Teachers' Competence in Using Educational Technologies: The Case of Science Education Teachers in Turkey

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For effective teaching and learning, teachers need a diverse set of skills. Proficient use of information and communication technologies is one such skill crucial in modern learning environments. Teachers should possess the ability to design, develop, and evaluate unique learning experiences and assessments incorporating contemporary tools. In our global, digital society, teachers are expected to showcase their knowledge, skills, and operational processes as innovative professionals. Both at international and national levels, proficiency in using technology is a desirable trait for teachers. Meeting this expectation is closely tied to teachers' competence in employing existing educational technologies. The main goal of this study is to assess the proficiency levels of science teachers in public institutions affiliated with the Ministry of National Education (MoNE) in Turkey concerning their use of educational technologies. The study evaluates teachers' competencies in technological literacy, technology integration in lessons, adherence to social, ethical, and legal provisions, and communication factors. Data, collected through a scale with four sub-dimensions and 38 items, underwent reliability and validity assessments. The scale was administered to 306 science teachers, and the collected data were analyzed using SPSS 26.0 software. An Independent Samples t-Test examined whether science teachers' proficiency in using educational technologies changed based on gender, prior training status, and educational level. Additionally, a one-way ANOVA test determined differences based on professional tenure, duty location, and age. The analysis revealed: (1) Significant differences in utilization levels of educational technologies among teachers based on age, gender, duty location, professional tenure, and participation in training; (2) However, no significant differences based on educational attainment were found. The results suggest that younger teachers, male teachers, those working in district-based locations, individuals with fewer years of professional experience, and teachers who received training in educational technology tend to exhibit higher proficiency in using educational technologies. The results have been further discussed, and several recommendations have been provided.

Keywords: Educational technologies, science education, technological literacy, technology integration in lessons

Introduction

Technology, with its facilitating role, continues to play a central role in daily life, introducing innovations and remaining a pivotal factor in contemporary integration across various sectors. Education is one such sector profoundly impacted by technological advancements, observable in the methods and activities implemented in educational environments (İşman, 2015). These technological progressions and innovations significantly contribute to the evolution and enhancement of educational activities conducted in schools (Zucker, 2008).

Currently, there is a noticeable shift from traditional learning environments, where technological tools are used at a basic level, to electronic learning (e-learning) environments. Additionally, traditionally utilized learning theories, still in use, are observed to adapt in line with this shift (Gillani, 2003). When designing learning environments, it is not only tailored to a specific physical location and time but also facilitates remote learning, allowing learners to study independently of location and time (Elbaum et al., 2002; Smith & Rose, 2002).

In both face-to-face and distance education, a plethora of computer-assisted instructional materials are available. These materials are employed in learning environments designed for diverse needs (Clarke, 2001). For instance, tools such as m-SES (Yılmaz & Sanalan, 2015), DYS (Yıldırım & Karaman, 2012), Clickers (Blasco-Arcas et al., 2013; Zhu, 2007), and CRS (Fies & Marshall, 2006) are designed to foster interactions among students and between students and teachers in face-to-face learning settings. Additionally, there exist classroom and remote learning technologies requiring specialized technological equipment or software for various purposes (Acadly, 2019). These technologies consistently feature in the agenda of educational policies aimed at delivering quality education. The objective when formulating educational policies is to provide the best education with minimal challenges (Wiliam, 2011). Addressing existing challenges is a vital element for each country's educational policy. While technological tools play a significant role in resolving many educational issues, merely possessing technology is insufficient. Both teachers and students, as the primary users of this technology, need to be proficient in utilizing these tools effectively.

Effective learning is intricately tied to the teacher's ability to engage students. To enhance the learning process, the design, implementation, and evaluation of learning experiences must conform to certain standards. In this regard, the International Society for Technology in Education (ISTE) has formulated standards for teachers concerning educational technologies (Mahiri, 2011).

ISTE posits that all educators should meet these established standards and performance indicators (Mahiri, 2011).

Teachers are expected to leverage their subject knowledge and understanding of teaching-learning-technology to create experiences that enhance learning and creativity in both face-to-face and virtual environments. They should strive to maximize content learning within a given context. To foster the necessary knowledge, skills, and attitudes, teachers must excel at designing, developing, and evaluating unique learning experiences and assessments that incorporate contemporary tools and resources. As professionals in a global digital society, educators are required to demonstrate proficiency in knowledge, skills, and work processes. Moreover, they should comprehend local and global societal challenges and responsibilities within the evolving digital culture, exhibiting ethical and legal behaviors in their professional practices.

