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Research Article

Investigating the Relationship between Digital Literacy and TPACK Levels of Pre-Service English Teachers***

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ABSTRACT

This mixed methods study explores the correlation between digital literacy and Technological Pedagogical Content Knowledge (TPACK) among pre-service English teachers at a Turkish state university. With 118 junior and senior participants, the study employs the Digital Literacy Scale and TPACK-Deep Scale for quantitative data, supplemented by focus group interviews for qualitative insights. Overall, pre-service teachers exhibited high TPACK and digital literacy levels, except for a medium proficiency level. Females scored higher in ethics. Significant differences emerged among participants with and without educational technology training, impacting digital literacy, TPACK, exertion, and proficiency. Pearson correlation analysis established a positive relationship between digital literacy and TPACK, with regression analysis identifying digital literacy as a predictor of TPACK. Qualitative findings underscore pre-service EFL teachers' perceptions of digital competence and TPACK.

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Statement of Publication Ethics

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Authors' Contribution Rate

Both authors were equally involved in the literature review, data collection, data analysis, and reporting stages.

Conflict of Interest

The authors declare that they have no conflict of interest.

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Introduction

Digitalization in education is not a new topic; however, with the entrance of Covid-19 into people's lives, it has gained much importance. Sudden lockdowns caused school closures and owing to current advanced technologies and the Internet, education continued online using various platforms. Digital skills and technological knowledge of both teachers and learners has come forward to be able to transfer traditional methods and techniques to this new learning environment smoothly and teachers have been required to find new methods and techniques if there is a conflict. In other words, the Covid-19 pandemic's emergency condition has demonstrated the importance of digital skills for both educators and students (Perifanou et al., 2021). Most of the education authorities think that Covid-19 pandemic becomes a critical moment as it shows how technology could be utilized in education and training; therefore, digital transformation in education has begun to gather momentum (Damşa et al., 2021; European Commission, 2020).

The National Education Technology Plan, published by the Office of Educational Technology in U.S (2017) provides a national action and plan for all stakeholders and recommends that pre-service and in-service teacher education provide learning experiences with technology and build teachers' digital literacy. It is also recommended that teacher training institutions make sure that all pre-service teachers should have a digital competence at the end of the program and have the necessary knowledge to transform education using digital technologies. In another report by the same institution, it is advised that pre-service teachers' engagements with educational technologies should be integrated into their method courses rather than offered as a separate course (Stokes-Beverly & Simoy, 2016).

According to Eurydice report, Turkey is one of a few European countries which do not have teacher-specific digital competence framework and top-level regulation on initial teacher education (Bourgeoi et al., 2019). General Competencies for Teaching Profession published by Ministry of National Education (MoNE) in 2017 was prepared as a reference for defining teacher competencies in addition to being a guide for higher education institutions which train teachers so that they can establish standards. Although this report mentions pedagogical and content knowledge as main components of teacher competence, there is no mention of technological knowledge or digital competence. Similarly, MoNE's 2023 Education Vision (2018) does not address teachers' digital competencies. However, one of the goals was to improve teachers' digital skills. After the sudden changes with the rapid transition to distance education because of Covid-19 pandemic, MoNE has realized the need of a resource about digital technologies for teachers and published Digital Literacy Teacher Handbook in 2020. This handbook introduces digital literacy term to teachers, defines components, and explains why digital literacy is important. It also offers some tips and ideas to integrate digital literacy into lesson content and promote digital literacy of students. It shows the ways to use digital technologies critically, efficiently, and ethically and what needs to be done to raise awareness of digital literacy among students and raise digital citizens (MoNE, 2020). Although there are actions to improve teachers' digital competencies and to exploit the potential of digital technologies in Turkey, a digital

competence framework for teachers considering the national needs is still missing. This absence hinders to assess digital competencies, skills and knowledge of teachers and understand the present situation (TEDMEM, 2020).

