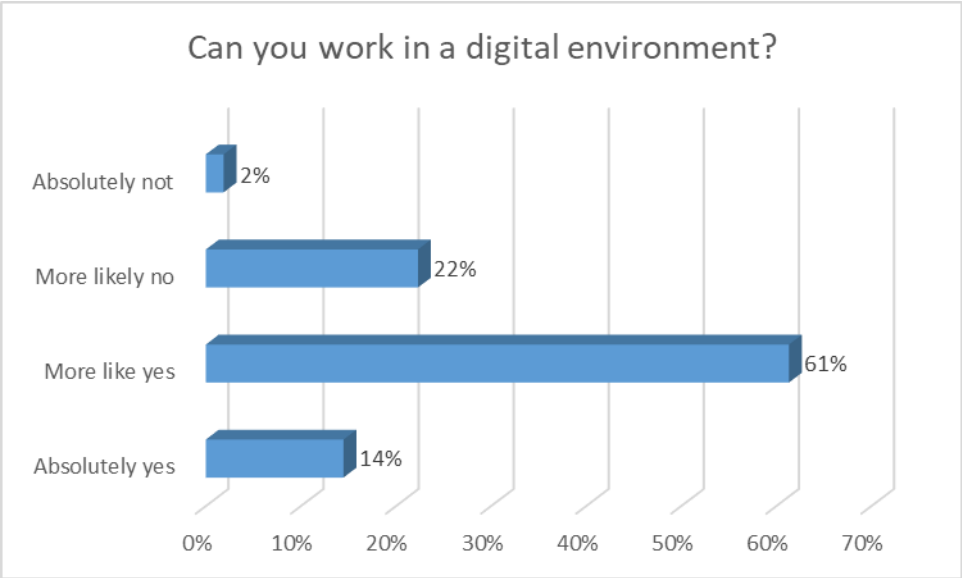

Figure 4.

Fig. 4 presents the participants' self-assessment of their ability to work in a digital environment. 61% felt that they could work in such an environment, while 14% stated that they "absolutely could". On the other hand, 22% considered that they "rather cannot" and 2% were categorical that they "absolutely cannot". These values indicate that the majority of participants have some level of confidence in their digital skills, but there is still a significant

minority who feel insecure or unable. This again may suggest the need for further training and support to improve digital literacy, particularly for those who are struggling.

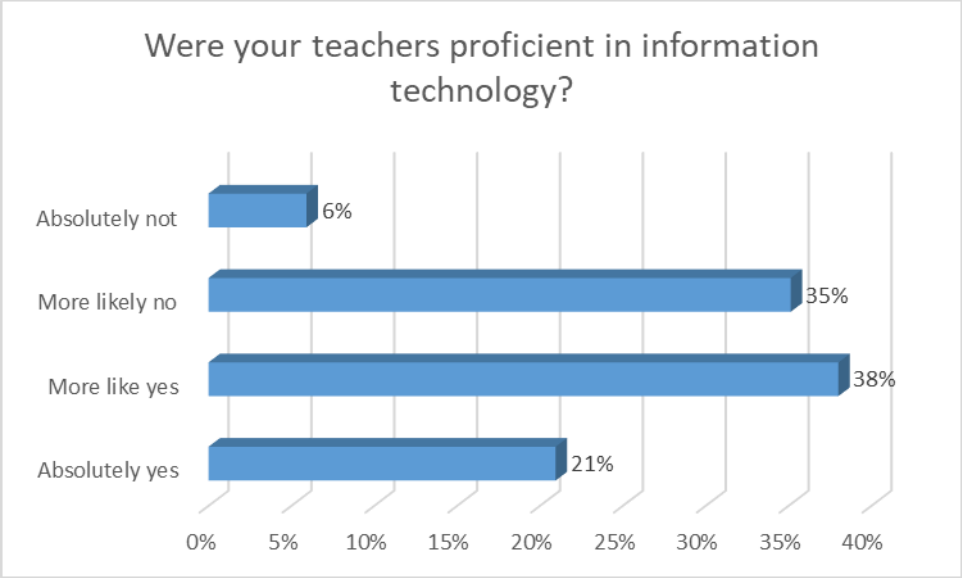

Figure 5.