When examining the educational landscape at the national level, teachers need a diverse skill set to effectively manage the teaching and learning process. Proficiency in using information and communication technologies within teaching and learning environments is highlighted as a crucial skill (MoNE, 2017). Teachers are expected to possess expertise in this area as a professional skill, an emphasis reinforced by the Ministry of National Education (MoNE). Both on an international and national scale, the effective utilization of technology by teachers is not only anticipated but also desired. Meeting this expectation is closely intertwined with teachers' competency in using available educational technologies.

It is imperative to assess the technology proficiency of specific subject teachers and, more broadly, all educators. This determination is pivotal for formulating professional development policies tailored to specific subject teacher groups and, on a broader scale, for ensuring the nation provides optimal education with minimal challenges.

The principal aim of this study is to assess the proficiency levels of science teachers employed in public institutions affiliated with the Ministry of National Education (MoNE) in utilizing educational technologies. To achieve this goal, the following research questions are investigated:

I. To what extent do science teachers participate in organized technology training sessions?

II. How proficient are science teachers in utilizing the technological tools at their disposal?

III. In relation to the technological proficiency levels of science teachers, how do factors such as "gender," "participation in education," "professional tenure," "work location," "educational level," and "age" influence:

• What is the proficiency level of science teachers in technological literacy?

• To what extent can science teachers integrate technology into their curriculum?

• How adept are science teachers at adhering to social, ethical, and legal guidelines in their use of technology?

• How skilled are science teachers in facilitating effective communication through technology?

Method

This study examines the proficiency levels of science teachers working in middle schools affiliated with the Ministry of National Education (MoNE) regarding the use of educational technologies. The research investigates whether specific characteristics of these science teachers, such as age, gender, professional tenure, duty location, educational level, and prior participation in technology-related training, influence their proficiency in utilizing educational technologies. This quantitative survey study aims to determine the proficiency levels of science teachers in the use of educational technologies

Population and Sample

The study centers on science teachers located in a major city within the Eastern Anatolia Region, which encompasses 13 districts. To attain a thorough representation of the study population, we obtained voluntary participation from science teachers in each district. Employing a cluster sampling approach, we aimed to guarantee that the probability of sampling each subpopulation reflects their proportional representation in the entire population (Karasar, 2017). Demographic information of the participants is presented in Table 1.

Table 1. Demographic information of the participants.

Variables	Groups	*f*	%
Gender	Female	166	54.2
	Male	140	45.8
	Total	306	100
Professional Tenure	1-4 Years	119	38.9
	5-9 Years	96	31.4
	10-14 Years	47	15.4
	15-19 Years	26	8.5
	20 Years and Over	18	5.9
	Total	306	100

Duty Location	Village-Town	61	19.9
	District	137	44.8
	City Center	108	35.3
	Total	306	100
Age	21-25 Years	26	8.5
	26-30 Years	118	38.6
	31-35 Years	75	24.5
	36-40 Years	46	15.0
	41-45 Years	20	6.5
	46-50 Years	12	3.9
	51 Years and Over	9	2.9
	Total	306	100
Education Level	Bachelor's Degree	279	91.2
	Postgraduate	27	8.9
	Total	306	100

As evident in Table 1, there is an approximate gender balance among the participants. Analysis of professional tenure reveals that a significant majority of the teachers are relatively new to the profession. The majority of these educators are stationed in central districts and sub-districts. Concerning age groups, a substantial portion of the teachers falls below the age of 35. Moreover, the prevailing educational qualification among them is at the bachelor's degree level.

Data Collection Tools

In this study, conducted to assess the proficiency levels of science teachers in utilizing educational technologies, a pre-established scale with previously validated reliability and validity measures was employed. The 'Educational Technology Proficiency Scale for Teachers,' developed by Bayraktar et al. (2015), consists of four factors and a total of 38 items. The data collection form was administered personally by the researcher to a total of 306 science teachers, with their participation being voluntary. Responses were recorded on a 5-point Likert-type scale.

Reliability coefficients for the scale were calculated as follows: 'Technological Literacy (TL): 0.95,' 'Technology Integration in Lessons (TIL): 0.91,' 'Social, Ethical, and Legal Provisions (SELP): 0.90,' and 'Communication (C): 0.76.' The overall Cronbach's Alpha consistency coefficient for the scale is reported as 0.97. The reliability coefficients calculated for this scale in the current study are: TL: 0.91; TIL: 0.95; SELP: 0.95; C: 0.85. Both the values obtained during the scale development and those from this study exhibit close alignment, affirming the high reliability of the scale.

