Journal of Educational Technology & Online Learning
Volume 6 | Issue 4 | 2023
http://dergipark.org.tr/jetol

The relationship between teachers' technology proficiencies and their levels of integrating technology into their lessons

Menekşe Eskici [a] *, Semih Çayak [b]

[a] Kırklareli University, Türkiye.
[b] Marmara University, Türkiye.

Suggested citation: Eskici, M. & Çayak, S. (2023). The relationship between teachers' technology proficiencies and their levels of integrating technology into their lessons. *Journal of Educational Technology & Online Learning*, 6(4), 808-821.

Highlights

- This research showed that teachers' technology proficiency levels and their levels of integrating technology into their lessons were high.
- This research emphasizes that teachers should have a certain level of technology proficiency in order to use technology effectively in the education process.
- This research highlights that as the education level of teachers increases, their technology proficiencies and their level of integrating technology into their lessons increase.

Article Info: Research Article

Keywords: *Educational technology, Technology integration, Technology proficiency, Teacher*

Abstract

This study examines the relationship between teachers' technology proficiencies and their level of integrating technology into their lessons. In this research, which was designed in a relational survey model, as data collection tools, the "Technology Proficiency Self-Assessment Scale for 21st Century Learning" developed by Christensen and Knezek and adapted to Turkish conditions by Fidan, Debbağ and Çukurbaşı (2020); and "Teachers' Technology Integration Indicators Scale" developed by Çakıroğlu, Gökoğlu and Çebi (2015) were used. The research sample consisted of 398 teachers working in public schools in Istanbul's Pendik and Tuzla districts. The findings showed that teachers' technology proficiencies and integration levels were high. In addition, teachers' technology proficiencies and ability to integrate technology into their lessons did not show statistically significant differences according to their gender, professional seniority and education level. However, the teachers' technology proficiency and the level of integrating technology into their lessons showed statistically significant differences according to their educational status. These differences in both variables were significantly higher for teachers with graduate education than those with undergraduate education. According to another finding from this research, there was a positive, high level and significant relationship between teachers' technology proficiency and their ability to integrate technology into their lessons. As a result of the regression analysis, it was seen that technological proficiency was a significant predictor of technology integration. Technological proficiency explains 53.9% of technology integration.

1. Introduction

In order to keep up with the needs of the age, the aims of education are also shaped according to the developments. In a period when the effects of technology are powerful, it is crucial to raise individuals who are compatible with technology. At this point, teachers' use of technology is also a remarkable issue. Therefore, with the development of technology, the proficiencies of the teacher in the educational process

* Corresponding author. Department of Educational Sciences, Atatürk Faculty of Education, Marmara University, Türkiye.
e-mail address: semihcayak@gmail.com
This study was partly presented as a proceeding at the 3rd International Conference on Educational Technology and Online Learning held between 20-23 June 2022.

Doi: http://doi.org/10.31681/jetol.1331971
Received 24 Jul 2023; Revised 12 Sep 2023; Accepted 18 Sep 2023
ISSN: 2618-6586.

also have also changed. Teachers must constantly keep their technological equipment fresh.to support their lessons with technology and provide their students with a more effective learning experience. When teacher proficiencies are questioned, two basic frameworks emerge, in this context. The first one is content knowledge, while the other is pedagogical knowledge (Demir & Bozkurt, 2011). As a matter of fact, it would not be wrong to say that after the 2000s, technopedegogical content knowledge, which can be defined as teachers' effective use of technology, was added to these skills. (Caluza, 2020; Lambot & Yango, 2023; Qurashi & Jan, 2022). Leema & Saleem (2017) underlined that teachers should be a technopedagogue in organizing classroom activities. The techno pedagogical skills of teachers are the most critical determinant for unlimited and easy access to education (Thakur, 2015). Based on these considerations, this study exmined the relationship between teachers' technology proficiencies and their level of integrating technology into their lessons.

2. Literature

2.1. Teachers' Technology Proficiencies

Teachers' proficiencies in using technology play a major role in making education easy and effective. In the study conducted by Zhu, Wang, Cai & Engels (2013), it has been concluded that teachers' educational competence, social competence and technological competence are related to their innovative teaching performance. The fact that the technology proficiencies of the teachers have such a great place in the success of the education process requires that attention should be paid to the technology proficiencies in the teacher training process (Elmalı & Balkan Kıyıcı, 2022). In the study conducted by Foulger, Graziano, Schmidt-Crawford, & Slykhuis (2017), it is emphasized that education should be made according to 12 criteria related to technology proficiencies in the teacher training process.

These 12 proficiencies are as follows:

1. Educators should design guidelines that use content-specific technologies to enhance teaching and learning.

2. Educators should include pedagogical approaches that prepare trainees to use technology effectively.

3. Educators should support the course content with technology.

4. Educators should use online tools to improve teaching.

5. Educators should use technology to differentiate teaching.

6. Educators should use appropriate technology tools for assessment.

7. Educators should use effective teaching strategies online and/or in blended/hybrid learning environments.

8. Educators should use technology to connect globally with diverse regions and cultures.

9. Educators should consider technology’s legal, ethical and socially responsible use in education.

10. Educators should engage in ongoing professional development and networking activities to improve technology integration into teaching.