It is obvious that authorities accept that digital competence become a big aspect of education and they look for ways to integrate it into teacher training. König, Jager-Biela and Glutsch (2020) investigated early career teachers' adaptation to online teaching during Covid-19 pandemic and it was found out that teachers who had been taught about the effective use of digital technologies in teacher education and those who developed technological pedagogical knowledge were better at dealing with online teaching. It indicates that teachers who are aware of the potential of educational technologies as well as the risks and dangers and those who are competent to use them in teaching become advantageous. Moreover, teachers who cannot develop digital competency have difficulty in incorporating digital technologies in a meaningful way (Kabakçı-Yurdakul & Çoklar, 2014; Petko, 2012). Therefore, it can be said pre-service teachers are expected to graduate with necessary digital competencies (Howard et al., 2021); however, it does not mean that they know how to integrate technology into lessons content. They should also know how to design lessons combining content, pedagogy and technology. This leads to technological pedagogical content knowledge (TPACK) which this research will examine as part of the study. Technology use in language teaching has been well-received by the stakeholders because technology integrated lessons can promote the motivation and engagements of language learners (Mei et al., 2017). Teachers' TPACK knowledge is necessary for successful technology adoption in EFL context (Raygan & Moradkhani, 2020). Therefore, it can be concluded that it is important to learn the level of digital literacy and TPACK of future English teachers to better address technology integration in teacher preparation programs.

Literature Review

Digital literacy is "the awareness, attitude and ability of individuals to appropriately use digital tools and facilities to identify, access, manage, integrate, evaluate, analyze and synthesize digital resources, construct new knowledge, create media expressions, and communicate with others, in the context of specific life situations, in order to enable constructive social action; and to reflect upon this process" (Martin, 2005, pp. 135-136). Dudeney and Hockly (2016) argue that digital literacy is more than knowing how to use technological tools. Besides technical skills, people need to understand the potential of technology and utilize it to grow professionally and personally. They also prefer to call it digital literacies in plural form because it consists of various literacies under it. This view is supported by Lankshear and Knobel (2008) who state that digital literacies demonstrate the underlying socio-cultural perspective and it underscores diversity of digital literacy. Pegrum, Hockly and Dudeney (2022) put forward a four-part framework of digital literacy according to which the interconnectedness of communicating" (print, hypertext, multimodal, immersive, spatial, mobile, and code literacy), "informing" (tagging, search, filtering, and information literacy), "collaborating" (personal, network, participatory, intercultural, and ethical literacy), and "(re)designing"

(attentional, critical, and remix literacy) are essential components to enhance digital literacy skills for global communication.

In the contemporary era, where technology is ubiquitous in every aspect of our lives, students must acquire digital literacy to become responsible digital citizens and use technology not only within formal education but also in their personal lives. Teachers play a crucial role as role models in fostering good digital literacy. According to Redecker's report (2017), teachers need digital skills beyond operational knowledge to seamlessly integrate digital literacy into their lesson plans.

A substantial body of research assess the digital literacy levels of pre-service teachers, aiming to determine the readiness of higher education in adequately supporting future educators in this domain. In diverse studies, teachers demonstrated a willingness to learn and utilize digital tools but expressed concerns about their technological competence (Guikema & Menke, 2014). Additionally, the positive impact of a brief digital and media technology course on teachers' enthusiasm for integrating digital literacy into lessons was evident (Botturi, 2019). Casillas Martin et al. (2019) found a favorable attitude towards ICT among teachers. Similarly, Peled (2021) revealed a high perceived digital literacy level among teachers but identified challenges in critical analysis and ethical knowledge. Overall, research indicates that pre-service teachers benefit from practical experience to enhance and apply their digital literacy skills (Akayoğlu et al., 2020; Reisoğlu & Çebi, 2020), with pre-service teachers generally demonstrating moderate (Özcan, 2022) to high levels of digital literacy (Üstündağ, Güneş & Bahçıvan, 2017).