Data Analysis

The data obtained from the scale, implemented to assess the proficiency levels of science teachers in utilizing technology in education, were processed using the specialized statistical software SPSS. Initially, the demographic characteristics of the science teachers were described through frequency distributions and percentage values. Subsequently, the frequency values and percentage distributions of responses on scales indicating science teachers' proficiency in using educational technologies were identified. Frequencies and percentages were utilized to delineate the types of technology available at schools and the personal technology possessed by teachers.

Furthermore, a One-Way ANOVA was employed to scrutinize potential differences in technology use proficiency based on age, educational level, professional tenure, and duty location. The Independent Samples t-Test was applied to investigate whether there was a significant disparity in technology usage levels based on whether the teachers had received relevant training and gender.

Findings

The findings of this study, conducted to determine the proficiency levels of science teachers in using educational technologies, are sequentially listed below.

Participation Status of Science Teachers In a Technology-Related Training

Table 2. Frequency and percentage distributions regarding participation in a technology-related training.

Groups	*f*	%
No	204	66.7
Yes	102	33.3
Total	306	100.0

Upon scrutinizing Table 2, it is noted that approximately one-third of the teachers in the research group have undergone technology training, while a significant portion has not participated in any form of training.

Technological Tools That Science Teachers Possess in Schools and Personally

Table 3. Frequency and percentage distributions of types of technologies present in schools and types of technologies personally owned by teachers.

Variables	Groups	*f*	%
Technologies Found in Schools	Computer	219	71.6
	Projector	98	32.0
	Smartboard	293	95.8
	Document Camera	14	4.6
	Multi-Function Printer	135	44.1
	Others	7	2.3
Technologies Personally Owned by Teachers	Desktop Computer	62	20.3
	Laptop	280	91.5
	Tablet	55	18.0
	Smartphone	305	99.7
	Others	11	3.6

Upon examining Table 3, it is evident that computers rank first in the types of technology, both in schools (71.6%) and among the technologies owned by teachers (Desktop: 20.3%, Laptop: 91.5%). When variables are analyzed individually, smartboards emerge as the primary technology in schools, while smartphones are the foremost personally-owned technology type. Another significant finding is that nearly all the schools where teachers work are equipped with smartboard technology (95.8%).

Technology Usage Skill Levels of Science Teachers Based on Gender

Table 4. Independent samples t-Test analysis results based on gender variable.

Variables	Groups	N	M	SD	t-test		
					t	df	p
Technology Literacy	Female	166	3.49	.70	-2.32	304	.01*
	Male	140	3.70	.85			
Technology Integration in Lessons	Female	166	4.14	.81	-1.79	304	.62
	Male	140	4.31	.82			
Social, Ethical, and Legal Provisions	Female	166	4.26	.84	-1.25	304	.37
	Male	140	4.38	.82			
Communication	Female	166	3.03	1.19	.26	304	.54
	Male	140	3.00	1.23			

Overall Scale Total (OST)	Female	166	3.72	.66	-1.94	304	.18
	Male	140	3.88	.76			

*p<0,05

Table 4, illustrates the outcomes of an Independent Samples t-test utilized to ascertain the presence of a significant disparity in the proficiency scores of science teachers in utilizing educational technologies based on their gender. The analysis particularly focused on the "Technology Literacy" factor. The findings disclosed a noteworthy dissimilarity in the scores. The mean score for female science teachers in technology literacy (Mfemale = 3.49) exhibited a statistically significant difference from the mean score of their male counterparts (Mmale = 3.70), t(304) = -2.328; p<0.05. Notably, this variance favored male teachers. Nevertheless, no statistically significant differences based on gender were discerned in other skill areas. Upon closer examination at the organizational support (OST) level, it was observed that the overall scores of science teachers, concerning their proficiency in utilizing educational technologies, did not manifest a significant difference based on the gender variable.

Science Teachers' Competence Levels in Utilizing Educational Technology: An Examination Grounded in Their Engagement with Technology-focused Training Programs

Table 5. Results of the independent samples t-Test analysis based on the participation in training factor.