The next question was devoted to the assessment of the teachers' capacity to apply information technology. The largest percentage of participants (38%) considered that their teachers were " rather competent" in information technology, while 21% stated that they were " absolutely competent". On the other hand, 35% perceived that their teachers were "rather incompetent" and 6% were categorical that they were "absolutely incompetent". These results highlight that there is a significant gap in teachers' digital competence, which can be attributed to various factors such as age, training and access to resources. Although the majority of participants considered that their teachers had at least some level of competence, there was still a significant proportion who perceived that their teachers were not sufficiently prepared. This may suggest the necessity for better and more intensive training not only of prospective teachers but also of current teachers in the area of information technology so that they can effectively integrate them in their teaching.

Extremely worrying is the fact that only 40% of students can name the antivirus program they use. Because it shows low awareness of cyber security and data protection, i.e. they may not be paying attention to the security of their devices, making them more vulnerable to viruses, malware and hacking attacks. This highlights the need for better training and awareness on the topic of cyber security.

The next 20 questions were devoted to specific topics, testing the knowledge of the newly admitted students on the use of Microsoft office software, specifically Word, Excel and PowerPoint. The level of difficulty is not high, most of the questions are related to elementary functionalities, settings and tools available in the office software package. Extremely worrying is the fact that not a single student (out of a participation of 600) answered all 20 questions correctly. The highest result was 16 correct answers. The average number of correct answers for Bachelor students was 8.67. And for Master students - 8,71. These results are also very worrying, especially concerning the students who have just graduated from secondary education and who should have studied a large number of hours of information technology and subjects of this cycle. Masters students are performing at almost the same level, which we can attribute to their previous education or professional career.

Table 1.

By year of secondary school graduation				
	Bachelor		Master	
Year	**Number of students**	**Average Number of correct answers**	**Number of students**	**Average Number of correct answers**
2023	100	10,32	-	-
2022	89	9,06	-	-
2021	39	9,26	-	-
2020	20	10,30	1	13,00
2019	11	11,18	7	10,70
2018	15	8,47	15	10,16
2017	3	11,67	12	10,83
2016	2	11,50	5	7,80
2015	4	8,50	12	9,30
2014	5	9,80	5	11,60
2013	4	9,75	7	10,00
2012	6	6,00	11	8,45
2011	5	8,40	14	8,86
2010	8	9,00	4	9,50
2009	7	7,00	12	7,41
2008	4	4,75	13	7,80
2007	8	5,38	8	5,75
2006	10	4,80	10	11,70
2005	7	5,00	15	7,87
2004	8	4,12	7	10,00
2003	5	7,20	10	6,60
2002	2	9,00	6	8,50
2001	3	5,33	3	8,33
2000	8	7,37	4	4,50
1999	3	1,00	4	8,75
1998	3	4,33	4	10,00
1997	1	5,00	1	7,00
1996	6	6,50	1	9,00
1995	2	1,00	2	9,00
1994	2	3,50	2	4,50
1993	2	1,50	2	2,50
1992	2	5,00	2	5,50
1991	1	7,00	-	-
1989	1	10,00	1	14,00
1988	1	9,00	2	1,00
1987	1	3,00	-	-

Table 1 presents the average number of correct answers to the test, with students distributed by the year of their high school graduation. The diversity here shows us that some students continue to a bachelor's or master's degree after a considerable period of time, not necessarily immediately after completing their secondary education. The data shows that students who complete secondary education in earlier years have lower average scores than those

in more recent years. This may be due to factors such as knowledge outdating or lack of access to modern educational resources.

Although the number of Masters students is smaller compared to Bachelors, their average scores are higher. These findings highlight the importance of context and the factors that influence educational outcomes. They also show that it is necessary to consider different aspects, such as age, access to resources and changes in the education system, when analysing the performance of newly admitted students from their previous education.

Table 2.

According to age				
	Bachelor		Master	
Years	**Number of students**	**Average Number of correct answers**	**Number of students**	**Average Number of correct answers**
53	-	-	1	1,00
52	-	-	2	7,50
51	1	9,00	-	-
50	3	4,33	-	-
49	2	5,00	2	5,50
48	1	0,00	1	0,00
47	3	3,33	3	6,60
46	1	7,00	2	5,50
45	3	4,33	2	8,50
44	3	9,33	-	-
43	4	1,25	4	10,00
42	3	8,33	2	12,00
41	3	1,00	2	5,00
40	3	6,00	4	6,00
39	6	6,67	9	6,66
38	9	6,89	11	7,20
37	6	5,83	9	7,33
36	10	3,50	12	10,75
35	10	6,60	13	8,30
34	5	2,80	11	8,54
33	7	5,28	12	8,00
32	6	8,67	8	7,50
31	6	9,83	8	9,50
30	8	7,25	16	8,00
29	5	5,20	7	9,57
28	3	10,33	9	9,66
27	4	11,00	6	12,83
26	5	8,00	8	8,50
25	4	13,75	6	10,33
24	4	7,50	11	10,27

