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INNOVATIVE TECHNOLOGIES IN HIGHER EDUCATION: AN ANALYSIS OF TEACHERS' ATTITUDES

Abstract: Contemporary higher education is confronted with intensive changes driven by the development of information and communication technologies (ICT), which increasingly shape the ways in which knowledge is transmitted, constructed, and acquired. Although ICT is widely recognized as a significant factor in enhancing the quality of the teaching process, its effective implementation largely depends on teachers' attitudes, beliefs, perceptions, and their willingness to adopt technological innovations in instruction. The aim of this study is to examine the integration of ICT into teaching practices at higher education institutions, with a particular focus on teachers' attitudes as a key determinant of the effectiveness of this integration. The paper analyzes the use of various ICT tools, as well as the impact of teachers' professional competencies and the availability of technological resources on teaching quality, student motivation, and engagement, with the intention of providing a systematic overview of the opportunities and challenges of digital transformation in higher education.
The research was conducted as a quantitative study on a convenience sample of 152 higher education teachers in the Republic of Serbia. The study is theoretically grounded in contemporary concepts of ICT integration in higher education, drawing on the sociocultural paradigm of learning—crucial for didactic approaches as it enables the understanding of AI as a cultural artifact and mediator in learning—Bandura's Social Cognitive Theory, and elements of emancipatory didactics. The main findings indicate predominantly positive attitudes of teachers toward the use of ICT, with observed differences in the perception of its contribution depending on the type of higher education institution.

Keywords: information and communication technologies (ICT), higher education institutions, teachers, technological tools.

1. Introduction

"Technology will not replace teachers, but teachers who use technology will replace those who do not."
Eric Mazur (University Professor)

The teaching process, as the fundamental form of organized learning, has evolved throughout history in accordance with social needs, pedagogical conceptions, and the technical possibilities of

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its time. In the ancient schools of Greece and Egypt, where oral exposition, teacher authority, and the reproduction of knowledge played a central role, instructional tools were limited to elementary aids primarily serving as support for the verbal interpretation of content. From wax tablets and rare manuscripts, through printed books as symbols of the intellectual legitimization of knowledge, to the blackboard and chalk as dominant visual media of instruction, the evolution of teaching aids has reflected gradual changes aligned with the needs of the instructional process itself.

Change is the only constant in the process of teaching and learning, while adaptability has become one of the key skills of the twenty-first century, essential for personal and professional development as well as for improving student performance (Boholano et al., 2021). A fundamental turning point occurred with the emergence of modern ICT, which, beyond being recognized as new technical tools, represent a profound epistemological shift in the organization of the teaching and learning process. ICT exerts an immeasurable influence on the global economy, corporate management, and globalization trends, while simultaneously possessing the potential to reshape the nature of education and learning environments, whether in traditional institutions or distance education settings (Пешикан, 2016). In the dynamic landscape of higher education, ICT has emerged as a powerful catalyst, revolutionizing traditional teaching and learning paradigms, and its integration has significantly influenced the accessibility, dissemination, and application of knowledge within educational institutions (Gupta, 2024).

In this context, it is important to emphasize the theoretical foundations of ICT implementation in education. From an epistemological perspective, digital tools transform the ways in which knowledge is created, interpreted, and transmitted, enabling students to actively participate in the learning process (Siemens, 2005). From a pedagogical standpoint, technology integration requires new instructional strategies in which the teacher assumes the role of moderator, guide, and facilitator of learning (Mishra & Koehler, 2006). Finally, from a psychological perspective, the role of students is reshaped, as interactive and personalized platforms foster autonomy, critical thinking, and metacognitive skills (Zimmerman, 2002).

Carnoy (2004) defines ICT as a tool primarily oriented toward the creation of various databases, which are indirectly intended to enhance the efficiency of societal functioning, within which education holds the role of a constitutive element.

The application of ICT in education is widely disseminated due to its visible transformative effects in enhancing the quality of teaching and learning, resulting in far-reaching social changes (Lim et al., 2013). The global shift toward a knowledge-based economy requires students to be equipped with digital literacy skills from an early age, which consequently draws increasing attention to the integration of ICT into education (Obeng et al., 2025). The introduction of ICT into the teaching process has been encouraged by a series of interrelated factors, primarily including the growing need to increase efficiency in curriculum implementation, the possibility of more flexible organization of instruction, and the technological capacities that support educational programs in accordance with individual students' needs, as well as the unlimited use of the Internet as a tool for accessing information and facilitating communication (Alam, 2016). Since contemporary teaching implies continuous improvement and more effective learning, appropriate ICT implementation enables a more dynamic and content-rich instructional process (Milošević et al., 2011).

In this context, the role of the teacher transforms from being the sole transmitter of knowledge to becoming a moderator and mediator of learning, while teachers' attitudes toward ICT emerge as a key factor in its genuine integration into higher education, thereby opening space for scholarly re-examination of the relationship between technology, pedagogy, and academic culture. At the same time, the introduction of ICT into the teaching process is not a simple technological transformation but requires a reconsideration of pedagogical strategies and methodological approaches that had previously been widely applied. Teachers are placed in a position of synchronizing traditional forms

of instruction with new digital possibilities, which demands both technical competence and pedagogical flexibility. Teacher competencies constitute an inexhaustible field of research that has always been and will remain highly relevant (Milanović & Maksimović, 2025). As Milanović and Maksimović (2025) emphasize, one of the reasons for this continuous relevance lies in the fact that teachers' competencies directly influence students' competencies, which essentially means that the future of society lies in the hands of teachers (Caena & Redecker, 2019). The need for appropriate teacher training in the use of digital tools in education is confirmed by research indicating that higher levels of teacher education correlate with greater perceived effectiveness in integrating tools into the teaching process (Mandić et al., 2025a). Educational systems worldwide aim to empower teachers through systematic training, reflective practice, and blended learning models, thereby fostering professional growth and adaptability to change (Mandić et al., 2025b). Therefore, understanding teachers' attitudes toward ICT use becomes central to assessing the effectiveness of digital integration in higher education, given that their perceptions shape the way technology enters educational practice.

