RedFame

Journal of Education and Training Studies
Vol. 14, No. 1; January 2026
ISSN 2324-805X E-ISSN 2324-8068
Published by Redfame Publishing
URL: http://jets.redfame.com

The Application of Digital Technology Solutions and Their Impact on Learning Effectiveness: A Pedagogical Challenge

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Received: November 4, 2025 Accepted: December 15, 2025 Online Published: December 17, 2025

doi:10.11114/jets.v14i1.8139 URL: https://doi.org/10.11114/jets.v14i1.8139

Abstract

The integration of digital technologies in education is widely recognized as a pedagogical necessity, yet teachers' readiness and perceptions remain critical in shaping their effective use. This research paper aims to understand teachers' perceptions of learning technology and the challenges they encounter in applying it to the classroom. A quantitative, cross-sectional survey was conducted with 96 teachers in Kosovo, using adapted instruments from Horn et al. (1998) and Edison and Geissler (2003). Data were collected through a six-item online questionnaire measured on a four-point Likert scale and analyzed using independent-samples t-tests, ANOVA, and descriptive statistics.

The findings reveal that gender does not significantly influence teachers' comfort with learning new technologies or their satisfaction with technological skills. However, age-related differences were evident: teachers aged 41–49 reported the highest competence and motivation, whereas those aged 55 and above demonstrated lower confidence and readiness. Furthermore, teachers with master's degrees expressed greater confidence in integrating digital tools compared to those with only bachelor's qualifications.

These results underscore the importance of differentiated professional development, particularly targeted at older teachers, to build confidence and reduce technology-related anxiety. By highlighting the intersections of age, education, and technological readiness, the study contributes to the understanding of how contextual factors influence digital transformation in education.

Keywords: teachers, learning, perception, readiness, digital technology

1. Introduction

We reside in a time of colossal technological development, enabling us to have remote electronic connections. Technology in education is more integrated than it used to be time before (Joshi, 2023). The abrupt blooming of technology is present in every corner, even if we as human detest it or not, we are exposed to it. We are not talking about a new phenomenon. Technology is now perennial in people's lives (Okojie et al., 2006), and it is kindly changing human relationships and increasing productivity (Foina, 2024) and well-being (Hosseini & Kinnunen, 2021). This issue reveals that the technology functioning simply as a supporting tool, like an inevitable development that can, of course, be used to provide cognitive benefits. According to a research study conducted by Cabahug et al. (2024), digital technology impacts cognition, including memory, problem-solving, and social-emotional development. When a teacher designs a class that thoughtfully integrates technology into the curriculum, children can also experience social-emotional development benefits (Holt, 2015). Meanwhile, according to Courtville (2011), technology is also considered as a tool that facilitates the social aspect of children's development but also has an impact on cognitive and constructivist methods. In this case, it is about the computerized cognition, which means that children will be cognitive treated through technology (Westwood et al., 2023). It is related with inhibition, interference inhibition and sustainability attention (Banaschewki et al., 2018). Thus, it is related to cognitive flexibility on one side and decision-making (OECD, 2019). The efficient use of technology is another focus, meaning that the correct instructions from teachers during children's use of technology. In this context, the teacher provides guidance and support to students in utilizing the instructional materials and applying the relevant technological resources. If the use of technology is excessive, it is harmful to children (Tihah et al., 2024), including metal health problems (Ricci et al., 2022), and poor relationship with others (Silva, 2025). The situation may worsen, when the content does not suit the age of the children (Vedechkina & Borgonovi, 2021), and it is not controlled from the adults (Courage & Troseth, 2021). While discussing the technology in the pedagogical aspect, teachers have an unavoidable responsibility. Teachers can use technology for various pedagogical issues. However, the idea is to use technology to enhance children's

development (La Fleur & Dlamini, 2022). On the other hand, children's engagement with technology may commence at a very early age, even during early childhood. Consequently, assessing its impact and observing how it manifests in children throughout their school years can be challenging. Psychologists claim that early childhood plays a pivotal role in the later formation of the individual personality, which implies the great importance that should be given to children in their early childhood. Teachers should embrace the technology integration trend and determine the purposes of teaching innovatively in that form so that the technology can be flexibly integrated as a teaching resource (Mata & Clipa, 2021). Psychologists claim that early childhood plays a pivotal role in the later formation of the individual personality, which implies the great importance that should be given to children in their early childhood. Early childhood education should be more attentive to personality and human development aspects (Bissoli, 2014) without excluding individuality and trait complexity (Shiner & Masten, 2008). Based on the provided facts, we can say that teachers(Monteiro et al., 2022), educators (Fitzpatrick et al., 2023), and parents (Kamal et al., 2025) should to be mindfulwith their approach toward children. Since early learning has an impact on children's lives in the future, what about technology? Therefore, at this point, it is always how that technology will be used and whether there is a disconnection between those two variables in educational achievements (Hatzigianni, 2018).