11. Educators must lead to using technology.

12. Educators should apply basic troubleshooting skills to solve technology problems.

In the light of these proficiencies that should be considered in the teacher training process, there are also technology-related proficiencies that teachers should have. Using, managing and evaluating technology can be considered technology literate (Hasse, 2017). However, it is emphasized that technology literacy is not only about the ability to use digital tools and information effectively but also closely related to ensuring social participation and establishing effective cooperation using digital technologies and information

(Güngör & Atman Uslu, 2022; Kim, 2019). In order to increase the technology literacy of teachers and to enable them to better integrate technology into their lessons, teachers should be given qualified training (Bowman et al,, 2022).

Teachers who succeed in technology literacy make the best use of e-learning platforms in their lessons. Teachers can choose the most suitable e-learning platforms to meet different learning goals, teach students effectively, and actively manage learning activities (Ly et al., 2021). E-learning is a crucial practice worldwide encouraging lifelong learning by enabling students to learn anytime and anywhere (Aixia & Wang, 2011). Thus, it is inevitable that teachers should educate themselves on e-learning and incorporate technology into their lessons.

One of the crucial benefits of being proficient in technology for teachers is using instructional technologies and technology tools, such as web 2.0 tools, in their lessons (Chunyan et al., 2014). For example, augmented reality applications will greatly help in the realization of blended learning, where face-to-face and online education are combined with the contribution of technology (Asiri, 2022). High-level thinking skills that are aimed to be acquired by students are realized when students face the problems they may encounter in daily life. The way to combine the problems that students encounter daily with technology is to use augmented reality applications (Saphira & Prahani, 2022; Soutthaboualy et al., 2022). Augmented reality is a technology that provides the opportunity to make many innovations in the education process and its infrastructure is constantly renewed (Hanid, Said & Yahaya, 2020). In addition, using augmented reality in lessons has many advantages, such as increasing students' motivation and interest (Triansyah et, al., 2023). In this context, Raja & Priya (2021) underlines that the use of augmented reality and virtual reality applications in education is increasing daily. Such a situation is an indication that teachers should develop themselves to be able to use advanced technologies in their lessons.

2.2. Integration of Technology into Education

As in every field, it is witnessed that artificial intelligence ignites the fire of considerable changes in education (Sünger, Çankaya & Durak, 2022). In the educational process, beyond many activities using artificial intelligence in lessons, it is also possible to teach effective lessons to the extent that one takes lessons from a human (Roll & Wylie, 2016). In addition, artificial intelligence allows teaching to occur faster (Devedžić, 2004). Artificial intelligence applications, especially in creating innovative lesson systems for special education, creating a natural language processing environment for language education, developing educational robots, training data mining for performance prediction, and creating neural networks for instructional assessment, students are accustomed to making emotional calculations for detecting emotions (Chen et al., 2022).

Teachers who adapt digital tools and applications to their lessons also ensure that their preferred methods and techniques change (Haghshenas, 2019). For example, a teacher who uses robotic coding applications in his/her lessons contributes to his/her students' programming and creativity skills by designing (López-Belmonte, Segura-Robles, Moreno-Guerrero & Parra-González, 2021). For example, the use of robotic coding programs, such as Scratch, is a factor that improves students' thinking skills (Dúo-Terrón, 2023). On the other hand, teachers can design technology-supported educational games to enable students to learn while having fun.

Another factor that enables teachers to be competent in technology is their awareness of technology security (Chou & Peng, 2011). Cyberbullying takes its place as a severe problem in every environment where the internet is used. This problem also affects education (Eden et al.,2013).

2.3. The Relationship between Teachers' Technology Proficiencies and their Levels of Integrating Technology into their Lessons

The integration of technology into education is inevitable. In this case, it is inevitable for teachers to train themselves in using technology. It is a fact that the success of the courses where technology is used

successfully will increase. The importance of strengthening the technology proficiencies of teachers with pre-service and in-service training emerges at this point because inadequacies and mistakes in using technology may cause the quality of the educational outputs to be questioned. For example, one of the most common situations that enable teachers to be competent in technology is that teachers are conscious of technology security (Chou & Peng, 2011). As a matter of fact, negative situations such as cyberbullying take their place as a serious problem in the education sector, as in every environment where the internet is used (Eden, Heiman & Olenik-Shemesh, 2013). Based on these considerations, this study examined the relationship between teachers' technology proficiencies and their levels of integrating technology into their lessons. In line with this general purpose, answers to the following questions were sought in this study.

1. What are the teachers' technology proficiency levels?

2. What is the level of teachers' ability to integrate technology into their lessons?

3. Do the technology proficiency levels of the teachers show a significant difference according to the gender of the teachers, their professional seniority and the education level they work in?

4. Do teachers' levels of integrating technology into their lessons show a significant difference according to teachers' gender, professional seniority and education level?

5. Is a statistically significant relationship between teachers' technology proficiencies and their ability to integrate technology into their lessons?