Contemporary higher education stands at the center of profound social and technological changes that redefine the ways knowledge is acquired, transmitted, and evaluated. Digitalization has become a crucial driver of transformation in higher education institutions, not only in a technical sense but also in pedagogical, organizational, and strategic contexts. As Klaus Schwab, founder of the World Economic Forum, emphasizes, "The Fourth Industrial Revolution is not only changing what we do, but also who we are," highlighting that digitalization fundamentally transforms education, the economy, and society as a whole. On the other hand, Peter Drucker, one of the most prominent management theorists, points out that "The greatest danger in times of turbulence is not the turbulence—it is to act with yesterday's logic," which in the context of higher education underscores the need for institutions to adapt their educational models in a timely manner to contemporary technological challenges. The educational space of higher education institutions is undergoing intensive modernization, reflected in the growing differentiation of academic education, the use of more flexible educational communication mechanisms, and the increasing complexity of technological, organizational, and intercultural relations under the influence of globalization (Nakaznyi et al., 2015). Higher education institutions must meet the expectations of modern society in order to become more open and competitive in times when digital tools reshape the very nature of learning and the academic experience (García-Valcárcel & Tejedor, 2009).

In this process, ICT occupies a central position, enabling the development of new learning models, greater accessibility of educational resources, personalization of instruction, and enhanced interaction between teachers and students. Kent and Facer (2004) state that higher education institutions represent environments in which students engage in a broad spectrum of digital activities, while the home serves as a complementary setting for regularly engaging in a narrower set of such activities. Over the past decade, educational systems worldwide have implemented various initiatives aimed at ICT application, as well as at addressing the challenges brought by its integration. The challenges of digital transformation in education are reflected both in the human factor (teachers, institutional support, management structures) and in technological infrastructure (access to computers, technical support, and e-materials) (Farrukh & Pal Singh, 2014). For these reasons, ICT integration into the higher education system enables the academic community—students, teachers, and policymakers—to access, process, and share information in innovative ways, thereby promoting a more efficient, flexible, and interactive learning environment (Farooq & Shamim, 2025).

According to Novaković Cvetković et al. (2022), the informatization of education encompasses:
- universal information technologies (word processing tools, graphic packages, database management systems, spreadsheets, modeling systems, expert systems);
- computer telecommunication devices;

- computer programs for teaching and management, as well as digital textbooks;
- multimedia products.

The digitalization of higher education does not merely reflect technological progress; it opens space for reconsidering the very meaning of learning and the relationship between knowledge and experience. Each new digital tool, presented as an ICT instrument, represents an opportunity for students and teachers to jointly re-examine the ways in which the world is understood, explored, and conveyed, reminding us that education is always a pathway toward a deeper understanding of human potential and possibilities.

According to the GEM Report (2023), students and teaching staff are rapidly adopting ICT tools. In this regard, the number of learners participating in Massive Open Online Courses (MOOCs) increased from zero in 2012 to just over 220 million in 2021. Furthermore, the PISA study conducted in 2018 confirmed that 65% of fifteen-year-olds in OECD countries attend schools where principals agree that teachers possess the technical and pedagogical skills necessary for ICT integration, while 54% of students attend schools where an effective platform supporting online learning is available. Based on the same report, ICT use in higher education is expanding intensively, particularly through learning management and data management platforms; however, its implementation is not uniform across countries and institutions. In other words, significant differences exist in technology integration depending on teacher preparedness, available resources, and institutional policies. Global studies confirm that although more than half of countries have established standards for ICT in education, the use of educational software and technology does not always reach the same level of effectiveness, as evidenced by the example of the United States, where as many as 67% of licensed educational software products were not intensively used in teaching (GEM, 2023).

Although various factors contribute to the effective integration of ICT into higher education, teachers' attitudes and technological competencies undoubtedly serve as its foundation (Yang et al., 2023). The importance of teachers' personal initiative in professional development is increasingly recognized, particularly through participation in online programs, communities of practice, and the use of contemporary digital learning tools. Different professional development programs and approaches demonstrate that well-designed training is essential for preparing teachers to meet the challenges of the digital age and to successfully implement modern technologies in teaching (Alférez-Pastor et al., 2023).

Teachers who actively invest in their professional development not only adopt new digital tools but also shape the ways in which students think, explore, and learn. Their readiness to adapt pedagogical strategies to contemporary technologies creates space for dynamic and interactive learning, where each student becomes an active participant in the process of knowledge construction. However, despite the potential of ICT (including e-learning and educational technologies) to enhance and transform teaching and learning practices in higher education, ineffective implementation remains a globally present issue. At the same time, there is limited evidence that teachers who use ICT in instruction genuinely internalize their acquired experiences or that its application consistently contributes to the systematic integration of digital tools into everyday pedagogical practice (Dintoe, 2018).

In interpreting the obtained results, the findings of this study were compared with relevant national and international empirical research addressing ICT implementation in higher education, teachers' attitudes, and factors influencing the effectiveness of integration. Particular attention was devoted to studies indicating the predominance of basic digital tools in instructional practice (Soomro et al., 2020; Tulinayo et al., 2018), to research highlighting positive perceptions of ICT contributions to teaching quality, student motivation, and engagement (Marković Blagojević et al., 2021; Kirkwood & Price, 2014), as well as to studies identifying differences in technology use according to age, academic rank, and scientific field (Aivazidi & Michalakelis, 2023; Mercader & Gairín, 2020). The

results were also considered in light of findings that point to the existence of a gap between the formal alignment of curricula and the actual implementation of ICT, as well as the importance of institutional infrastructure and digital services for the successful integration of technology into teaching (Tondeur et al., 2007).

2. Method

The aim of this paper is to systematically examine the application of ICT in teaching at higher education institutions and to analyze teachers' attitudes as key factors in their effective integration, with particular emphasis on the use of various ICT tools, as well as on the impact of teachers' professional preparedness and the availability of technological resources on teaching quality, student motivation, and engagement.

The methodology of the study is based on quantitative research conducted among teachers employed at higher education institutions. Participants were informed about the purpose of the research, and participation was entirely voluntary. Responses were collected anonymously using a Google Forms questionnaire, which enabled sincere and unobstructed expression of attitudes. The survey was conducted between December 15, 2025, and January 20, 2026, using respondents' email addresses. The processed data were analyzed using the statistical package SPSS Version 26.