Teaching and learning are complex processes requiring structured integration of technology. Through technology, students can enhance knowledge, improve skills, and resolve a systematic chanllenges, of course, by being supported from the teachers (Msambwa et al., 2024). The idea of this discussion is to integrate technology effectively, to adopt learning methods, and the nature of teaching subjects or lessons with technology integration. Certainly, the way of realization and integration of technology has a vast role here: Tallent-Runnels et al. (2006), the quality of digital teaching plays a crucial role in student success, unsurprisingly students enrolled in well-structured and thoughtfully implemented online courses achieve remarkably better learning outcomes than those in poorly designed courses. On the other hand, Edip et al. (2021) emphasize that while using technology, the teacher's focus should be on problem-solving, collaborative, and practical activities to measure and evaluate learning in the technology area. Furthermore, creating an environment conducive to research or learning new things takes us to an advantageous dimension for children. At the moment when the teacher sees it reasonable to involve technology in the learning process, one must be well prepared and have coherence within the learning task, the child can have cognitive benefits from technology. Also, in those technology designs, cognition is usually the target (Mayer & Moreno, 2003). Meanwhile, technology can enhance children's learning in different subjects (Aktas, 2022).

This research paper aims to understand teacher's perceptions about learning technology and the challenges teachers face while learning technology and applying it in the learning process. While the objective of the research paper are:To examine teachers' perceptions of technology integration in classrooms; To analyze differences in perceptions based on gender and age, To assess teachers' satisfaction with their technological skills

2. Literature review

2.1 Curriculum and Technology

The integration of digital technology into curricula has been widely recognized as an essential component of 21st-century education. Teachers work under particular curriculum and materials that facilitate the learning process with children. However, about the methodologies in the learning process, they are free to decide and operate. Moreover, teachers are free to organize the comprehension of educational activities based on children's needs and necessaries and in the proper place and environment (Law No. 04/L-032 on Pre-university education in the Republic of Kosovo, Republic of Kosovo, 2011). Involving technology in the teaching curriculum is not a replacement but a new manner to learn (Chan, 2020). When adopting new methodologies, it is worth implementing different learning ways and involving emotional and motivational aspects of the child, and not focusing only on the cognitive domain. It is a kind of multimedia involvement, findings from the realm of a cognitive theory of multimedia under ecologically valid circumstances (Zumbach et al., 2008). But, always consider the 'student-centered' methodology and the inclusion of all children regardless of their cognitive, social, emotional, or physical development, adaptive e-learning features help to understand. Technology and student-centered are supportive ways for students to make them learn actively and as per their decisions (Samaranayake, 2022). The responsibility of a teacher can become particularly demanding when instructional practices lack of coherence. The teacher should be a guide, an instructor, a helper, and an organizer, but never be the center of attention during the implementation of the activity by children. One is also the knowledge assessor and evaluator (Hubalovska, 2015).

Curriculum design plays a central role in this integration. Teachers are responsible for aligning digital tools with established learning objectives and adapting materials to suit the diverse needs of students (Republic of Kosovo, 2011). However, all those tasks require an organizing form, the teachers should be working following Bloom's taxonomy Bloom's theory is fundamental because it focuses on the cognitive domain and provides a structured framework that categorizes both intellectual skills and observable learning behaviors(Momen et al., 2022). Bloom's Taxonomy, long used

as a framework for categorizing educational goals, has been extended into Bloom's Digital Taxonomy to address skills required in technology-enhanced learning environments (Churches, 2008). This taxonomy emphasizes creativity, critical thinking, and collaboration, framing digital tools as vehicles for higher-order learning rather than as ends in themselves. In the study research of Husain (2021), the combination of Benjamin Bloom's cognitive taxonomy and Andrew Church Digital Bloom's Taxonomy will have a productive impact on children's development, but children need to have already created some abilities. It is still about critical thinking based on digital taxonomy and authentic materials (Lidawan & Shlowiy, 2020). Overall, creative technology for education should have adaptive elements (Hubalovsky et al., 2019).