3. Methodology

3.1. Research Model

This study, which examined the relationship between teachers' technology proficiencies and their levels of integrating technology into their lessons, was designed in the relational survey model, one of the quantitative research models. Survey models are research approaches that aim to describe a past or present situation as it exists (Karasar, 2010).

3.2. Data Collecting Tools

The data collection tool consisted of three parts. In the first part, there were questions to learn the personal information of the participants. In the second and third sections, there was the "Technology Proficiency Self-Assessment Scale for 21st Century Learning" developed by Christensen and Knezek and adapted to the conditions of Turkey by Fidan et al. (2020) and the "Teachers' Technology Integration Indicators Scale" developed by Çakıroğlu et al. (2015).

3.2.1. Technology Proficiency Self-Assessment Scale for 21st Century Learning

The Technology Proficiency Self-Assessment Scale in 21st Century Learning" was developed by Christensen and Knezek (2017) and adapted to Turkish conditions by Fidan, Debbağ and Çukurbaşı (2020). The total variance explained by the scale, which consists of 24 items and four sub-dimensions (e-mail, World Wide Web, Integrated Applications, and Teaching with Technology), was 68.98%. In addition, the results of confirmatory factor analysis revealed that the model showed a good fit (χ^2/sd = 4.12, $p < .01$; AGFI = .90, CFI = .91, TLI = .92, RMSEA = .05, SRMR = .06). The Cronbach's alpha (α) reliability coefficients for the sub-dimensions of the scale were .88 for the e-mail sub-dimension, .85 for the World Wide Web, .83 for Integrated Applications, and .79 for Teaching with Technology. The Cronbach's alpha (α) reliability coefficient for the overall scale was .81.

3.2.2. Teachers' Technology Integration Indicators Scale

"Teachers' Technology Integration Indicators Scale," which measures teachers' ability to integrate technology into their lessons, was developed by Çakıroğlu, Gökoğlu, and Çebi (2015). The total variance explained by the scale, which consists of 28 items and five sub-dimensions (Technology Literacy, Teaching

with Technology, Professional Development, Ethics and Policies, Organization and Management), was 62.50%.

The results of confirmatory factor analysis also revealed that the model showed a good fit (χ^2/df=2.10 p<.01; RMSEA= .06; GFI= .88; AGFI= .85; CFI=.98; NFI= .96; SRMR = .05). The Cronbach's alpha (α) reliability coefficients for the sub-dimensions of the scale were .84 for Technology Literacy, .83 for Teaching with Technology, .87 for Professional Development, .86 for Ethics and Policies, and .84 for Organization and Management. The Cronbach's alpha (α) reliability coefficient for the overall scale was .93.

3.3. Sampling

The research population in this study consisted of 9184 teachers working in public schools in Pendik (6398) and Tuzla (2786) districts of Istanbul in the 2022-2023 academic year. Yazıcıoğlu and Erdoğan (2004, p. 50) state that it is sufficient for the sample to represent the universe, which is in the range of 5000-10000 with a 5% error rate in the sampling table, to be in the range of 357-370. However, considering possible data losses, more data were collected. Three hundred ninety-eight teachers selected from the population using the simple random sampling method formed the study sample. The personal information of the sample group is presented in Table 1.

Table 1.

Frequency and Percentage Values of Personal Information

Variable	Groups	Frequency (f)	Percentile (%)
Gender	Female	282	71
	Male	116	29
	Total	398	100
Professional Seniority	0-5 years	75	19
	6-10 years	73	18
	11-15 years	98	25
	16-20 years	104	26
	21 years or more	48	12
	Total	398	100
Educational Level of Instruction	Primary school	105	26
	Secondary school	171	43
	High school	122	31
	Total	398	100
Education Level	Undergraduate degree	326	82
	Graduate degree	72	18
	Total	398	100

Table 1, shows 398 teachers in the sample group, 282 (71%) female and 116 (29%) male. Of the teachers participating in this research, 75 (19%) 0-5 years, 73 (18%) 6-10 years, 98 (25%) 11-15 years, 104 (26%) 16-20 years and 48 (12%) had 21 years or more of professional seniority. Of the teachers, 105 (26%) worked in primary schools, 171 (43%) in secondary schools and 122 (31%) in high schools. In addition, 326 (82%) participants had undergraduate and 72 (18%) graduate education degrees.

3.4. Procedures and Data Analysis

Necessary official permissions were obtained from the relevant institutions before collecting data from the teachers who constituted the sample of this study. Then, the data were collected by sending the link to the online form containing the data collection tools to the teachers who voluntarily participated in the research. The data from 398 scales filled by the participants using the link sent were included in the analysis. The

collected data were analyzed using the SPSS 25.0 program. Before starting the analysis, whether the collected data met the one-way and multi-way normality assumptions were examined. George and Mallery (2003) state that the data distribution meets the assumption of normality if the skewness and kurtosis coefficients are in the range of ±2. Based on this information, the skewness and kurtosis values of the data and Q-Q graphs were examined and e-mail (-.042 to .119), www (.167 to -.609), integrated applications (-.307 to -.315), teaching with technology. (.012 to -.474), technology proficiency (scale total score) (.196 to -.218), technology literacy (.023 to .298), teaching with technology (-.156 to -.298), professional development (-.209 to -.285), ethics and policies (-.107 to -.506), organization and management (-.633 to .271), and technology integration (total scale score) (-.393 to -3, 10) scores were within the normal distribution limits.