An online questionnaire was designed specifically for the purposes of this study and consisted of five sections. The first section gathered respondents' sociodemographic characteristics: gender, age, type and location of the higher education institution where respondents are employed, academic rank, and length of professional experience. The second section included general questions related to ICT implementation in higher education institutions, the scientific field of the institution in which respondents work, the form of instruction applied, as well as questions concerning the institution's equipment in terms of computers and Internet access.

The third, fourth, and fifth sections of the questionnaire were structured as five-point Likert scales. The third section included items related to the evaluation of online services, the institution's website, and the use of email in communication with students (OOS – Online Services Evaluation). The fourth section focused on assessing the contribution of ICT to teaching quality, student motivation, examination performance, and active participation in the instructional process (OD – Contribution Evaluation). The fifth section addressed questions related to the frequency and dynamics of using computer programs and materials (KRP – Use of Computer Programs).

The scales used in the research demonstrated satisfactory reliability, considering the relatively small number of items within each scale. Cronbach's alpha coefficient ranged from $\alpha = 0.667$ for the Use of Computer Programs scale (KRP) to $\alpha = 0.891$ for the Contribution Evaluation scale (OD), while the coefficient for the Online Services Evaluation scale (OOS) was $\alpha = 0.713$.

The total research sample consisted of 152 respondents ($N = 152$), residing in the Republic of Serbia, with 1.4% of participants from the Republic of Srpska. The study included teaching staff from several universities, both genders, various age groups, academic ranks, and lengths of professional experience. Regarding gender distribution, slightly more than half of the sample were female respondents (53.3%), while 46.7% were male. The average age of respondents was $M = 47.14$ years, with the youngest participant aged 24 and the oldest 75.

In terms of institutional affiliation, the majority of respondents were employed at faculties (70.4%), most commonly with 11–15 years of professional experience (23.4%). Respondents employed at colleges of applied studies accounted for 29.6% of the sample, with the largest subgroup within this category having 6–10 years of work experience (28.9%). The sample was relatively balanced in terms of gender and age; however, certain differences were observed regarding the type of institution

and length of professional experience. Other sociodemographic characteristics of the respondents are presented in Table 1.

Table 1. *Sociodemographic Characteristics of the Respondents*

Gender	**∑**	%
Female	81	53.3
Male	71	46.7
TOTAL (∑)	**152**	**100.0**
Age	**∑**	%
24-35	26	17.1
36-45	43	28.3
46-55	44	28.9
more than 55 years	39	25.7
TOTAL (∑)	**152**	**100.0**
Type of institution	**∑**	%
Faculty	107	70.4
Higher vocational school	45	29.6
TOTAL (∑)	**152**	**100.0**
Length of professional experience	**∑**	%
1-5	21	13.8
6-10	28	18.4
11-15	36	23.7
16-20	23	15.1
more than 20	44	28.9
TOTAL (∑)	**152**	**100.0**

With regard to academic rank, the largest proportion of respondents held the title of Full Professor, accounting for 24.3% of the total sample. The second most represented group consisted of Associate Professors (18.4%), followed by Professors of Applied Studies (15.8%). In terms of frequency, these were followed by Assistant Professors (14.5%) and Teaching Assistants (12.5%). Significantly smaller proportions were recorded for the ranks of Teaching Associate (2.6%), Assistant with a PhD (3.3%), and Lecturer and Senior Lecturer (4.6%). Following the analysis of the sample structure in relation to academic rank, additional insight into respondents' characteristics is obtained by examining the location of the higher education institutions where they are employed. Accordingly, nearly two-thirds of respondents work in institutions located in Belgrade (64.5%), indicating a pronounced concentration of higher education institutions in the main university center. Respondents employed at faculties or colleges of applied studies in other cities, such as Leskovac and Kragujevac, accounted for 4.6% of the sample, while the cities of Čačak and Šabac were represented by 2.6% of respondents (Figure 1).

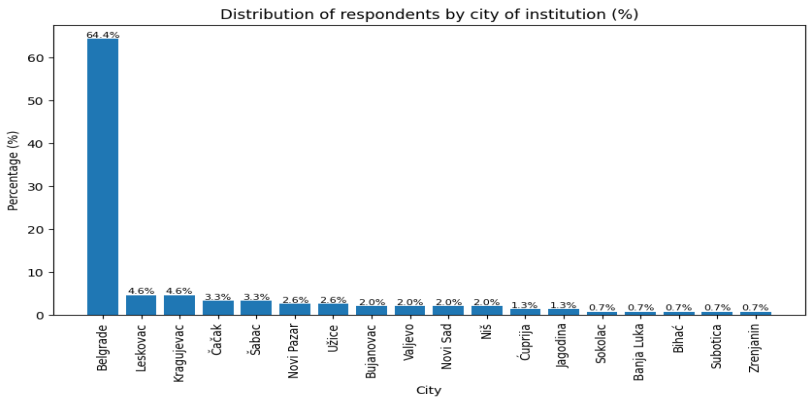

Figure 1. *Location of the Institution*

The structure of the sample was further analyzed with regard to the scientific field of the faculties or higher education institutions in which the respondents are employed, with the possibility of multiple responses. In this respect, the largest proportion of respondents work in the field of social sciences and humanities (46.7%). Slightly more than one quarter of the respondents are employed at higher education institutions in the technical and technological fields (27.0%), while less than one fifth identified mathematics as their primary field of work (18.4%). Respondents from the field of medical sciences account for 17.2% of the sample, whereas only 7.2% come from the field of arts.

Given the heterogeneity of scientific fields represented in the sample, the study further examined whether the respondents' field of expertise belongs to the ICT domain. A total of 20.4% of respondents answered affirmatively, while 79.6% stated that their scientific field does not fall within the ICT domain. These results indicate the diversity of academic disciplines included in the research, as well as varying levels of formal affiliation of respondents with the ICT domain.

3. Results

In contemporary educational settings, teachers are expected to implement creative and innovative teaching strategies in order to meet the individual needs of pupils and students (Tecnia Institute of Advance Studies, 2021). This implies the use of diverse instructional formats that enable flexibility, adaptation of content to different student needs, and active participation in the teaching process. At the same time, teachers combine traditional and modern approaches to ensure a dynamic and effective transfer of knowledge.