Variables	Groups	N	M	SD	t-test		
					t	df	p
Technology Literacy	Female	204	3.53	.71	-1.96	304	.001*
	Male	102	3.71	.89			
Technology Integration in Lessons	Female	204	4.22	.79	.01	304	.436
	Male	102	4.22	.88			
Social, Ethical, and Legal Provisions	Female	204	4.33	.81	.45	304	.927
	Male	102	4.28	.87			
Communication	Female	204	2.90	1.18	-2.42	304	.016*
	Male	102	3.25	1.23			
Overall Scale Total	Female	204	3.75	.66	-1.40	304	.022*
	Male	102	3.87	.81			

*p<0,05

As indicated in Table 5, an Independent Samples t-Test was employed to

ascertain whether there existed a noteworthy disparity in the overall scores of science teachers within the study cohort in terms of their competence in utilizing educational technologies, contingent upon their previous involvement in technology-related training. A substantial distinction was noted in the domain of technology literacy. Science educators lacking prior engagement in technology-related training exhibited an average technology literacy score of MNo = 3.53, while those who had undergone such training attained an average score of MYes = 3.71. This variance was statistically significant, $t(304) = -1.962$; $p < 0.05$. This outcome implies that the discrepancy favored science teachers with prior participation in technology-related training. In relation to the communication aspect, science teachers without prior involvement in technology-related training achieved an average communication score of MNo = 2.90, in contrast to their counterparts who had participated in such training, with an average score of MYes = 3.25. This difference was statistically significant, $t(304) = -2.425$; $p < 0.05$. This indicates that the advantage lies with science teachers who had previously taken part in technology-related training. Upon an examination at the overall science teachers' proficiency level in utilizing educational technologies with respect to their antecedent engagement in technology-related training, a significant difference was observed at the OST level, $t(304) = -1.408$; $p < 0.05$. This discrepancy favored teachers who had undergone the training

Educational Technology Use Skill Levels of Science Teachers Depending on Professional Tenure Variable

Table 6. One-Way ANOVA test analysis results applied according to the professional tenure factor.

					One-Way ANOVA Test						
Variables	Groups	N	M	SD	Source of Variation	SoS	df	MS	F	p	Difference
Technology Literacy	1-4 Years	119	3.74	.69	Within	22.16	4	5.54	10.08	.00*	A>E B>E C>E D>E A>D B>D
	5-9 Years	96	3.67	.79							
	10-14 Years	47	3.60	.69	Between	165.46	301	.55			
	15-19 Years	26	3.25	.72							
	20 Years and Over	18	2.65	.92							
	Total	306	3.59	.78	Total	187.63	305				

Technology Integration in Lessons	1-4 Years	119	4.39	.68	Within	27.13	4	6.78	11.47	.00*	A>E B>E C>E D>E
	5-9 Years	96	4.21	.732							
	10-14 Years	47	4.36	.70							
	15-19 Years	26	3.95	.91	Between	177.92	301	.59			
	20 Years and Over	18	3.15	1.28							
	Total	306	4.22	.81	Total	205.06	305				
Social, Ethical, and Legal Provisions	1-4 Years	119	4.49	.663	Within	22.02	4	5.50	8.67	.00*	A>E B>E C>E
	5-9 Years	96	4.28	.821							
	10-14 Years	47	4.43	.72							
	15-19 Years	26	4.08	.86	Between	191.12	301	.63			
	20 Years and Over	18	3.37	1.38							
	Total	306	4.31	.83	Total	213.15	305				
Communication	1-4 Years	119	3.19	1.18	Within	19.77	4	4.94	3.49	.00*	A>E B>E
	5-9 Years	96	3.07	1.23							
	10-14 Years	47	2.94	1.17							
	15-19 Years	26	2.74	1.05	Between	426.47	301	1.41			
	20 Years and Over	18	2.15	1.24							
	Total	306	3.01	1.20	Total	446.25	305				
Overall Scale Total (OST)	1-4 Years	119	3.95	.58	Within	22.47	4	5.61	12.53	.00*	A>D A>E B>E C>E D>E
	5-9 Years	96	3.83	.70							
	10-14 Years	47	3.84	.61							
	15-19 Years	26	3.49	.71	Between	134.87	301	.44			
	20 Years and Over	18	2.83	.98							
	Total	306	3.79	.71	Total	157.35	305				

*P<0,05, A:1-4 Years, B:5-9 Years, C:10-14 Years, D:15-19 Years, E:20 Years and Over

As illustrated in Table 6, the objective was to assess whether a significant variation existed in the total scores of science teachers within the research

cohort based on their professional seniority, with respect to their competency in utilizing educational technologies. Findings from a one-way ANOVA analysis revealed noteworthy differences across all factors.

In the Technology Literacy factor, educators with 1-4 years of seniority achieved an average score of MA = 3.74, those with 5-9 years scored MB = 3.67, with 10-14 years scored MC = 3.60, with 15-19 years scored MD = 3.25, and those with 20 years or more scored ME = 2.65. A statistically significant difference was evident among these groups. Multiple comparison results indicated that teachers with 20 years or more of seniority displayed a lower level of technology literacy. Additionally, teachers with 15-19 years of seniority exhibited lower technology literacy scores compared to those with 1-4 and 5-9 years of seniority.