In the analyses, the significance of the difference between the means was tested at the .05 level. In the interpretation of arithmetic mean, the range of 1.00-1.79 was evaluated as "very low," the range of 1.80-2.59 as "low", the range of 2.60-3.39 as "medium," the range of 3.40-4.19 as "high" and the range of 4.20-5.00 as "very high." In the interpretation of the correlation analysis, the range of .00-.30 was accepted as "low," the range of .31-.70 as "medium" and the range of .71-1.00 as "high" relationship (Büyüköztürk, 2011). Descriptive statistics, correlation and regression analysis were used in the data analysis.

4. Findings

The arithmetic mean, standard deviation, and skewness and kurtosis values of the scales are presented in Table 2.

Table 2.

Arithmetic Mean, Standard Deviation and Skewness-Kurtosis Values regarding the Variables of the Study

Scales and Sub-Dimensions	x̄	Sd	Skewness	Kurtosis
1. e-mail	3,63	,64	-,04	,12
2. www	3,49	,77	,17	-,61
3. integrated applications	3,71	,72	-,31	-,32
4. teaching with technology	3,77	,62	,01	-,47
5. technology proficiency (scale total score)	3,66	,59	,20	-,22
6. technology literacy	3,68	,51	,02	,30
7. teaching with technology	3,59	,60	-,16	-,30
8. professional development	3,44	,72	-,21	-,29
9. ethics and policies	3,81	,53	-,11	-,51
10. organization and management	3,74	,66	-,63	,27
11. technology integration (total scale score)	3,65	,39	-,40	-,31

The findings showed that teachers' technology proficiency levels (scale total score) ($\bar{x}$=3.66) and technology integration levels (scale total score) ($\bar{x}$=3.65) were high. In addition, all sub-dimension scores of these two scales were high.

Comparison of Teachers' Technology Proficiency and Technology Integration Levels in terms of Demographic Variables

To determine whether the technology proficiency scale and technology integration scale scores of the teachers showed a significant difference according to the gender variable, an independent group t-test was conducted.

Table 3.

Independent Groups t-test Results according to Gender Variable

Score	Groups	n	$\bar{x}$	Sd	Se	*t* Test		
						t	**Df**	*p*
Technology proficiency	Female	282	3,66	,58	,04	-,30	396	.768
	Male	116	3,68	,63	,06			
Technology integration	Female	282	3,66	,38	,02	.45	396	.653
	Male	116	3,64	,42	,04			

As shown in Table 3, there was no significant difference between the groups' technology proficiency (t= -.30; P>.05) and technology integration (t= .45; P>.05) scores according to the gender variable.

One-way analysis of variance (ANOVA) was conducted to determine whether the technology proficiency scale and technology integration scale scores of the teachers constituting the sample group showed a significant difference according to the variable of professional seniority.

Table 4.

One-way Analysis of Variance (ANOVA) Results according to the Variable of Professional Seniority

Score	Groups	n	$\bar{x}$	Sd	Source of Variation	SS	Df	MS	F	p
Technology proficiency	0-5 years	75	3,65	,55	Between Groups	2,910	4	.727	2.095	,081
	6-10 years	73	3,52	,61	Within Groups	136.499	393	,347		
	11-15 years	98	3,63	,56	Total	136.409	397			
	16-20 years	104	3,77	,62						
	21 years or more	48	3,74	,61						
	Total	398	3,66	,59						
Technology integration	0-5 years	75	3,66	,44	Between Groups	1.330	4	.332	2.184	.070
	6-10 years	73	3,54	,40	Within Groups	59.824	393	,152		
	11-15 years	98	3,65	,33	Total	61.154	397			
	16-20 years	104	3,71	,38						
	21 years or more	48	3,70	,45						
	Total	398	3,65	,39						

As shown in Table 4, there was no significant difference between the groups' technology proficiency (F= 2.095; p>.05) and technology integration (F= 2.184; p>.05) scores according to the variable of professional seniority.

Table 5.

One-way Analysis of Variance (ANOVA) Results according to the Education Level Variable

Score	Groups	n	$\bar{x}$	Sd	Source of Variation	SS	Df	MS	F	p
Technology proficiency	Primary school	105	3,58	,55	Between Groups	1.048	2	.524	1.496	,225
	Secondary school	171	3,71	,62	Within Groups	138.361	395	,350		
	High school	122	3,66	,59	Total	139.409	397			
	Total	398	3,66	,59						
Technology integration	Primary school	105	3,62	,42	Between Groups	.193	2	.096	.625	.536
	Secondary school	171	3,66	,39	Within Groups	60.961	395	,154		
	High school	122	3,68	,38	Total	61.154	397			
	Total	398	3,65	,39						

As shown in Table 5, there was no significant difference between the technology proficiency (F= 1.496; p>.05) and technology integration (F= .625; p>.05) scores of the groups according to the education level variable.