When reporting on the forms of instruction they apply, respondents identified the modernized traditional form of teaching as one of the most prevalent in their teaching practice (56.6%) (Table 2). In response to the question, "According to which system is computer-assisted instruction organized at your faculty/higher school?", slightly more than half of the respondents (52.6%) indicated that they use a one computer–one student system, while 47.4% reported using a one computer–multiple student's system.

Table 2. Forms of Instruction Applied by the Respondents

Form of instruction	∑	%
Conventional (traditional) form of instruction	8	5.3
Modernized traditional form of instruction (smart boards, projectors, presentations)	86	56.6
Instruction with frequent use of ICT	46	30.3
Instruction based exclusively on the use of ICT	12	7.9
Total (∑)	**152**	**100.0**

The degree of ICT implementation in the teaching processes of the faculties and higher education institutions included in the sample was rated with a mean score of M = 3.55 on a five-point scale (1–5). Individually, the largest proportion of respondents assigned a score of 3 (38.8%) or 4 (34.2%). Additionally, 16.4% of respondents gave a score of 5, 9.2% a score of 2, and 1.3% a score of 1.

The factors identified by respondents as influencing ICT implementation in teaching indicate that one of the most significant limiting factors is insufficient ICT equipment at faculties/higher education institutions (68.4%), followed by teachers' activities and professional competencies (61.2%). A considerably smaller proportion of respondents reported that insufficient support from faculty deans/school directors, as well as from the Ministry of Education, Science and Technological Development, affects the low level of ICT implementation in higher education institutions (11.8%).

The alignment of curricula with contemporary ICT represents an important prerequisite for their effective implementation in the teaching process. Teachers' perceptions regarding the degree of this alignment indicate how normative frameworks are reflected in teaching practice and highlight

the scope for further improvement. In this context, the largest percentage of respondents believe that curricula follow ICT developments partially (42.8%) or sufficiently (35.5%), while a smaller—though not negligible—percentage state that the alignment is insufficient (12.5%) or non-existent (2.0%). In addition, 7.2% of respondents indicated that they were unsure.

However, the effective integration of ICT into curricula depends not only on instructional content but also on the practical availability of digital infrastructure. High-quality digital infrastructure, such as reliable Wi-Fi access at faculties and higher schools, is a prerequisite for delivering instruction supported by modern ICT. In this study, more than two thirds of respondents reported that the higher education institution where they work provides Wi-Fi of satisfactory quality (69.7%). Furthermore, 25.5% indicated that Wi-Fi is available but with low connection speed, while the smallest percentage (4.6%) reported that Wi-Fi is not available at their institution.

Evaluation of Online Teaching Services (OTS)

At the level of the overall scale, OTS demonstrates a high mean value (M = 4.26; SD = 0.683), with scores ranging from 2 to 5. Such a mean value indicates a distinctly positive perception among respondents regarding the quality of online instruction.

Table 3. *Expression of OTS*

Online Services Assessment	MIN	MAX	AS	SD
Student service	1	5	4.13	1.008
Website	2	5	4.14	0.857
E-mail	2	5	4.51	0.671
OSA	**2**	**5**	**4.26**	**0.683**

At the item level, the highest mean score was recorded for the effectiveness of using e-mail in communication with students and the student administration (M = 4.51; SD = 0.671), whereas the lowest mean score was assigned to the online student service (M = 4.13; SD = 1.008). All three mean values are substantially above the scale midpoint, indicating a markedly positive evaluation.

Table 4. *Differences in the Level of OTS Expression with Respect to Respondents' Gender*

Scale	Gender	AS	SD	T	p
OTS	Female	4.23	0.728	-0.630	0.530
	Male	4.30	0.630		

N=152;

The analysis of differences in OTS with regard to respondents' gender did not reveal any statistically significant differences. Although male respondents demonstrated a slightly higher mean score compared to female respondents, the identified difference did not reach statistical significance.

Table 5. *Difference in OTS Expression in Relation to Respondents' Age*

Scale	Age	AS	SD	F	p
OTS	24-35	4.32	0.676	0.300	0.825
	36-45	4.23	0.688		
	46-55	4.20	0.765		
	Over 55	4.32	0.595		

df=3;

With regard to respondents' age, no statistically significant differences were confirmed in the level of OTS expression. The highest mean scores were recorded among the youngest respondents (24–35 years) and the oldest group (over 55 years), while the lowest mean score was observed among

respondents aged 46 to 55 years. However, the differences were not substantial, and statistical significance was not established.

Table 6. *Differences in the Level of OTS Expression with Respect to the Type of Higher Education Institution*

Scale	Type of Institution	AS	SD	T	p
OTS	Faculty	4.32	0.624	1.705	0.090
	Higher School	4.12	0.795		

N=152;

The comparison of OTS according to the type of institution did not indicate statistically significant differences. Although a slightly higher mean score was observed among respondents employed at faculties, this difference was not statistically significant.

Table 7. *Differences in the Level of OTS Expression with Respect to Respondents' Length of Service*

Scale	Length of Service	AS	SD	F	p
OTS	1–5 years	4.46	0.591	1.770	0.138
	6–10 years	4.00	0.697		
	6–10 years	4.31	0.714		
	16–20 years	4.39	0.763		
	More than 20 years	4.23	0.617		

df=4;

With regard to the total length of respondents' service in higher education institutions, no statistically significant differences were confirmed in the evaluation of online services. The highest mean score was recorded among respondents with 1–5 years of service, while the lowest mean score was observed among those with 6–10 years of service. However, the identified differences were not statistically significant.

Evaluation of the Contribution (EC) of Information and Communication Technologies

Regarding the evaluation of the contribution of ICT to teaching, the obtained mean score was M = 4.01 (SD = 0.747), with scores ranging from 1 to 5. The calculated mean indicates a high level of expression above the scale midpoint.