2.2 Digital Transformation in Education

Education systems, respectively, schools, are also involved in this trend of technological changes. This pragmatic revolution in the field of education. The idea is to shift teaching and learning methods and, in this way, all the changes that come with this digitalization process to be embraced in an enterprising way (Tai & Son, 2023). Accordingly, combining existing experiences and innovations in digital technology brings a developed education condition (Zizikova et al., 2023). This transformation is about empowering the learning and teaching process. In this context, transformation or integration of technology should be well-structured and constructive. Because of technological involvement, there can be an inclusive learning environment that supports the creation of potential dynamics and enhances students' learning process (Joseph et al., 2024).

The responsibilities of teachers must take precedence when integrating technology. Training and capacity-building workshops are indispensable in digital education processes. (OECD-Education International, 2023). The Technological Pedagogical Content Knowledge (TPACK) model (Mishra & Koehler, 2006) provides a widely accepted framework for guiding this integration. It argues that effective technology use requires teachers to balance three domains of expertise: content knowledge, pedagogical knowledge, and technological knowledge. Successful teaching, therefore, depends not only on access to digital tools but also on teachers' ability to merge them coherently into instructional practice. In other words, teachers need to attend training to develop strong digital competencies (Fox & Jones, 2018).

The innovations should be under the necessary pedagogical shift and supporting teachers in those integrations (Mthembu et al., 2023). With the teacher's directions, children can use technology for various learning concepts and benefit immensely from distinct schemes. The use of technology consists of building new knowledge, practicing, learning, promoting learning, taking feedback, collaborating on learning, and so on (Clark & Mayer, 2023). Students can use technology for homework or project-building and technology integration to understand clashing science phenomena (Oliveira & de Souza, 2021). The scope is to enhance pedagogical practices for a sustainable learning process for students. (Akram et al., 2021).

2.3 Teachers' Roles and Perceptions

Teachers' perceptions and attitudes toward technology are crucial determinants of its successful integration. Studies suggest that teachers with positive attitudes toward digital tools are more likely to adopt them meaningfully in their classrooms (Akram et al., 2022; Giannoutsou et al., 2024). According to Giannoutsou et al.(2024), the impact of involving technology is found in teachers who have more work experience. Akram et al. (2022) found that teachers believe integrating technology supports their teaching process and, when used effectively, can motivate students and foster a more interactive learning environment

Technology-based teaching and learning are the foundation for raising the quality of teaching (Feyisa et al., 2024). The quality can be conserved through teachers and teaching capacity building. Hence, curriculum and learning strategies reviewed by teachers to integrate technology and not discount them is a necessary procedure (Mundy et al., 2012). One of the potential barriers is the discipline of humanities and arts (Mercader & Gairin, 2020) meanwhile including artificial intelligence in STEAM has resulted in positive scaffolding (Kim & Kim, 2022), or to use of technology as a tool to improve children who have difficulties with reading and writing, which had a positive impact on students' development (Falth & Selenius, 2022). On the other hand, regarding barriers, Stenbom and Geijer (2024) found that digitalization could at times push teachers into more interdisciplinary roles that emphasize social connections.

3. Method

This is a Cross-sectional quantitative survey research. In this research, two questionnaires are utilized, a fusion of those two questionnaires: Horn et al. (1998). Maslach Burnout Inventory: The Dutch Educators Survey, Psychometric evaluations; and Edison et al., (2003). Measuring attitudes towards general technology: Antecedents, hypotheses and scale development. The adapted questionnaires weresubjected to a reliability and validity analysis to ensure its appropriateness for the present study. Internal consistency was examined using Cronbach's alpha, which demonstrated satisfactory reliability for all subscales ($\alpha = .78$, and $\alpha = .85$).