To determine whether the technology proficiency scale and technology integration scale scores of the teachers constituting the sample group showed a significant difference according to the education level variable, an independent group t-test was conducted.

Table 6.

Independent Groups t-test Results according to Educational Status Variable

Score	Groups	n	$\bar{x}$	Sd	Se	*t* Test		
						t	**Df**	*p*
Technology proficiency	Undergraduate degree	326	3,61	,57	,03	-3,63	396	.000
	Graduate degree	72	3,89	,66	,08			
Technology integration	Undergraduate degree	326	3,64	,40	,02	-1.98	396	.048
	Graduate degree	72	3,74	,35	,04			

As shown in Table 3, significant differences were found between the groups' technology proficiency (t= -3.63; P<.05) and technology integration (t= -1.98; P<.05) scores according to the educational status variable. These differences were in favor of teachers with graduate education in both scales.

Relationships between Variables

The relationships between the dependent and independent variables of this study are presented in Table 6.

Table 7.

Relationships between Variables

		technology literacy	teaching with technology	professional development	ethics and policies	organization and management	technology integration (total scale score)
e-mail	r	,102*	,633**	,230**	,275**	,394**	,492**
	p	,041	,000	,000	,000	,000	,000
www	r	,213**	,540**	,393**	,416**	,434**	,600**
	p	,000	,000	,000	,000	,000	,000
integrated	r	,339**	,435**	,365**	,402**	,282**	,556**
applications	p	,000	,000	,000	,000	,000	,000
teaching with	r	,188**	,574**	,534**	,660**	,516**	,741**
technology	p	,000	,000	,000	,000	,000	,000
technology	r	,216**	,653**	,486**	,570**	,517**	,734**
proficiency (scale total score)	p	,000	,000	,000	,000	,000	,000

*p<.05, **p<.001; N=398

As a result of Pearson correlation analysis, it was found that there was a positive, high level and significant relationship (r= .734; p<.001) between teachers' technology proficiencies and their levels of integrating technology into their lessons.

Simple linear regression analysis was performed to examine the effect of teachers' technology proficiencies on technology integration levels and the results are presented in Table 8.

Table 8.

The effect of teachers' technology proficiencies on technology integration levels.

Independent variable	Dependent variable	B	β	t	p	F	R^2
Technology proficiency	Technology literacy	0.184	0,216	4.398	0.000	19.344	0.047
	Teaching with technology	0.665	0.039	17.164	0.000	294.616	0.427
	Ethics and policies	0.512	0.570	13.799	0.000	190.409	0.325
	Professional development	0.590	0.486	11.077	0.000	122.691	0.237
	Organization and management	0.578	0.517	12.028	0.000	144.683	0.268
	Technology integration	0.486	0.734	21.500	0.000	462.271	0.539

As shown in table Table 7 teachers' technological proficiency levels were a positive and significant predictor of their technology integration levels and all sub-dimensions of the scale. [“Technology integration level” ($F_{(1,396)}$ = 462.271; p<.001); “technology literacy” ($F_{(1,396)}$= 19.344; p<.001); “teaching with technology” ($F_{(1,396)}$= 294.616; p<.001); “ethics and policies” ($F_{(1,396)}$= 190.409; p<.001); “professional development” ($F_{(1,396)}$= 122.691; p<.001); “organization and management” ($F_{(1,396)}$= 144.683; p<.001)]. Technological proficiency levels of teachers; explain 53.9% (R^2=0.539) of the “technology integration levels” variance. In addition, teachers' technological proficiency level was a significant predictor of each of the technology integration scale sub-dimensions.

5. Conclusion, Discussion and Suggestions

This study discussed teachers' technology proficiencies in 21st century learning and their ability to integrate technology into their lessons. Initially, the proficiency of teachers in technology for 21st century learning was evaluated through their self-assessments and technology integration indicator scales, and subsequently, the average scores obtained from their sub-dimensions were computed. Upon examination of the calculations, it is apparent that scores ranging from 3 to 4 have been obtained in all scales and their corresponding sub-dimensions. In the study conducted by Elkıran (2021), it was found that pre-service teachers with similar qualifications had high self-evaluation of technology proficiency in learning. In addition, in the study conducted by Sabuncu, Çalışır, and Kışla (2022), the fact that the sub-dimension in which teachers got the highest score in the sub-dimensions of the Technology Proficiency in 21st Century Learning Self-assessment scale was "teaching with technology," which exactly matches the finding of this study. In the qualitative study conducted by Yılmaz and Ayaydın (2015), which supports the finding of this study, it was concluded that the vast majority of teachers found themselves proficient in technology.

Based on the previous studies in this study and the literature, teachers perceive themselves as sufficient in using technology. The level of proficiency an individual feels in a subject is an absolutely crucial factor in determining his/her motivation to succeed in the said subject (Alaei et. al., 2012; Pajares, 2003; Zhang, et al., 2015).

In the study conducted by Turgut and Başarmak (2019), the high level of teachers' scores on the primary indicators for technology integration scale shows parallelism with the finding of this research. Similarly, in the study conducted by Bakır (2022), the findings showed that teachers' technology integration levels are high. In addition, in the study conducted by Birişçi and Kul (2018) with teacher candidates, the result of high technology proficiency self-efficacy beliefs supports the finding of this study.