23	15	9,13	14	10,92
22	12	10,41	9	6,00
21	25	8,92	1	8,00
20	35	10,91	-	-
19	126	9,47	-	-
18	56	9,89	-	-
17	1	12,00	-	-

Table 2 visualizes the results of the participants distributed according to their age. As we can notice, it plays a significant role in academic achievement. Younger students, especially those 20-22 years old, show higher average results, while older students, especially those over 30 years old, show lower results. These observations can be useful for developing strategies to support students of different age groups to improve their future performance.

The data in the table provide additional insights that may be useful for further analysis. For example, it can be noted that students aged 24 years who participate in master's programs have an average number of correct answers of 10.27, which is one of the highest performances in this group. This may be due to the fact that these students are at an age at which they have already gained some experience and maturity, which helps them to handle academic requirements more effectively.

On the other hand, students aged 36 who participate in undergraduate programmes have an average number of correct answers of 3.50, which is one of the lowest performances. This may be explained by the fact that these students may have returned to education after a long break and may be having difficulty adjusting to the academic requirements. It is interesting to notice that students aged 28 years, in both Bachelor and Master programmes, show relatively high average scores - 10.33 for Bachelors and 9.66 for Masters. This may be due to the fact that at this age the participants are young enough to be motivated and energetic, but also have some life experience that helps them to perform better in academic tasks.

Table 3.

According to the specialty in which they are studying		
Specialty	**Number of students**	**Average Number of correct answers**
Pre-school and elementary school pedagogy	193	9,31
Elementary school pedagogy	109	9,48
Pre-school pedagogy	83	7,80
Special pedagogy	65	5,79
Social pedagogy	57	7,61
Physical education and sport	38	9,00
Elementary school pedagogy with a foreign language	29	9,72
Pre-school school pedagogy with a foreign language	18	8,72
Pedagogy of art education	8	10,62

The next table (number 3) shows the average number of correct answers given by students, distributed according to the major they enrolled in. The largest group chose the major " Pre-school and elementary school pedagogy ", with a total number of 193 students. The average number of correct answers for this group was 9.31, indicating relatively good academic performance. This may be due to the fact that this specialty is among the most popular and probably attracts students with high motivation and interest in education.

The highest scores were obtained by students from the specialisation "Pedagogy of art education", who also had the lowest number (8). The second best performing group includes students from the specialty "Elementary school pedagogy with a foreign language", followed by "Elementary school pedagogy". The lowest results are shown by the students of the specialty "Special pedagogy". This could be explained by a variety of factors, such as a different curricular focus or greater preparation challenges. In general, the analysis of the results suggests that the number of students in a specialty does not always correlate with their achievement, and that motivation and the specificity of the training play a central role in academic success. This may be useful information for future educational reforms or changes in teaching methodology in different majors.

Table 4.

Question	Total number of correct answers	Percentage ratio	Master		Bachelor	
Which menu can be used to set the line spacing?	401	67%	143	71%	258	65%
How can the selected letters be made uppercase?	416	69%	135	67%	281	71%
How can you make the indentation at the beginning of each paragraph?	89	15%	26	13%	63	16%
By selecting which menu can you determine the amount of indentation to the page margins?	110	18%	53	26%	57	14%
Restoring an old position when working in a text document is done with the command:	387	65%	149	74%	238	60%
Which button is used to split a table:	324	54%	108	53%	216	54%
The Select Cell command is used to highlight:	286	48%	104	51%	182	46%
On which panel of the Format menu are the buttons for selecting the location of a graphics form and a graphics schema:	152	25%	51	25%	101	25%
On which panel of the Layout menu are the cell split and merge buttons located:	221	37%	80	40%	141	35%
The Number tab of the Format Cells dialog box is used to set:	117	20%	35	17%	82	21%
In what order to perform the sorting is specified:	169	28%	64	32%	105	26%
On which panel of the Insert menu are the buttons for inserting diagrams:	187	31%	76	38%	111	28%
In the electronic spreadsheets, when cell addresses are involved in the formulas, they can be:	233	39%	69	34%	164	41%
Which of the functions will return the correct answer if we want the value in cell C1 to be at least 10?	342	57%	116	57%	226	57%
Which of the functions will return the correct answer if we want the value in cell B1 to be at least 5?	280	47%	90	45%	190	48%
Which function will check whether the student is eligible to participate in the basketball team, namely: be taller than 175 cm and lighter than 75 kg? (If his height is listed in cell C2 and weight in cell E2)	138	23%	43	21%	95	24%
On which panel of the Insert menu are the buttons for inserting video and sound:	473	79%	156	77%	317	80%
Which panel of the Animations menu is used to assign animation effects to a slide element?	237	40%	60	30%	177	44%