An online survey consisting of six items assesses teachers' perceptions of the degree to which technologies enable them to motivate, evaluate students, manage classrooms effectively, guide parents in assisting their children's learning, and perceptions of their technological skills and ability to expand these skills. Because the study focuses on teachers' use of technology, I chose to distribute the questionnaire online. The completion of the questionnaire by the teachers also served as an indicator of the age of the teachers who generally use technology.

The items in the questionnaire were depicted on a four-point Likert scale, ranging from 1-completely disagree to 4-completely agree. The instrument was delivered online to teacher groups on various social media platforms. Table 1 presents the demographic data for all the participants in this research. Based on the nature of the research, it was necessary to have different age groups of the participants as they correspond to the experience of the teachers. On the other hand, Table 1 also shows the level of education of the participants and the location of the school. The final sample collects 96 teachers, 73 female teachers (76%) and 23 male teachers (24%).

Table 1. Demographic details of the sample

	N	%		N	%
Gender			Age distribution		
Female	73	76	23-30	30	31
Male	23	24	31-40	33	34
			41-49	24	25
Teaching experience			50-55	5	5
0-1 year	12	12	56-65	4	4
2-5 years	21	22			
6-10 years	20	21	Education level		
11-19 years	28	29	BA in Education	58	60
More than 20 years	15	15	MA	35	36
			Other	3	4
School location					
Urban	43	44			
Rural	53	55			

i. Research question

The statistical analysis of these results was done depending on Anova, T-test, and descriptive statistics.

This research conceives on these questions:

- Do teachers experience difficulties or technological challenges during the teaching process, and are these influenced by gender?
- To what extent do teachers feel comfortable using technology in their work?
- How satisfied are teachers with the technological skills they apply in their teaching practice?

ii. Ethical aspect

Ethics were respected in this research, as the participants were informed at the beginning of the questionnaire about its duration, what it measures, and its purpose. Participants provided informed consent, anonymity guaranteed. Likewise, the data collected in this research are kept confidential and anonymous. As a researcher, I affirm that the data of this research will not be resorted for other research and that all the data obtained from the questionnaire will be submitted as they were received, without any distortion or change in their meaning and content.

iii. Research limitation

Considering that this research is directly related to today's reality and knowing that the integration of teaching technology is a desideratum, we can affirm that the number of participants was small since they had to fulfill the questionnaires online. While the study provides valuable insights into teachers' perceptions of technology integration, its generalizability is limited by the relatively small sample size (n = 96) and its focus on a single national context. Nevertheless, the findings are transferable to similar education systems in Southeastern Europe where technological adoption faces comparable infrastructural and pedagogical challenges. Expanding the research with larger, more diverse samples in future studies would improve the robustness and generalizability of the conclusions.

4. Results

Related to the first research question, about how teachers deal with difficulties or technological problems, based on the t-

test, we may conclude that there are significant differences between female teachers and male teachers, t(96)=-.873, p<.06. When we make another analysis based on mean and standard deviation, we may find some differences between these two groups. Female teachers (M=3.2, SD=.62) report a lower level of competencies compared to male teachers (M=3.45, SD=.57). Table 2 presents the descriptive distribution of questions for dealing with difficulties or technological problems.

Table 2. Dealing with technological problems

		Frequency	Percent
Valid	Strongly disagree	1	1.0
	Disagree	6	6.3
	Agree	57	59.4
	Strongly disagree	32	33.3
	Total	96	100.0

Whether the teachers feel comfortable when they are learning technology, we found no gender-based significant differences t (96) =-1.450, p<.06. On the other side, male teachers (M=3.65, SD=.48) have shown that they feel more comfortable when they are learning technology compare to female teachers (M=3.45, SD=.60).

The last research question is the teacher's satisfaction with the technological skills they are applying in the teaching process, which has resulted in no significant t (96) =.359, p<.5. However, female teachers have shown a tiny higher competence (M=3.19, SD=.71) compared to male teachers (M=3.13, SD=.69).

There are no significant differences between genders in their perception of the easiness of learning technological solutions t (94) =1.08, p<.05. However, female teachers (M=3.17, SD=.65) have shown a higher self-confidentiality compared to male teachers (M=3, SD=.79). Based on variance calculation, there are significant differences between groups of teachers in their perceptions of the easiness of learning technology solutions F (4, 91) = 2.49, p<.05. In terms of group differences, it is evident that the oldest age group 56-65 report the lowest confidence in learning new technologies (M=2.25, SD=.50).