There was no significant difference between the scale scores used in the study according to the gender variable. Whether the teachers are male or female does not make a significant difference regarding Technology Proficiency Self-Assessments in 21st Century Learning and Teachers' Technology Integration Indicators. In the literature, there are studies (Elkıran, 2021; Sabuncu, Çukurbaşı et. al., 2022) that found that the scores of the Technology Proficiency Self-Assessment Scale of 21st Century Learning of teachers or prospective teachers do not change significantly regarding gender. Similarly, in the studies conducted by Bakır (2022) and Birişçi and Kul (2018), which is in line with the finding of this study, no significant difference was found between the teachers' technology integration lines and the gender variable. However, in contrast with the finding of this study, in the study conducted by Turgut and Başarmak (2019), it was concluded that the scores obtained by teachers from the scale of fundamental indicators for technology integration differed significantly according to the gender variable.

According to the variable of professional seniority, there was no significant difference between the scale scores used in the study. It shows that how many years teachers have taught does not make a significant difference in regarding Self-Assessments of Technology Proficiency in 21st Century Learning and Teachers' Technology Integration Indicators. In the study conducted by Sabuncu, Çukurbaşı Çalışır and Kışla (2022), a significant difference was found between the professional seniority of teachers and the scores of the Technology Proficiency Self-Assessment Scale in 21st Century Learning, contradicting the finding of this research. This difference is in favor of teachers with low professional seniority. Some studies in the literature are consistent with the finding of this study (Bakır, 2022; Turgut & Başarmak, 2019) find that the Teachers' Technology Integration Indicators scale scores do not change significantly in terms of professional seniority.

There was no significant difference between the scale scores used in this study according to the education level variable. The fact that teachers work in primary, secondary or high school does not make a significant difference in terms of Technology Proficiency Self-Assessments in 21st Century Learning and Teachers'

Technology Integration Indicators. Based on this finding, the teachers' education level does not affect their technology use and integration it into their lessons.

A significant difference was found between the scale scores used in the study according to the educational status variable. The fact that the teachers have undergraduate or graduate degrees makes a significant difference in Technology Proficiency Self-Assessments in 21st Century Learning and Teachers' Technology Integration Indicators. Similarly, in the study by Bakır (2022), graduate education teachers received higher scores on the Teachers' Technology Integration Indicators scale. From this point of view, it can be said that as the teachers' education level of the increases, the technology integration levels also increase.

It has been found that there is a positive, high and significant relationship between teachers' technology proficiencies and their ability to integrate technology into their lessons. Based on this finding, a linear relationship exists between how well teachers perceive themselves about technology and their level of integrating technology into their lessons. Similarly, in the study conducted by Bakır (2022), a significant and positive relationship was found between teachers' innovativeness levels and their level of integrating technology.

Based on the limitations and findings of this study, the following suggestions can be made for researchers and practitioners; i) This research was conducted in Istanbul, the largest and most developed city in Turkey. Therefore, a similar study can be conducted with teachers working in rural areas where technological equipment opportunities are more limited in schools; ii) this research was conducted with teachers working in public schools, a similar study could be conducted with teachers working in private schools, and the findings could be compared, (iii) In this study, measurement tools that are based on participants' self-reports and belonging to the quantitative research paradigm were used, similar studies can be conducted using different data collection techniques, such as interview and observation belonging to the qualitative research paradigm, (iv) According to the research findings, as the education level of teachers increases, both their self-perception of technology and their level of integrating technology increase. Thus, teachers should be encouraged to do graduate education, (v) pre-service and in-service training can be given to increase teachers' technology proficiency levels and ability to integrate technology into their lessons.

References

Aixia, D., & Wang, D. (2011). Factors influencing learner attitudes toward e-learning and development of e-learning environment based on the integrated e-learning platform. *International Journal of e-Education, e-Business, e-Management and e-Learning, 1*(3), 264. http://dx.doi.org/10.7763/IJEEEE.2011.V1.43

Alaei Kharaem, R., Narimani, M., & Alaei Kharaem, S. (2012). A comparison of self-efficacy beliefs and achievement motivation in students with and without learning disability. *Journal of Learning Disabilities, 1*(3), 85-104.

Asiri, M. M. (2022). Employing technology acceptance model to assess the reality of using augmented reality applications in teaching from teachers' point of view in Najran. *Journal of Positive School Psychology, 6*(2), 5241-5255.

Bakır, G. (2022). *Branş öğretmenlerinin yenilikçi öğretmen özellikleri ve teknoloji entegrasyonunu gerçekleştirebilme yeterliliklerinin incelenmesi.* (Yayınlanmamış Yüksek Lisans Tezi). Necmettin Erbakan Üniversitesi, Fen Bilimleri Enstitüsü, Bilgisayar ve Öğretim Teknolojileri Eğitimi Anabilim Dalı, Konya.