With the Trim Audio (Trim Video) command:	296	49%	93	46%	203	51%
When printing a presentation, which option is used to print only the current slide:	353	59%	111	55%	242	61%

The data in the table show interesting trends in the knowledge and skills of bachelor and master students in regards to technical and software competencies. First, students demonstrated the highest success in questions related to basic text editor functions. For example, the question about converting letters to capital letters had the highest percentage of correct answers - 69% of all participants. This shows that basic text manipulation skills are well mastered by both Bachelors (71%) and Masters (67%). This result can be explained by the fact that working with text-processing programs is a major part of daily academic and professional practice, leading to a good familiarity with these functions.

However, for more specific and technical issues, the success rate decreases significantly. For example, only 18% of students correctly answered the question about identifying indentation from the margins on the page. It is interesting that Masters students show better results (26%) compared to Bachelors (14%). This may be due to the greater experience of Masters students in working with documents, making them more confident in using more sophisticated features of text editors. This highlights the importance of continuing education and skills development in masters programmes.

For questions related to working with tables and graphs, the success rate is moderate. For example, 54% of the students answered the question on splitting tables correctly, with both bachelor and master groups showing similar results (53% and 54% respectively). However, for more specific functions, such as the use of tab "Number" to format cells, the success rate was significantly lower, with only 20% of students answering correctly. This may be due to the more complex nature of these tasks, which require a deeper understanding of the software tools.

In addition, questions related to the use of condition checking functions also showed lower success rates. For example, only 23% of students correctly answered the question about checking conditions for participation on a basketball team. This highlights that participants struggle with applying logic functions that require a higher level of rational thinking.

The question on embedding video and sound in a presentation was the best answered by students, with 79% answering correctly, probably because this is a commonly used feature in the learning process by both teachers and students. And the lowest score was obtained on the question "How can you make the indentation at the beginning of each paragraph?". The low score on this question could be due to several possible reasons. One of them is that students are not sufficiently familiar with text formatting settings in text-processing programs, probably because their training places more emphasis on the content of the text than on its layout. This may suggest a need for more practical exercises related to text formatting to enhance students' ability to structure their documents in a professional style.

In general, the data show that students are more confident with the basic functions of word processing and spreadsheet editors, but struggle with more specific and technical aspects. Masters students show a slight advantage in some areas, which may be due to their more advanced training and experience. This highlights the need for better training and education in software tools, especially for the more complex functions that are essential for academic and professional tasks.

Analysis of the obtained results

The obtained arithmetic mean shows that the average number of correct answers of student's bachelors is 8,67, with n = 398. Correspondingly, for master's students, we have an average number of correct answers of 8.71, with n = 202. This shows that both groups have very similar mean scores, suggesting that there is no significant difference in overall success rates between bachelors and masters students. This can be explained by the fact that both groups are subjected to similar educational requirements and standards.

Considering that the standard deviation indicates how close or far from the mean performance the students' scores are, in our case we obtain $\sigma = 3.867751674$ for bachelors and $\sigma = 4.183506$ for masters. This shows that the results of masters students are slightly more dispersed compared to those of bachelors students. This may be due to the greater heterogeneity in training, experience and interests of masters students, who may have more diverse academic and professional goals. The standard deviation itself is a nominal variable and not suitable for comparison. Therefore, we also calculate a coefficient of variation, specifically $V\sigma\% = 44.61074596$ for bachelors

and Vσ% = 48.03106954 for masters. It is assumed that when it is below 50%, it means that the variance is small (or negligible). Since both coefficients are below 50%, this indicates that the variance of the results is relatively small, meaning that most students performed close to the mean. However, the slightly higher coefficient for masters students highlights that their results are slightly more varied than those of bachelors students.