There are significant differences between male and female teachers in their perceptions towards the development of a class management system based on each student group t (94) =1.98, p<.04, specifically female teachers (M=3.54, SD=.60) report higher levels of competencies compared to male teachers (M=3.26, SD=.61).

There are no significant differences between genders in their perceptions of motivation strategies for students t(94)=-.049, p>.05, it is influential to note that female teachers report lower abilities to motivate students (M=3.38, SD=.82)compared to male teachers who reported higher capacities (M=3.39, SD=.65). The differences here are petite, but when we take into consideration the number of women and men who participated in this research, we naturally understand that we are dealing with a substantive element that represents gender.

i. Teachers and age groups

An ANOVA test of variance was conducted to assess the differences in perceptions based on age groups, along with a Bonferroni post-hoc test of significance.

ANOVA test results reveal significant differences between groups in the perceptions of their ability to motivate low-interest students F (4,91) =3.33, p=.013. The all-age group teachers who were between 41 and 49 years old were the ones who reported higher competencies to motivate students compared to all other groups. In contracts, teachers between 55 and 65 years old reported the lowest level of perceptions compared to all other groups. Results of the Bonferroni post-hoc test reveal that teachers between the ages of 55 and 65 had significantly lower perceptions of their ability to motivate students compared to teachers aged 41 to 49 and 31 to 40 years old who reported higher abilities.

Based on the ANOVA test, teachers' perception of their ability to make students learn is significant, F(4,91)=3.34, p=.013. From all the teacher groups, based on age, 41-year-old teachers to 49 years old have shown a higher perception of their ability to make students learn, even the age of teachers with 23 to 30 years old self-perception as good ones. From all these groups, teachers aged 55-56 have shown the lowest perception of making students learn. Bonferroni's post-hoc test results reveal that teachers between the ages of 55 and 65 have shown lower perception regarding their ability to make students learn, compared to teachers aged 31-40 years old, 41-49 years old, and 50-55 who have resulted with higher ability to make students learn.

The teachers' perception of their ability to create a classroom management system with each group of students is not significant, since F (4,91) =1.56, p=.195, there are within-group differences since teachers aged 41-49 have shown the lowest self-ability (M=3.54, SD=.50) regarding, and teachers aged 55-65 have shown highest perception (M=2.75, SD=.50).

ANOVA test results reveal that there are no significant differences between groups in the perceptions of their ability to create a variety of assessment strategies F (4,91) =1.28, p=.282. However, for all age groups of teachers, there are reported higher differences between age group 50-55 with lower perception (M=3.80, SD=.81) and aged teachers 55-56 with higher perception (M=3.80, SD=.44).

Relating to the question, an alternative explanation can be given: as an example, when students are confused, there is not a significant result F (4,91) =2.28, p=.067, but there are differences within groups of teachers. Based on the results, the lowest perception about their ability to give explanations to students when they are confused have resulted in teachers of group age 41-49 (M=3.66, SD=.48), and the lowest ones are teachers of group age 55-65 (M=275, SD=.50).

The question arises about teachers' approach to helping families to assist their children improve in their studies, ANOVA test has not shown significant differences F (4,91) =.37, p=.82. Either way, there are identified differences within groups, and the teachers aged 23-30 have resulted with the highest approach (M=3.40, SD=.77), while teachers aged 55-56 have resulted with the lowest approach (M=3.00, SD=.81).

The ANOVA test reveals no significance between groups in the teacher's perception of how they deal with the implementation of alternative teaching strategies in the classroom F (4,91) =.32, p=.86. The found differences are shown within group age 50-55 with the highest perception (M=3.60, SD=.54), and age 55-65 with the lowest perception (M=3.25, SD=.95).

ANOVA test results are significant in the teacher's perception of their ability to deal with technological difficulties or problems F (4,91) =.95, p=.04. Teachers aged group 41-49 years old have reported the highest abilities (M=3.29, SD=.55) to deal with technical difficulties or problems. The teacher's group aged 55-56 years old reported the lowest ability (M=3.00, SD=.81) to deal with technical troubles or hurdles.

According to ANOVA test results, if teachers feel comfortable about learning new things in technology, has no significant results F (4,91) =.83, p=.50. Within the groups of teachers, teachers aged group 55-56 years old showed the lowest feeling (M=3.00, SD=.81), while teachers aged group 41-49 (M=3.54, SD=.50) years old have shown the highest feeling.