In the "Technology Integration in Lessons" factor, educators with 1-4 years of seniority achieved an average score of MA = 4.39. Those with 5-9 years scored MB = 4.21, with 10-14 years scored MC = 4.36, teachers with 15-19 years of seniority scored MD = 3.95, and those with 20 years or more scored ME = 3.15. A statistically significant difference was noted among these groups. According to multiple comparisons, teachers with 20 or more years of seniority demonstrated a reduced ability to integrate technology into their lessons. In the "Social, Ethics, and Legal Provisions" factor, educators with 1-4 years of seniority achieved an average score of MA = 4.49. Those with 5-9 years scored MB = 4.28, with 10-14 years scored MC = 4.43, while those with 20 or more years scored ME = 3.37. A statistically significant difference was observed among these scores. Based on multiple comparisons, teachers with 20 years or more of seniority demonstrated lower proficiency in adhering to social ethics and legal provisions.

In the "Communication" factor, educators with 1-4 years of seniority achieved an average score of MA = 3.19. Those with 5-9 years scored MB = 3.07, while those with 20 or more years scored ME = 2.15. A statistically significant difference was observed among these scores. Based on multiple comparisons, teachers with 20 years or more of seniority exhibited lower communication skills. When assessing the overall scale score, educators with 1-4 years of seniority achieved an average score of MA = 3.95. Those with 5-9 years scored MB = 3.83, with 10-14 years scored MC = 3.84, those with 15-19 years scored MD = 3.49, and educators with 20 years or more scored ME = 2.83. A statistically significant difference was noted among these scores. Upon examination of the average scores, it became evident that teachers with fewer years of seniority demonstrated higher proficiency in using educational technologies. According to multiple comparisons, teachers with 20 or more years of seniority exhibited lower proficiency in using educational technologies

Proficiency Levels in Using Educational Technology Among Science Teachers Based on Duty Location

Table 7. Results of the one-way ANOVA test based on duty location factor.

Variables	Groups	N	M	SD	One-Way ANOVA Test						
					Source of Variation	SoS	df	MS	F	**p**	**Source of Variation**
Technology Literacy	Village-Town	61	3,56	,58	Within	1,28	2	,64	1,04	,353	There is no significant difference
	District	137	3,67	,76	Between	186,34	303	,61			
	City Center	108	3,51	,89							
	Total	306	3,59	,78	Total	187,63	305				
Technology Integration in Lessons	Village-Town	61	4,24	,79	Within	3,61	2	1,81	2,72	,067	There is no significant difference
	District	137	4,32	,73	Between	201,44	303	,66			
	City Center	108	4,08	,91							
	Total	306	4,22	,81	Total	205,06	305				
Social, Ethical, and Legal Provisions	Village-Town	61	4,32	,79	Within	6,92	2	3,46	5,08	,007*	B>C
	District	137	4,46	,72	Between	206,23	303	,68			
	City Center	108	4,12	,94							
	Total	306	4,31	,83	Total	213,15	305				
Communication	Village-Town	61	2,55	1,03	Within	17,07	2	8,53	6,02	,003*	B>A C>A
	District	137	3,18	1,23	Between	429,18	303	1,41			
	City Center	108	3,07	1,21							
	Total	306	3,01	1,20	Total	446,25	305				

Overall Scale Total	Village-Town	61	3,74	,60	Within	2,47	2	1,23	2,42	,090	There is no significant difference.
	District	137	3,89	,66	Between	154,87	303	,51			
	City Center	108	3,70	,82							
	Total	306	3,79	,71	Total	157,35	305				

(*p<0.05) A: Village-Town, B: District, C: City Center

As depicted in Table 7, the primary aim of the one-way ANOVA test was to discern significant differences in the overall scores of the scale, evaluating the proficiency levels of science teachers in utilizing educational technologies, contingent upon their professional duty location factor. Noteworthy distinctions were evident in the Social Ethics and Legal Provisions factor. Within this factor, the average score for teachers stationed in the district was recorded as MB = 4.46, while those situated in the city center achieved an average score of MC = 4.12. A statistically significant difference materialized between teachers in the district and those in the city center. This discrepancy is observed to favor science teachers working in the district. Multiple comparison results suggest that teachers in the district tend to adhere more closely to social ethics and legal provisions compared to their counterparts in the city center. According to the outcomes of the one-way ANOVA test, substantial differences were identified in the communication factor. In this factor, teachers in villages and towns garnered an average score of MA = 2.553, while teachers in the district scored an average of MB = 3.182, and those in the city center had an average score of MC = 3.076. A statistically significant difference was noted between teachers stationed in the district or city center and those working in villages and towns. This disparity appears to favor science teachers working in the district and the city center.