Table 8. *Level of Expression of EC (Evaluation of Contribution)*

Evaluation of Contribution	MIN	MAX	AS	SD
Contribution to teaching quality	1	5	4.24	0.770
Contribution to learning motivation	1	5	4.01	0.822
Contribution to student participation in teaching	1	5	3.89	0.907
Contribution to improved knowledge acquisition (exam performance)	1	5	3.89	0.928
EC	**1**	**5**	**4.01**	**0.747**

According to the respondents' perceptions, the highest evaluation of the contribution of ICT refers to its impact on the quality of teaching (M = 4.24; SD = 0.770). The lowest contribution ratings were recorded for student participation in teaching (M = 3.89; SD = 0.907) and improved knowledge acquisition (M = 3.89; SD = 0.928).

Table 9. *Differences in the Level of EC Expression with Respect to Respondents' Gender*

Scale	Gender	AS	SD	T	p
EC	Female	4.03	0.773	0.454	0.650
	Male	3.98	0.722		

N=152;

With respect to respondents' gender, no statistically significant differences were confirmed in the level of EC expression. A marginally higher level of expression was observed among female respondents compared to male respondents; however, the difference was not statistically significant.

Table 10. *Differences in the Level of EC Expression with Respect to Respondents' Age*

Scale	Age	AS	SD	F	p
EC	24-35	3.75	0.857	1.566	0.200
	36-45	4.01	0.839		
	46-55	4.15	0.650		
	Over 55	4.02	0.645		

df=3;

The comparison of EC across age groups did not reveal statistically significant differences. A tendency toward slightly higher mean scores was observed among respondents in the middle and older age group (46–55 years), while lower values were recorded among the youngest respondents (24–35 years). However, these differences did not reach statistical significance.

Table 11. *Differences in the Level of EC Expression with Respect to the Type of Higher Education Institution*

Scale	Type of Institution	AS	SD	t	P
From	Faculty	3.89	0.748	**-3.246**	**0.001****
	Higher School	4.31	0.664		

*N=152; p<0,01**;*

With regard to EC in relation to the type of higher education institution in which the respondents are employed, a highly statistically significant difference was confirmed (t = -3.246, p = 0.001). The obtained difference is substantial and indicates that respondents working at higher schools (M = 4.31; SD = 0.664) assigned, on average, higher ratings to the contribution of ICT compared to respondents employed at faculties (M = 3.89; SD = 0.748).

Table 12. Differences in the Level of EC Expression with Respect to Respondents' Length of Service

Scale	Length of Service	AS	SD	F	p
EC	1–5 years	3.93	0.775	0.309	0.871
	6–10 years	4.11	0.695		
	11–15 years	4.03	0.820		
	16–20 years	4.06	0.838		
	More than 20 years	3.94	0.678		

df=4

With regard to the total length of respondents' service in higher education institutions, no statistically significant differences were confirmed in the level of EC expression. The highest mean score was given by respondents with 6–10 years of service, while the lowest mean score was recorded among those with 1–5 years of service. The observed differences were small and did not reach statistical significance.

Dynamics of the Use of Computer Programs (UCP)

The final scale of the questionnaire consists of items examining the dynamics of the use of computer programs in teaching. On this scale, a mean score of M = 3.15 (SD = 1.067) was obtained. This level of expression is considered above average and indicates that computer programs are used in teaching from once a week to several times per week.

Table 13. Level of Expression of the Dynamics of Computer Program Use

Use of Computer Programs	MIN	MAX	AS	SD
MS Office programs (Word, Excel, PowerPoint, etc.)	1	5	3.71	1.593
Distance learning programs (Moodle, Blackboard, etc.)	1	5	2.77	1.511
Social networking programs for teaching purposes (Facebook, Google Apps, etc.)	1	5	2.88	1.390
Electronic materials available on online platforms	1	5	3.29	1.530
UCP	**1**	**5**	**3.15**	**1.067**

The results of the analysis of the UCP scale items indicate a differentiated frequency in the use of specific digital tools in teaching practice. The highest values were recorded for software solutions from the MS Office package, while slightly lower—but still relatively high—values were identified for the use of electronic teaching materials on online platforms, as well as tools for digital communication and collaboration.

In contrast, the lowest frequency levels were observed for distance learning platforms such as Moodle and Blackboard. Nevertheless, all items included in the UCP scale demonstrated above-average values, indicating the presence of a stable dynamic in the implementation of ICT within the teaching process.

Table 14. *Differences in the Level of UCP Expression with Respect to Respondents' Gender*

Scale	Gender	AS	SD	t	p
UCP	Female	3.09	1.200	-0.742	0.459
	Male	3.22	0.901		

N=152;

With regard to respondents' gender, no statistically significant differences were confirmed in the level of UCP expression. A slightly higher level of expression was observed among male respondents compared to female respondents; however, the difference did not reach statistical significance.

Table 15. *Differences in the Level of UCP Expression with Respect to Respondents' Age*

Scale	Age	AS	SD	F	p
UCP	24-35	3.00	0.880	0.340	0.796
	36-45	3.26	1.010		
	46-55	3.18	1.171		
	Over 55	3.10	1.141		

df=3;

The comparison of the dynamics of UCP with respect to respondents' age did not reveal statistically significant differences. Slightly higher values were recorded among respondents in the middle age group, while lower values were observed in the youngest age group.

Table 16. *Differences in the Level of UCP Expression with Respect to the Type of Institution*

Scale	Institution type	AS	SD	t	p
UCP	Faculty	3.17	1.061	0.268	0.789
	Higher School	3.11	1.094		

N=152;

With regard to the type of institution in which the respondents are employed, no statistically significant differences were confirmed in the level of UCP expression. A marginally higher level of expression was observed among respondents working at faculties compared to those employed at higher schools; however, the difference was not statistically significant.

Table 17. *Differences in the Level of UCP Expression with Respect to Length of Service*

Scale	Length of Service	AS	SD	F	p
UCP	1–5 years	2.75	0.870	1.813	0.129
	6–10 years	2.96	0.949		
	11–15 years	3.23	1.105		
	16–20 years	3.55	1.117		
	More than 20 years	3.20	1.125		

df=4;

The analysis of differences in the dynamics of UCP with respect to the total length of respondents' service in higher education institutions did not indicate statistically significant differences. Although the highest frequency of use was recorded among respondents with 16–20 years of service and the lowest among those with 1–5 years of service, the observed differences were of low intensity and did not reach statistical significance.