Birişçi, S. & Kul, Ü. (2018). Pedagojik formasyon eğitimi alan öğretmen adaylarının teknoloji entegrasyonu öz-yeterlik inanışlarının incelenmesi. *Fen Matematik Girişimcilik ve Teknoloji Eğitimi Dergisi, 1*(1), 1-18.Retrieved from https://dergipark.org.tr/en/pub/fmgted/issue/40553/452349

Büyüköztürk, Ş. (2011). *Sosyal bilimler için veri analizi el kitabı - istatistik, araştırma deseni, spss uygulamaları ve yorum* (15. Baskı). Ankara: Pegem Akademi

Bowman, M. A., Vongkulluksn, V. W., Jiang, Z., & Xie, K. (2022). Teachers' exposure to professional development and the quality of their instructional technology use: The mediating role of teachers' value and ability beliefs. *Journal of Research on Technology in Education, 54*(2), 188-204. https://doi.org/10.1080/15391523.2020.1830895

Caluza, L.J.B. (2020). Development of J48 algorithm-based application in predicting teacher's techno-pedagogical competence. *Mindanao Journal of Science and Technology 18,* (2). 293-310.

Chen, X., Zou, D., Xie, H., Cheng, G., & Liu, C. (2022). Two decades of artificial intelligence in education. *Educational Technology & Society*, *25*(1), 28-47.

Chou, C., & Peng, H. (2011). Promoting awareness of Internet safety in Taiwan in-service teacher education: A ten-year experience. *The Internet and Higher Education*, *14*(1), 44-53. https://doi.org/10.1016/j.iheduc.2010.03.006

Chunyan, L., Haitao, C., & Guolin, L. (2014). The effect of Web2. 0 on learning management system. *International Journal of Multimedia and Ubiquitous Engineering*, *9*(10), 67-78. http://dx.doi.org/10.14257/ijmue.2014.9.10.07

Çakıroğlu, Ü., Gökoğlu, S., & Çebi, A. (2015). Basic indicators for teachers' technology integration: a scale development study. *Gazi University Gazi Journal of Faculty of Education, 35*(3), 507-522.

Demir, S. & Bozkurt, A. (2011). İlköğretim matematik öğretmenlerinin teknoloji entegrasyonundaki öğretmen yeterliklerine ilişkin görüşleri. *İlköğretim Online, 10* (3), 850-860. Retrieved from https://dergipark.org.tr/en/pub/ilkonline/issue/8591/106780

Devedžić, V. (2004). Web intelligence and artificial intelligence in education. *Journal of Educational Technology & Society*, *7*(4), 29-39.

Dúo-Terrón, P. (2023). Analysis of scratch software in scientific production for 20 years: programming in education to develop computational thinking and steam disciplines. *Education Sciences*, *13*(4), 404. https://doi.org/10.3390/educsci13040404

Eden, S., Heiman, T., & Olenik-Shemesh, D. (2013). Teachers' perceptions, beliefs and concerns about cyberbullying. *British journal of educational technology*, *44*(6), 1036-1052.

Elkıran, Y. M. (2021). Türkçe öğretmeni adaylarının akademik okuryazarlık düzeyleri ile teknoloji yeterliği öz-değerlendirmeleri arasındaki ilişki. *Manisa Celal Bayar Üniversitesi Sosyal Bilimler Dergisi, 19* (3), 325-343. DOI: 10.18026/cbayarsos.975296

Elmalı, Ş. & Balkan Kıyıcı, F. (2022). Technology-based professional development program: Experiences of science teachers. *Journal of Educational Technology & Online Learning*, *5*(2), 297-315. https://doi.org/10.31681/jetol.1081367

Fidan, M., Debbag, M., & Çukurbasi, B. (2020). Technology proficiency self-assessments of teachers becoming professional in the 21st century: A scale adaptation study. *Pegem Journal of Education and Instruction, 10*(2), 465-492.

Foulger, T.S., Graziano, K.J., Schmidt-Crawford, D. & Slykhuis, D.A. (2017). Teacher educator technology competencies. *Journal of Technology and Teacher Education, 25*(4), 413-448. Teacher Educator Technology Competencies - Learning & Technology Library (LearnTechLib)

George, D., & Mallery, M. (2003). *Using SPSS for Windows step by step: A simple guide and reference*. Boston, MA: Allyn & Bacon.

Güngör, H. & Atman Uslu, N. (2022). Öğretmenlerin teknoloji ile öğretime yönelik duygularının ölçülmesi: Bir geçerlik ve güvenirlik çalışması. *Instructional Technology and Lifelong Learning 3*(2), 115-128. https://doi.org/10.52911/itall.1079254

Haghshenas, M. (2019). A model for utilizing social softwares in learning management system of E-learning. *Quarterly of Iranian Distance Education Journal*, *1*(4), 25-38. https://doi.org/10.30473/idej.2019.6124

Hanid, M. F. A., Said, M. N. H. M., & Yahaya, N. (2020). Learning strategies using augmented reality technology in education: Meta-analysis. *Universal Journal of Educational Research, 8*(5), 51-56.

Hasse, C. (2017). Technological literacy for teachers. *Oxford Review of Education, 43*(3), 365-378. https://doi.org/10.1080/03054985.2017.1305057

Karasar, N. (2010). *Bilimsel arastırma yöntemi* (21. Basım). Nobel Yayın Dağıtım: Ankara.