The skewness coefficient for bachelor's students is -0.40, while for master's students, it is -0.27. This indicates that the distribution of results is slightly negatively skewed, meaning that there are more students with higher scores compared to those with lower scores. The kurtosis coefficient for bachelor's students is -0.39, while for master's students, it is -0.51. This indicates that the distribution of results is flatter compared to the normal distribution, meaning there are fewer extreme values. The range of results for bachelors is 16 and for masters is 19. This indicates that masters students have a wider range of results, which may be due to the greater heterogeneity in their knowledge and skills.

Then, we calculate the standard error of the mean. We obtain μ = 0.193872873 for bachelors and μ = 0.294350455 for masters. This indicates that the average for bachelors is more stable and less vulnerable to random variation than that for masters. Based on the standard error, the maximum allowable error is calculated, which has greater interpretative significance. The maximum allowable error is usually denoted by Δ and is calculated using the formula: $\Delta = t.\mu$, where t is a guarantee multiplier whose value depends on the guarantee probability with which we want to guarantee our conclusions. Usually, we work with a guarantee probability of 95%, where the guarantee multiplier t = 1.96. Therefore, the maximum error for this guarantee probability, calculated using the above formula, we obtain Δ = 0.379990832 for bachelors and Δ = 0.576926892 for masters. This means that we can state with 95% confidence that the true mean of the results lies in the range 8.29 to 9.05 for bachelors and 8.13 to 9.29 for masters. This shows that although both groups have similar means, the confidence interval for the masters is slightly wider, again highlighting the greater variation in their results. The findings highlight the need for targeted learning approaches to meet the specific needs of each group of students.

3. CONCLUSION

The present study provided an analysis of the information technology application skills of students in education majors and their implication for modern education. The results clearly show that almost all respondents believe that information technology proficiency is essential for the teaching profession. However, a significant proportion of students do not feel fully confident in their digital skills, indicating a need for further training and development in this area.

An analysis of students' self-assessment of working in a digital environment reveals that while most feel relatively prepared, there is still a group that experiences uncertainty or confidence in using technology. This is particularly important in the context of the increasing role of technology in the educational process. At the same time, the results of the evaluation of the digital competences of their lecturers show a significant gap - a large percentage of students feel that their lecturers are not sufficiently prepared in this area.

Particularly worrying is the fact that fewer than half of students can name the antivirus program they use, indicating a low level of cyber security awareness. This highlights the need for more profound training in this area, as a lack of knowledge and skills in protecting personal and professional data can lead to serious problems in the professional practice of future teachers.

The results of the basic skills test show that no student was able to answer all questions correctly, and the average number of correct answers was relatively low for both undergraduates and postgraduates. This is indicative of the need for further training and practical improvement in the use of basic office applications such as Word, Excel and PowerPoint, which are fundamental not only to the teaching profession.

The analysis also shows that age and year of secondary school graduation have an impact on results, as younger students and recent graduates show better results compared to older participants. This suggests that technological competencies change over time and require constant updating and adaptation.

In conclusion, the study clearly outlines the need for more in-depth and practically oriented preparation of future teachers in the field of information technology. Despite the high awareness of the importance of technology in the educational process, the actual level of skills in the area of technology competences remains unsatisfactory, which requires a rethinking and improvement of training programmes in this direction.

Limitations of the study include: limited scope of the study group; unstudied external factors; existing differences in participants' previous education, year of graduation, age and work experience; limited time period; limited scope of skills tested; lack of analysis of the impact of socioeconomic factors and potential for subjectivity in responses.

After the conducted research, we can identify the following recommendations: the need to conduct targeted courses dedicated to information technology (disciplines should cover not only basic applications, but also interactive educational platforms, cybersecurity, digital teaching methodologies and the use of AI tools in education); Regular evaluation and updating of school curricula (schools should periodically update curricula in line with technological trends and labour market requirements); Creating additional online resources and digital libraries to support future educators (Access to specialized materials, video tutorials, and interactive platforms will help students improve their skills in self-directed learning); Establish better collaboration with schools (partnerships between universities and schools can lead to better preparation of future educators); Conduct further research (continued research is needed in the area of digital competencies of pre-service teachers, tracking the long-term outcomes of training and its impact on the practical work of graduate educators).

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