In order to examine the interrelationships among the analyzed variables, following descriptive statistics and tests of differences, a correlation analysis was conducted based on Pearson's correlation coefficient, with consideration of the statistical significance of the obtained coefficients.

Table 18. *Correlation Matrix of the Analyzed Variables*

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	1														
2	-0.033	1													
3	.653**	-0.268*	1												
4	.748**	-0.196*	0.641*	1											
5	0.006	-0.137	0.085	0.047	1										
6	0.182*	0.054	0.071	0.076	0.353**	1									
7	-0.068	-0.182	0.076	0.078	0.284**	-0.137	1								
8	0.123	0.018	-0.030	-0.040	-0.318**	0.381*	0.428*	1							
9	-0.164*	0.024	-0.126	-0.104	0.146	-0.317**	0.097	-0.452*	1						
10	-0.147*	-0.069	-0.114	-0.129	0.110	-0.158	0.137	-0.271*	0.144	1					
11	0.043	-0.228**	0.041	0.015	-0.112	0.035	-0.085	0.314*	-0.188*	-0.139	1				
12	-0.133	-0.076	-0.123	-0.106	-0.125	-0.032	-0.130	0.285*	-0.102	0.023	0.538**	1			
13	0.071	0.020	-0.019	-0.020	-0.051	0.127	0.235*	0.332*	-0.179*	-0.125	0.379**	0.481*	1		
14	-0.041	0.157	-0.187*	-0.185*	0.355**	0.294**	-0.138	0.272	-0.109	-0.145	0.267**	0.138	0.314**	1	
15	0.088	0.218**	-0.115	-0.065	-0.211	0.149	-0.047	0.122	-0.117	-0.010	0.118	0.054	0.192*	0.613*	1
16	0.142	0.235**	-0.064	0.027	-0.312	0.190*	-0.050	0.150	-0.083	0.020	0.073	0.045	0.035	0.605*	0.783**
17	0.156	0.267**	-0.117	-0.011	-0.328	0.292**	-0.129	0.261*	-0.075	0,089	0.160	0.079	0.168*	0.717*	0.630**
18	-0.076	0.035	-0.234**	-0.157	0.067	-0.155	0.004	-0.073	0.076	0.107	0.006	-0.016	-0.065	0.072	0.024

$* \ p < 0.005$
$** \ p < 0.001$

LEGEND

1 – Age
2 – Higher Education Institution
3 – Academic Rank
10 – Wi-Fi Usage
11 – Functioning of the Online Student Service
12 – Website Performance

4 – Length of Service	13 – Efficiency of E-mail Use
5 – Scientific Field	14 – Teaching Quality
6 – Teaching Format	15 – Student Motivation
7 – Instruction Delivery System	16 – Student Participation in Teaching
8 – ICT Implementation System	17 – Improved Knowledge Acquisition
9 – Curricula and ICT	18 – Distance Learning Programs

4. Interpretation

With the aim of examining the degree of implementation of various ICT tools in teaching at faculties and higher schools, and analyzing teachers' attitudes as key factors of effective integration—with particular reference to technology use, teachers' professional preparedness, and the availability of technological resources affecting teaching quality, student motivation, and engagement—a study was conducted using an original questionnaire on a sample of 152 respondents.

The results indicate that more than half of the total sample employ a modernized traditional form of teaching (e.g., smart boards, video-beam presentations), and that instruction in most institutions is organized according to the one computer–one student model. According to respondents, the overall level of ICT implementation was rated at M = 3.55, with its application depending both on teachers' activities and professional competencies and on the ICT equipment available at faculties/higher schools. The findings further show that curricula partially follow ICT developments and that the majority of higher education institutions provide free Wi-Fi access of satisfactory speed.

Regarding the OTS, EC, and UCP scales, all three demonstrated high above-average levels of expression. On the OTS scale, the highest rating was assigned to the use of e-mail in communication with students and the student administration. Similar findings were reported by Tulinayo et al. (2018), confirming that e-mail represents one of the most frequently used forms of digital communication in teaching activities. No statistically significant differences were identified on this scale with respect to gender ($t = -0.630$; $p = 0.530$), age ($F = 0.300$; $p = 0.825$), type of institution ($t = 1.705$; $p = 0.090$), or length of service ($F = 1.770$; $p = 0.138$).

On the EC scale, the highest rating was attributed to the contribution of ICT to teaching quality, consistent with the findings of Gonzalez-Laguna et al. (2026), where teachers perceived ICT as a foundation for improving the pedagogical process through technology integration. A statistically significant difference was confirmed with respect to the type of institution ($t = -3.246$; $p = 0.001$), indicating that respondents employed at higher schools valued the contribution of ICT more highly than those working at faculties.

On the UCP scale, MS Office programs (Word, Excel, PowerPoint) were most frequently used. Soomro et al. (2020) similarly note that teachers across various educational contexts more commonly use basic office and presentation tools, while more complex technologies demonstrate slower adoption due to pedagogical and infrastructural factors. No statistically significant differences were identified in relation to gender, age, type of institution, or length of service.

Correlation analysis revealed a weak positive relationship ($\rho = 0.182$; $p = 0.025$) between age and teaching format. Younger respondents (24–35) predominantly apply modernized traditional teaching formats (69.2%), while respondents over 36 years (65%) most frequently use ICT in teaching. Negative correlations were identified between age and "curricula and ICT" ($\rho = -0.164$; $p = 0.044$), as well as between age and Wi-Fi usage ($\rho = -0.147$; $p = 0.046$), suggesting that younger staff perceive technical aspects of ICT more positively. These findings align with Peng et al. (2023), who report stronger digital competencies among younger teachers. As expected, very strong

statistically significant correlations were confirmed between age and academic rank (ρ = 0.653; p = 0.000), as well as age and length of service (ρ = 0.748; p = 0.000).

A weak positive correlation (ρ = -0.196; p = 0.016) was found between length of service and type of higher education institution, with longer-serving staff predominantly employed at faculties. A statistically significant negative relationship (p = 0.005) was identified between type of institution and the functioning of the online student service, indicating perceptual differences between faculties and higher schools. Positive relationships were also found between ICT contribution and student motivation (ρ = 0.218; p = 0.007), student participation (ρ = 0.235; p = 0.004), and improved knowledge acquisition (ρ = 0.267; p = 0.001), consistent with Marković Blagojević et al. (2021).