Science Teachers' Technology Usage Skills Based on Educational Level

Table 8. Independent samples t-Test analysis results according to the educational level factor.

Variables	Groups	N	M	SD	t-test		
					t	df	p
Technology Literacy	Bachelor's Degree	279	3,55	,78	-2,55	304	,645
	Postgraduate	27	3,95	,69			
Technology Integration in Lessons	Bachelor's Degree	279	4,20	,83	-1,43	304	,152
	Postgraduate	27	4,44	,56			

Social, Ethical, and Legal Provisions	Bachelor's Degree	279	4,29	,85	-1,42	304	,054
	Postgraduate	27	4,53	,54			
Communication	Bachelor's Degree	279	2,98	1,22	-1,66	304	,052
	Postgraduate	27	3,38	1,00			
Overall Scale Total	Bachelor's Degree	279	3,76	,72	-2,34	304	,076
	Postgraduate	27	4,10	,53			

(*p<0.05) A: Bachelor's Degree, B: Postgraduate

As observed in Table 8, the aim was to determine whether there was a significant difference in the overall scores of the scale used to assess the level of technology usage of science teachers based on the factor of educational level. The results of the Independent Samples t-test revealed that there was no significant difference in the factors of technological literacy, technology integration in lessons, social, ethics and legal provisions, and communication. Furthermore, no significant difference was identified at the overall scale total.

The Technology Usage Skill Levels of Science Teachers Based on The Age Variable

Table 9. One-Way ANOVA test analysis results according to the age factor.

Variables	Groups	N	M	SD	One-Way ANOVA Test						
					Source of Variation	**SoS**	**df**	**MS**	**F**	**p**	**Source of Variation**
Technology Literacy	21-25	26	3,63	,87	Within	18,90	5	3,78			A>F
	26-30	118	3,80	,71							B>F
	31-35	75	3,59	,68	Between	168,72	300	,56			C>F
	36-40	46	3,50	,76							D>F
	41-45	20	3,23	,69	Total	187,63	305		6,72	,000*	
	46 and Over	21	2,88	,99							
	Total	306	3,59	,78							

Technology Integration in Lessons	21-25	26	4,47	,70	Within	21,52	5	4,30	7,03	,000*	A>F B>F C>F D>F
	26-30	118	4,31	,69							
	31-35	75	4,24	,74	Between	183,53	300	,61			
	36-40	46	4,35	,64							
	41-45	20	3,91	1,01	Total	205,06	305				
	46 and Over	21	3,34	1,30							
	Total	306	4,22	,81							
Social, Ethical, and Legal Provisions	21-25	26	4,56	,68	Within	19,32	5	3,86	5,98	,000*	A>F B>F C>F D>F
	26-30	118	4,41	,71							
	31-35	75	4,30	,78	Between	193,82	305	,64			
	36-40	46	4,44	,72							
	41-45	20	4,00	,94	Total	213,15	305				
	46 and Over	21	3,50	1,33							
	Total	306	4,31	,83							
Communication	21-25	26	3,71	,96	Within	37,31	5	7,46	5,47	,000*	A>F B>F A>C A>E
	26-30	118	3,18	1,25							
	31-35	75	2,89	1,17	Between	408,94	300	1,36			
	36-40	46	3,02	1,10							
	41-45	20	2,55	1,03	Total	446,25	305				
	46 and Over	21	2,14	1,11							
	Total	306	3,01	1,20							
Overall Scale Total	21-25	26	3,98	,61	Within	19,35	5	3,87	8,41	,000*	A>F B>F B>E C>F D>F
	26-30	118	3,95	,64							
	31-35	75	3,78	,64	Between	137,99	300	,46			
	36-40	46	3,80	,62							
	41-45	20	3,44	,73	Total	157,35	305				
	46 and Over	21	3,01	1,03							
	Total	306	3,79	,71							

(*p<0.05) A: 21-25 Years B: 26-30 Years C: 31-35 Years D: 36-40 Years E: 41-45 Years F: 46 Years and Over

As observed in **Table 9**, the purpose of the one-way ANOVA test analysis was to determine whether there were significant differences in the total scores of the technology usage levels of the science teachers in the study group based on the age factor. The results indicated significant variations across the factors of Technology Literacy, Technology Integration in Lessons, Social, Ethical, and