Kim, K. T. (2019). The structural relationship among digital literacy, learning strategies, and core competencies among south korean college students. *Educational sciences: theory and practice, 19*(2), 3-21. DOI 10.12738/estp.2019.2.001

Lambot, G. V., & Yango, A. R. (2023). Secondary school heads' technology leadership skills, educational motivation, teachers' techno-pedagogical competence in the city schools division of Laguna. *Technium Social Sciences Journal, 44*, 449-476. https://doi.org/10.47577/tssj.v44i1.8927

Leema, K. M. & Saleem, T. M. (2017). Infusion of techno pedagogy in elementary teacher education curriculum: Perspectives and challenges. *IOSR Journal of Humanities and Social Science, 22*(1), 6-10. DOI: 10.9790/0837-2201010610

López-Belmonte, J., Segura-Robles, A., Moreno-Guerrero, A. J., & Parra-González, M. E. (2021). Robotics in education: A scientific mapping of the literature in Web of Science. *Electronics*, *10*(3), 291. https://doi.org/10.3390/electronics10030291

Ly, T. N. L., Nguyen, T. L., & Nguyen, H. N.(2021).Using e-learning platforms in online classes: A survey on tertiary english teachers' perceptions. *AsiaCALL Online Journal, 12*(5), 34-53. EOI:http://eoi.citefactor.org/10.11251/acoj.12.05.004

Pajares, F. (2003). Self-efficacy beliefs, motivation, and achievement in writing: A review of the literature. *Reading &Writing Quarterly*, *19*(2), 139-158.

Qurashi, G. U. D. & Jan, T. (2022). Techno-pedagogical competence of private and government secondary school teachers of Kashmir-a comparative study. *International Journal of Indian Psychology, 10*(3). 944-953.

Raja, M., & Priya, G. G. (2021). Conceptual origins, technological advancements, and ımpacts of using virtual reality technology in education. *Webology, 18*(2). 116-134.

Roll, I., & Wylie, R. (2016). Evolution and revolution in artificial intelligence in education. *International Journal of Artificial Intelligence in Education*, *26*, 582-599.

Sabuncu, F. H., Çalışır, E. Ç., & Kışla, T. (2022, August). Analysis of technology proficiency self-assessments of teachers in education. In *2nd Internatıonal Conference On Educatıonal Technology And Onlıne Learnıng-ICETOL 2022* (p. 275).

Saphira, H. V., & Prahani, B. K. (2022). Profile of senior high school students' critical thinking skills and the need of implementation PBL model assisted by augmented reality book. *Jurnal Pendidikan Sains Indonesia, 10*(3), 579-591. DOI: https://doi.org/10.24815/jpsi.v10i3.25031

Soutthaboualy, T., Chatwattana, P., & Piriyasurawong, P. (2022). Interactive augmented reality technology via blended ınstruction lesson on cloud. *Higher Education Studies, 12*(3). 9-18. DOI:10.5539/hes.v12n3p9

Sünger, İ., Çankaya, S., & Durak, G. (2022). Artırılmış gerçeklik: Lisansüstü tezlerin içerik analizi. *International Journal of Computers in Education, 5*(1), 31-48. https://doi.org/10.5281/zenodo.7504724

Şarlakkaya, K. & Sülün, A. (2022). Fen bilimleri öğretmen adaylarının 21. yüzyıl öğrenmelerinde teknoloji yeterliliği öz-değerlendirme düzeylerinin belirlenmesi. *Ege Bilimsel Araştırmalar Dergisi, 5* (1), 1-21.

Thakur, N. (2015). A study on implementation of techno-pedagogical skills, its challenges and role to release at higher level of education. *American International Journal of Research in Humanities, Arts and Social Sciences, 9*(2), 182-186.

Triansyah, F. A., Mitrayana, M., Yanti, F., Rabuandika, A., & Muhammed, I. (2023). Ortaokullarda Artırılmış Gerçeklik Araştırmaları: Bibliyometrik İnceleme. *EDUKASIA: Jurnal Pendidikan Dan Pembelajaran, 4*(1), 369-378. https://mail.jurnaledukasia.org/index.php/edukasia/article/view/268

Turgut, G. & Başarmak, U. (2019). Ortaokul öğretmenlerinin teknoloji entegrasyonu yeterliklerinin farklı değişkenlere göre incelenmesi. *Türk Akademik Yayınlar Dergisi 3*(2),51-66.

Yazıcıoğlu, Y., & Erdoğan, S. (2004). *SPSS applied scientific research methods*. Ankara: Detay Publishing.

Zhang, Z. J., Zhang, C. L., Zhang, X. G., Liu, X. M., Zhang, H., Wang, J., & Liu, S. (2015). Relationship between self-efficacy beliefs and achievement motivation in student nurses. *Chinese Nursing Research*, 2(2-3), 67-70.

Zhu, C., Wang, D., Cai, Y., & Engels, N. (2013). What core competencies are related to teachers' innovative teaching?. *Asia-Pacific Journal of Teacher Education, 41*(1), 9-27. https://doi.org/10.1080/1359866X.2012.753984