Statistically significant correlations were identified between academic rank and perceived teaching quality (ρ = -0.187; p = 0.032), as well as between academic rank and the use of distance learning programs (ρ = -0.234; p = 0.004). Assistants and junior staff more frequently use distance learning tools compared to full professors, supporting Idowu's (2025) assertion that teachers' attitudes and professional competencies influence the intensity and quality of ICT integration.

Very strong statistically significant relationships (p = 0.000) were confirmed between scientific field and teaching format (ρ = 0.353), system of instruction (ρ = 0.284), ICT implementation (ρ = -0.318), and teaching quality (ρ = -0.355). These findings suggest that disciplinary context influences instructional organization and perceptions of teaching quality. Mercader and Gairín (2020) similarly emphasize that academic discipline affects perceived barriers and ICT integration levels.

Furthermore, teaching format was positively associated with curricula and ICT alignment (ρ = 0.317; p = 0.000), teaching quality (ρ = 0.294; p = 0.000), student participation (ρ = 0.190; p = 0.019), and improved knowledge acquisition (ρ = 0.292; p = 0.000). Although moderate associations were observed, there remains space for further strengthening ICT integration, particularly in enhancing student engagement and teaching quality.

The system of ICT implementation showed a negative moderate correlation with curricula and ICT alignment (p = 0.024), indicating that institutional infrastructure influences perceptions of curricular alignment. The functioning of the online student service was moderately positively correlated with website performance (ρ = 0.538; p = 0.000), e-mail efficiency (ρ = 0.379; p = 0.000), and teaching quality (ρ = 0.267; p = 0.001). Additionally, e-mail efficiency was positively associated with teaching quality (ρ = 0.314; p = 0.000), student motivation (ρ = 0.192; p = 0.018), and improved knowledge acquisition (ρ = 0.285; p = 0.023).

Overall, the findings confirm that ICT plays an integral role in the structure and enhancement of the teaching process, particularly in supporting interactive methods and improving learning outcomes. The results highlight the importance of contextual factors—such as instructional organization and digital infrastructure—in maximizing the effectiveness of ICT implementation in higher education institutions, emphasizing the need for systematic and strategic integration of ICT into curricula and professional development programs.

5. Conclusion

The research conducted for the purposes of this study confirms the significant role of ICT in contemporary higher education. The applied research methodology enabled the identification of factors influencing the dynamics of IT tool usage, as well as their impact on the teaching process and the perception of teaching quality by academic staff. The results indicate that the specific characteristics of the scientific field, academic rank, length of service, and type of higher education institution represent key determinants of the way teaching methods and information and communication technologies are implemented. These factors shape the selection of instructional

strategies and the degree of alignment between curricula and contemporary digital opportunities, highlighting the importance of contextual and institutional variables in pedagogical practice.

The implementation and increased use of innovations related to modern technologies contribute to teaching quality, improved knowledge acquisition, and more active student participation. However, the research findings suggest that there is still room for enhancing the integration of contemporary technologies into the teaching process. Respondents with longer professional experience demonstrated a tendency to use more advanced teaching formats and digital tools, while younger categories of teachers more frequently applied modernized traditional methods. Similarly, teachers at faculties and higher schools evaluate the effectiveness of ICT implementation differently, indicating the need to adapt curricula and professional development programs to institutional specificities and teachers' needs.

The findings further confirm that the alignment of curricula with innovative technologies, as well as the technical equipment of higher education institutions, directly influences teachers' perceptions of instructional effectiveness. The use of digital tools shows positive effects on teaching quality, student motivation, and active participation; however, it also reveals a certain gap between proposed and implemented curricula. This underscores the need for systematic improvement of curricula and continuous professional development of teachers in the field of digital competencies and instructional methodologies.

In conclusion, the integration of information and communication technologies into higher education represents an essential prerequisite for the development of high-quality instruction aligned with the demands of the digital era. Targeted implementation of technology, combined with tailored professional development and strategic curriculum enhancement, enables the promotion of active student engagement, improved learning outcomes, and the construction of a sustainable higher education model responsive to the challenges of a knowledge- and innovation-based society. Therefore, the results of this study provide a foundation for recommendations aimed at the systemic improvement of the teaching process, the application of innovative methods, and the effective integration of ICT across all scientific disciplines.

References

Aivazidi, M., & Michalakelis, C. (2023). Information and communication technologies in primary education: Teachers' perceptions in Greece. Informatics, 10(3), 57. https://doi.org/10.3390/informatics10030057

Alam, M. (2016). Use of ICT in higher education. The International Journal of Indian Psychology, 3(4), 162–171. https://doi.org/10.25215/0304.208

Alférez-Pastor, M., Collado-Soler, R., Lérida-Ayala, V., Manzano-León, A., Aguilar-Parra, J. M., & Trigueros, R. (2023). Training digital competencies in future primary school teachers: A systematic review. Education Sciences, 13(5), 461. https://doi.org/10.3390/educsci13050461

Boholano, H. B., Cajes, R. C., & Boholano, G. S. (2021). Technology-based teaching and learning in junior high school. Research in Pedagogy, 11(1), 98–107. https://doi.org/10.5937/istrped2101098b

Caena, F., & Redecker, C. (2019). Aligning teacher competence frameworks to 21st century challenges: The case for the European Digital Competence Framework for Educators (DigCompEdu). European Journal of Education, 54(1), 356–369. https://doi.org/10.1111/ejed.12345

Carnoy, M. (2004). ICT in education: Possibilities and challenges. Inaugural lecture of the UOC 2004–2005 academic year. UOC.

Dintoe, S. S. (2018). Information and communication technology use in higher education: Perspectives from faculty. International Journal of Education and Development Using Information and Communication Technology, 14(2), 121–166.