ANOVA test results show that there is a significant result about the teachers' perception of themselves finding technology easy to learn F (4,91) =2.46, p=.03. Whereas, there are differences within teachers' groups when teachers aged 55-56 have shown the lowest perception (M=2.25, SD=.50), while teachers aged 50-55 have shown the highest self-perception (M=3.40, SD=.54). Results of the Bonferroni posthoc test revealed that there are significant differences between teachers aged 55-65 with the lowest perception, compared to teachers aged 23-30 years old with the highest perception.

According to the raised question about teachers' feelings about their up-to-date on technology as the other colleagues, ANOVA test results are significant F (4,91) =3.24, p=.01. Nonetheless, there can detect differences between teachers aged group 55-65 years old (M=2.00, SD=.81), compare to teachers aged 50-55 who have resulted with the highest perception (M=3.40, SD=.54). Bonferroni post-hoc test has identified significant differences between teachers aged 55-56, compare to teachers aged 31-40, 41-49, and 50-55 years old.

ANOVA test results show that there is a remarkable result in the teachers' satisfaction with their skills and the technology they have to use F (4,91) =.86, p=.48. There are teachers' age group differences, teachers aged 55-65 have the lowest perception (M=2.75, SD=.50), while teachers aged 23-30 years old have the highest perception (M=3.30, SD=.83). All those data are in Table 3.

Table 3. General data as per raised questions

Age		N	M	Sd
I can motivate students who show low interest in learning				
	23-30	30	3.33	.75
	31-40	33	3.45	.66
	41-49	24	3.62	.72
	50-55	5	3.00	1.22
	56-65	4	2.25	.95
I can motivate students who show low interest in learning				
	23-30	30	3.56	.67
	31-40	33	3.66	.47
	41-49	24	3.50	.51
	50-55	5	4.00	0.00
	56-65	4	2.75	.50
I can do a lot to make students believe they can learn				
	23-30	30	3.56	.67
	31-40	33	3.66	.47
	41-49	24	3.50	.51
	50-55	5	4.00	.00
	56-65	4	2.75	.50
You can create a classroom management system with each group of students				
	23-30	30	3.50	.68
	31-40	33	3.51	.61
	41-49	24	3.54	.50
	50-55	5	3.50	.54
	56-65	4	2.75	.50
I can use a variety of assessment strategies				
	23-30	30	3.60	.67
	31-40	33	3.54	.50
	41-49	24	3.62	.44
	50-55	5	3.80	.44
	56-65	4	3	.81
I can give an alternative explanation or example when students are confused				
	23-30	30	3.53	.68
	31-40	33	3.54	.50
	41-49	24	3.66	.48
	50-55	5	3.60	.54
	56-65	4	2.75	.50
I can help families to help their children improve in their studies				
	23-30	30	3.40	.77
	31-40	33	3.30	.58
	41-49	24	3.29	.69
	50-55	5	3.20	.44
	56-65	4	3.00	.81
I can implement alternative teaching strategies in the class				
	23-30	30	3.56	.72
	31-40	33	3.54	.50
	41-49	24	3.45	.58
	50-55	5	3.60	.54
	56-65	4	3.25	.95
I know how to deal with technical difficulties or problems				
	23-30	30	3.30	.74
	31-40	33	3.27	.57
	41-49	24	3.29	.55
	50-55	5	3.00	.00
	56-65	4	2.75	.50
I feel comfortable learning new things in technology				
	23-30	30	3..53	.68
	31-40	33	3.48	.50
	41-49	24	3.54	.50
	50-55	5	3.60	.54
	56-65	4	3.00	.81
I find most technology easy to learn				
	23-30	30	3.30	.65
	31-40	33	3.09	.67
	41-49	24	3.08	.71
	50-55	5	3.40	.54
	56-65	4	2.25	.50
I feel as up-to-date on technology as my colleagues				
	23-30	30	2.93	.73
	31-40	33	3.03	.68
	41-49	24	3.16	.48
	50-55	5	3.40	.54
	56-65	4	2.00	.81
I am satisfied with my skills with the technology I have to use in teaching				
	23-30	30	3.30	.83
	31-40	33	3.06	.65
	41-49	24	3.25	.67
	50-55	5	3.20	.44
	56-65	4	2.75	.50

5. Discussion

The findings indicate that gender does not significantly influence teachers' comfort in learning new technologies or their satisfaction with technological skills. However, age was found to be a more influential factor, as older teachers reported lower confidence and satisfaction with technology compared to younger colleagues.