Legal Provisions, and Communication. Upon examining the average scores, it was noted that younger teachers exhibited higher levels of technology literacy. For the Technology Literacy factor, teachers aged 46 and above scored lower compared to those aged 21-25, 26-30, 31-35, and 36-40. When evaluating the average scores for Technology Integration in Lessons, younger teachers demonstrated higher integration levels. Teachers aged 46 and above again scored lower in this factor compared to their counterparts in the age brackets of 21-25, 26-30, 31-35, and 36-40. For the Social, Ethical, and Legal Provisions factor, younger teachers had higher scores. Specifically, teachers aged 46 and above scored lower than those aged 21-25, 26-30, 31-35, and 36-40. In the Communication factor, younger teachers, particularly those aged 21-25 and 26-30, showcased higher levels than teachers aged 46 and above. Moreover, teachers aged 31-35 scored lower than those aged 21-25, and similarly, teachers aged 41-45 also had lower scores compared to the 21-25 age group.

Discussion and Conclusion

In this study, aimed at assessing the proficiency levels of science teachers in utilizing educational technologies, the obtained results are outlined below.

The participation levels of science teachers in technology-related training are notably low, with only one in every three teachers having engaged in such training. This finding aligns with similar studies conducted by Çelik (2017), Kahyaoğlu (2011), and Soran et al. (2010). The limited participation of science teachers in technology-related training programs may be attributed to two distinct factors. Firstly, it could be a result of the inadequacy of the essential infrastructure and technological tools necessary for applying the knowledge acquired through such training. In this context, an examination of the technological resources available to teachers is imperative. Analysis of the individual technologies possessed by teachers and those present in schools indicates that there is no significant deficit in terms of hardware. Akgündüz and Bağdiken (2018) reached a similar conclusion in their study focused on science teachers. The second reason may be linked to the insufficient training opportunities provided for teachers. The widespread availability of smartboard technologies in almost all schools is vital for implementing new learning and teaching approaches. Additionally, the level of technological devices personally owned by teachers is considerably high. The availability and quality of hardware and infrastructure, in general, are deemed satisfactory. Therefore, the priority should be placed on providing teachers with training on technology usage. Numerous studies on this subject underscore the imperative to enhance in-service training on technology use (Arabacıoğlu & Sultan Safa, 2021; Bolat et al., 2020; Ekici et al., 2014; Kahyaoğlu, 2011; Taşçı & Yaman, 2010). The principal factor contributing to the low participation levels of science teachers in technology-related training appears to be the lack

of adequate in-service training opportunities. Consequently, there is an urgent need to organize new in-service training programs and augment participation levels.

When scrutinizing the technological proficiency of female and male teachers in schools across various factors, it becomes apparent that male teachers exhibit greater expertise solely in the realm of "Technology Literacy." No significant disparities were identified between gender and skill levels in the other four factors or the overall scale. Numerous studies in the literature corroborate these findings (Akbulut et al., 2011; Durak & Seferoğlu, 2017; Menzi et al., 2012; Lin et al., 2012; Sağlam, 2007; Uyduran, 2018). Generally, science teachers display comparable levels of educational technology skills regardless of gender. However, in the specific dimension of "Technology Literacy," previous experiences may have influenced male teachers to demonstrate heightened proficiency. Niiranen (2018) underscored the role of technology in shaping children's gender identity, suggesting that girls, with less exposure to technological games, might encounter challenges in connecting with technology. This observation elucidates, in part, why male teachers excel in the domain of "Technology Literacy." While overarching differences in technology usage skills between male and female teachers may not be evident, this issue warrants further meticulous investigation.

Upon examining the disparity in skill levels among science teachers who undergo technology-related training, it is evident that they perform better in the domains of "Technology Literacy" and "Communication." In their respective studies, Uyduran (2018) and Bodur (2019) reported that teachers who underwent training exhibited higher proficiency levels in utilizing educational technologies in the dimensions of "Technology Literacy" and "Communication." Furthermore, when evaluated at the teacher training level, a significant difference in skill levels was observed among teachers who participated in the training. It can be inferred that teachers who attended the training sessions possess enhanced technology usage skills. Conversely, Çelik (2019) indicated in his study that science teachers who received training demonstrated higher competency levels in using educational technologies in the dimensions of "Technology Literacy" and "Communication," whereas those without any training had lower levels. No statistically significant difference was identified between science teachers' proficiency in the "Social, Ethical, and Legal Provisions" sub-dimension of using educational technologies and their training status. These findings suggest that the training received by teachers may predominantly concentrate on the areas of "Technology Literacy" and "Communication." Rather than undergoing training in areas where they are already proficient, teachers should be provided training in domains where their proficiency levels are comparatively lower.