Farooq, A., & Shamim, P. (2025). Impact of ICT tools on teaching–learning effectiveness in higher education. International Journal for Modern Trends in Science and Technology, 11(11), 49–55. https://doi.org/10.5281/zenodo.17796330

Farrukh, S., & Pal Singh, S. (2014). Teachers' attitude towards use of ICT in technical and non-technical institutes. Journal of Educational and Social Research, 4(7), 153–160. https://doi.org/10.5901/jesr.2014.v4n7p153

García-Valcárcel, A., & Tejedor, F. J. (2009). Information and communication technologies in university teaching: Implications in the European higher education space. Journal of Human Sciences, 6(2), 683–696.

Global Entrepreneurship Research Association. (2023). GEM 2023/2024 global report: 25 years and growing.

González-Laguna, M. V., López, P., Valenzuela, Á., Alves, R., Rodríguez, C., & Fidalgo, R. (2026). Teaching factors influencing ICT use in writing instruction. Education Sciences, 16(1), Article 68. https://doi.org/10.3390/educsci16010068

Gupta, P. (2024). Role of ICT in higher education. International Journal of Creative Research Thoughts, 12(5), 88–95.

Idowu, E. (2025). The impact of ICT on teaching and learning in higher education institutions. Preprints, 2025041600. https://doi.org/10.20944/preprints202504.1600.v1

Kent, N., & Facer, K. (2004). Different worlds? A comparison of young people's home and school ICT use. Journal of Computer Assisted Learning, 20(6), 440–455. https://doi.org/10.1111/j.1365-2729.2004.00102.x

Kirkwood, A., & Price, L. (2014). Technology-enhanced learning and teaching in higher education: What is "enhanced" and how do we know? A critical literature review. Learning, Media and Technology, 39(1), 6–36. https://doi.org/10.1080/17439884.2013.770404

Lim, C. P., Zhao, Y., Tondeur, J., Chai, C. S., & Tsai, C. C. (2013). Bridging the gap: Technology trends and use of technology in schools. Educational Technology & Society, 16(2), 59–68.

Mandić, D., Miščević, G., & Ristić, M. (2025a). Teachers' perspectives on the use of interactive educational avatars: Insights from non-formal training contexts. Research in Pedagogy, 15(1), 115–124. https://doi.org/10.5937/IstrPed2501115M

Mandić, D., Miščević, G., Starljaš, G., Bujišić, Lj., & Petrović, I. (2025b). Developing teachers' digital competencies for the application of artificial intelligence in education: An analysis of reflective practice and experiential learning. Research in Pedagogy, 15(3), 395–407. https://doi.org/10.5937/IstrPed2502395M

Marković Blagojević, M., Medić, Z., Cogoljević, M., & Milićević, R. (2021). Information and communications technologies and multimedia content as motivational factors for new generations of students. Serbian Journal of Management, 16(1), 85–101. https://doi.org/10.5937/sjm16-26433

Mercader, C., & Gairín, J. (2020). University teachers' perception of barriers to the use of digital technologies: The importance of the academic discipline. International Journal of Educational Technology in Higher Education, 17, Article 4. https://doi.org/10.1186/s41239-020-0182-x

Milanović, A., & Maksimović, J. (2025). Digital competencies in the reflective practice of teachers. Research in Pedagogy, 15(2), 275–290. https://doi.org/10.5937/IstrPed2502275M

Milošević, D., Blagojević, D., & Božović, M. (2011). Primena savremenih informaciono-komunikacionih tehnologija u nastavi medicine. In M. Danilović (Ed.), Simpozijum Tehnologija, informatika i obrazovanje – za društvo učenja i znanja (pp. 599–606). Tehnički fakultet.

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. Teachers College Record, 108(6), 1017–1054. https://doi.org/10.1111/j.1467-9620.2006.00684.x

Nakaznyi, M., Sorokina, L., & Roma, M. (2015). ICT in higher education teaching: Advantages, problems and motives. International Journal of Research in E-Learning, 1(1), 49–61.

Novković Cvetković, B., Arsić, Z., & Cenić, D. (2022). Attitudes of teachers to using information and communication technology in teaching – Advantages and obstacles. International Journal of Cognitive Research in Science, Engineering and Education, 10(2), 69–76. https://doi.org/10.23947/2334-8496-2022-10-2-69-76

Obeng, P., Atieku, J. N., & Segbefia, S. K. (2025). Influence of teacher perceptions, attitudes, and policy on ICT integration in basic schools in Ho Municipality, Ghana. Journal of Education, 8(2), 15–30. https://doi.org/10.53819/81018102t4357

Peng, R., Razak, R. A., & Halili, S. H. (2023). Investigating the factors affecting ICT integration of in-service teachers in Henan Province, China: Structural equation modeling. Humanities and Social Sciences Communications, 10, Article 380. https://doi.org/10.1057/s41599-023-01871-z

Siemens, G. (2005). Connectivism: A learning theory for the digital age. International Journal of Instructional Technology and Distance Learning, 2(1).

Soomro, K. A., Kale, U., & Curtis, R. (2020). Digital divide among higher education faculty. International Journal of Educational Technology in Higher Education, 17, Article 21. https://doi.org/10.1186/s41239-020-0191-5

Tecnia Institute of Advanced Studies. (2021). Pedagogy – Different methods and techniques of teaching (Ref. No. TIAS/IQAC/2021-22/115). Internal Quality Assessment Cell.

Tondeur, J., van Braak, J., & Valcke, M. (2007). Curricula and the use of ICT in education: Two worlds apart? British Journal of Educational Technology, 38(6), 962–976. https://doi.org/10.1111/j.1467-8535.2006.00680.x

Tulinayo, F., Ssentume, P., & Najjuma, R. (2018). Digital technologies in resource constrained higher institutions of learning: A study on students' acceptance and usability. International Journal of Educational Technology in Higher Education, 15, 36. https://doi.org/10.1186/s41239-018-0117-y

Yang, C., Guo, R., & Cui, Y. (2023). What affects vocational teachers' acceptance and use of ICT in teaching? Behavioral Sciences, 13(1), 77. https://doi.org/10.3390/bs13010077

Zimmerman, B. J. (2002). Becoming a self-regulated learner: An overview. Theory Into Practice, 41(2), 64–70. https://doi.org/10.1207/s15430421tip4102_2

Пешикан, А. (2016). Најчешће заблуде о информационо-комуникационим технологијама у образовању. Настава и васпитање, 65(1), 31–46. https://doi.org/10.5937/nasvas1601031P

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