These results are consistent with prior studies emphasizing generational differences in technology adoption. For example, Adeoye (2023) found that male teachers demonstrated stronger digital literacy in STEM-related teaching, while Gomez-Trigueros and de Aldecoa (2021) highlighted a persistent digital gap in teacher education, often more pronounced among older teachers. In contrast, the present study suggests that female teachers expressed slightly greater openness to acquiring new technological skills, aligning with Wood's (2012) conclusion that women in education may be more receptive to innovation despite reporting lower self-efficacy.

Age emerged as a significant factor across several dimensions of technology use. Teachers in the 41–49 age group reported the highest confidence in motivating students and managing classrooms with digital tools, while those aged 55 and above consistently demonstrated lower confidence. This pattern suggests that professional maturity may enhance pedagogical application of technology to some extent, but beyond a certain age, technological resistance or anxiety becomes more pronounced. Similar findings were reported by Peng et al. (2023), who identified age and gender as key predictors of teachers' willingness to adopt new educational technologies.

The results also have implications for teacher training and professional development. Teachers with master's degrees showed greater confidence in integrating technology, which suggests that advanced education enhances both awareness and readiness for technological integration. This indicates that investment in professional qualifications and ongoing capacity-building can narrow gaps between groups. However, the findings also highlight the need for targeted programs that support older teachers in overcoming resistance, developing digital competencies, and fostering confidence in using technology as a pedagogical tool.

Taken together, the study underscores the importance of addressing both structural and psychological barriers to technology integration. While access to resources and institutional support are necessary, equally critical is the provision of tailored professional development that recognizes generational differences in technological readiness.

Beyond the substantive findings, this study contributes to the measurement of teachers' perceptions of digital technology by demonstrating the validity and reliability of an adapted instrument in the Kosovo context. The results suggest that the scale can be used to evaluate teachers' technological readiness across diverse educational systems, with particular sensitivity to age-related differences. For practitioners, the measurement implications include the possibility of employing this instrument for needs assessment in teacher training programs, monitoring changes over time, and conducting cross-national comparisons.

6. Conclusion

The results indicate that gender differences are minimal; however, age strongly influences perceptions of confidence, comfort, and satisfaction in applying technology to teaching. Younger teachers reported greater ease and satisfaction in using technology, while older teachers—particularly those aged 55 and above—demonstrated lower confidence and readiness.

These findings indicate that the integration of digital technologies into educational contexts should not be conceptualized as a uniform or universally applicable process.Policymakers and school administrators must consider generational differences and provide differentiated professional development opportunities. Programs designed for older teachers should prioritize building confidence, reducing technology-related anxiety, and demonstrating the pedagogical value of digital tools. At the same time, younger teachers may benefit from advanced training that moves beyond basic competencies toward innovative and student-centered applications of technology.

The study contributes to the growing body of research emphasizing the need for continuous teacher training and highlights the importance of aligning educational policies with the realities of diverse teaching populations. While limited by its small sample size and reliance on self-reported data, the research provides a valuable starting point for understanding how teachers in Kosovo perceive digital technologies in their professional practice. Future studies should expand the sample, employ mixed-method approaches, and compare findings across different educational systems to deepen understanding of the complex relationship between technology, pedagogy, and teacher readiness.

Acknowledgments

I would like to sincerely thank all participants who generously contributed their time and cooperation to this study. Their involvement was essential to the successful completion of the research.

Authors contributions

Not applicable.

Funding

No financial support was obtained for the conduct of this study.

Competing interests

The authors declare that there are no competing financial interests or personal relationships that could have influenced the work reported in this manuscript.

Informed consent

Obtained.

Ethics approval

The Publication Ethics Committee of the Redfame Publishing.

The journal's policies adhere to the Core Practices established by the Committee on Publication Ethics (COPE).

Provenance and peer review

Not commissioned; externally double-blind peer reviewed.

Data availability statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Data sharing statement

No additional data are available.

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