Recently graduated science teachers demonstrate the highest proficiency in

utilizing technology. However, this proficiency tends to diminish over time, with a notable decline in knowledge and skills across all areas after 20 years in the profession. Several studies have consistently shown that less experienced teachers exhibit higher levels of proficiency in using educational technologies, while their more experienced counterparts demonstrate lower levels (Admiral et al., 2017; Aktürk & Delen, 2020; Bal & Karademir, 2013; Durak & Seferoğlu, 2017; Kahyaoğlu, 2011). Novice teachers are generally more inclined to adopt educational technologies readily and can adapt to them more easily (Aldurate & Nussbaumn, 2013). Despite the current knowledge and skills possessed by recently qualified teachers, there remains a necessity for periodic updates to this knowledge and expertise. To address this need, teachers should actively participate in specialized or professional training programs. This highlights the paramount importance and necessity of ongoing in-service training for educators

When examining the skill levels of science teachers based on their duty location, no significant differences were found at the OST level. However, differencies were noted in the areas of "Social, Ethical, and Legal Provisions (SELP)" and "Communication." In the SELP area, teachers working in districts demonstrated superior proficiency, whereas, in the "Communication" domain, teachers in both cities and districts exhibited a better command of technology usage. Kuzgun and Özdinç (2017) indicated in their study that teachers perceive technology use to be limited in rural settings, while those stationed in central schools are in a better position regarding this aspect. Considering that teachers working in villages and towns may find it relatively harder to access educational and communication technologies compared to their urban counterparts, such findings are anticipated. Therefore, in planning in-service training, priority should be given to teachers working in areas that can be deemed disadvantaged, such as villages and small towns.

The educational level, whether undergraduate or postgraduate, of science teachers does not appear to influence their ability to use technology. Similar conclusions were drawn in studies by Demirhan (2012), Akgündüz and Bağdiken (2018), and Sengir (2019). Regardless of their educational status, science teachers seem to have comparable characteristics in terms of the support they receive for technology use. In a study directed at science teachers by Baysal (2016), no significant difference was found between the use of educational technologies and the level of education. It can be posited that the educational level teachers possess does not significantly impact their technological proficiency.

When examining the technology usage levels of science teachers based on age, it was observed that the middle age bracket serves as a critical juncture. Teachers below middle age demonstrate good proficiency in technology use, with younger teachers particularly excelling, while those within the middle age

range display lower competency. This observation aligns with correlations made with professional experience. Both in specific sub-dimensions and the overall scale, younger teachers and those new to the profession exhibit higher levels of technological expertise. Conversely, older teachers with many years in the profession tend to have lower levels of technology use. A study in this domain by Durak and Seferoğlu (2017) indicated that teachers' use of educational technologies declines as they age. These findings are consistent with studies conducted by Kara (2011) and Sengir (2019). Post a certain age, typically around 30-35 years, teachers need to undergo specialized training to enhance their technological skills.

When considering both newly-inducted and younger teachers, it is evident that their proficiency in using technology is higher. However, over time, this competency does not remain constant and even shows signs of decline. Given the potential adverse effects of this decline on learning and teaching environments over time, the importance and necessity of in-service training becomes evident.

Suggestions

In this study, the proficiency levels of science teachers in using educational technologies were examined, and based on the results, the following suggestions are proposed:

- To proficiently use educational technologies, science teachers need to adapt to evolving technologies and continually update their knowledge. They should proactively keep themselves informed or participate in up-to-date in-service training sessions.
- No significant difference was observed in the technological proficiency of science teachers based on gender. However, considering that males tend to perform better in the sub-category of "Technology Literacy," specialized training programs should be designed for female teachers when organizing in-service training.
- Science teachers seem to excel in certain areas after receiving training on technology. Instead of retraining teachers in areas they already excel at, focus should be on areas where their proficiency is lacking.
- While newly-inducted science teachers start with a high level of technological proficiency, this competency tends to decline over time. When planning in-service training, specialized programs should be developed for senior, more experienced teachers.
- The regions where teachers are stationed influence their technological proficiency. Priority in in-service training plans should be given to teachers

working in areas that can be considered disadvantaged, such as rural regions.

- The scope of this study can be expanded to include different provinces and regions to determine the proficiency levels of science teachers in using educational technologies. This would aid in better planning of in-service training programs nationwide.

Limitations of the Study

This study is limited to teachers working in schools affiliated with the MoNE in line with the defined objectives. It was not conducted in private schools.

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