Repeatedly research shows that notwithstanding the considerable time spent on the internet, digital natives still exhibit gaps in certain aspects of digital literacy necessary for proficient use of various platforms (Margaryan et al., 2011; Miller & Bartlett, 2012; Ng, 2012). Similarly, pre-service teachers participating in List's (2019) study held the belief that they primarily gained digital literacy skills within the school environment rather than through their everyday experiences. Additionally, it was noted that individuals can autonomously develop digital literacy through exposure to technological tools or by creating content with a specific purpose. Hence, digital literacy for them emerged to be a skill acquired independently of being a digital native or joining a digital community.

The increase of ubiquitous technology usage around the world has caused inevitable end of integrating technology into education too. Scholars have started to answer questions stemming from the entrance of technology into education and they have been looking for the most efficient ways to take advantage of it. TPACK was born from this shared pursuit. TPACK is defined as:

> the basis of effective teaching with technology, requiring an understanding of the representation of concepts using technologies; pedagogical techniques that use technologies in constructive ways to teach content; knowledge of what makes concepts difficult or easy to learn and how technology can help redress some of the problems that students face; knowledge of students' prior knowledge and theories of epistemology; and knowledge of how technologies can be used to build on existing knowledge to develop new epistemologies or strengthen old ones (Koehler & Mishra, 2009, p. 66).

According to Koehler and Mishra (2009), the integration of fundamental teaching components, i.e., pedagogical content knowledge (PCK), technological content knowledge (TCK), technological pedagogical knowledge (TPK) generates technological pedagogical content knowledge (TPACK) at the intersection. TCK involves comprehending how technology and content mutually influence and limit each other (Koehler et al., 2013). TPK is an awareness of how technology can shape and facilitate specific pedagogical practices, while TPACK represents an understanding of the intricate connections among technology, pedagogy, and content, which empowers teachers to formulate suitable and context-specific teaching strategies (Koehler et al., 2014).

Given the pervasive use of technology everywhere, teacher education institutions are required to train educators capable of seamlessly integrating content, pedagogical, and technological knowledge, prepared to instruct students in line with 21st-century standards. Consequently, studies have concentrated on assessing the TPACK levels of pre-service teachers through surveys, interviews, documents, or observations, incorporating various variables. Typically, these measurements rely on self-statements from pre-service teachers, given the challenge of designing an instrument to independently gauge each knowledge domain, considering that each knowledge domain can vary based on factors like subject matter and age. Across studies, pre-service teachers have been found to rely on modeling for the integration of technology into courses (Redmond & Lock, 2013). With training on how to benefit from technology for subject-matter teaching, their TPACK levels increased (Lachner et al., 2021).

In large scale studies with large sample sizes, TPACK levels of pre-service teachers are shown to be high in Estonia (Luik, Taimalu & Suviste, 2018), China (Qui et al., 2022) and in Turkey (Kabakçı Yurdakul, 2018). There have also been efforts to integrate TPACK modules into experimental study designs (e.g. Lachner et al., 2021; Redmond & Lock, 2013). In one such study conducted in Turkey, Kurt, Mishra and Koçoğlu (2013) prepared a course design encouraging pre-service teachers to use technology in their teaching practice lessons. The survey data collected before and post-training showed that participants experienced a notable increase in their TK, TCK, TPK, and TPACK scores. Moreover, they developed an understanding of integrating technology skillfully into content and pedagogy, moving away from considering it as an additional tool. The results underscored the significance of the interplay between theory and practical applications of TPACK.

Research Aim and Research Questions

Technology-enhanced education systems demand teachers and learners who effectively and critically engage with digital technologies and who have the ability to access, manage, evaluate, integrate, create, and communicate information in all mediums in a web-based and networked environment. Accordingly, teacher education programs become places where future teachers learn not only content, methods and approaches but also relevant digital technologies and to orchestrate them synchronously.

The purpose of the study is to explore the relationship between digital literacy and TPACK levels of pre-service English as a foreign language (EFL) teachers in Turkey. With this aim in mind, the following research questions are put forward:

1. What are the perceived digital literacy and TPACK levels of pre-service EFL teachers?

2. How do gender, academic level, duration of the Internet use, frequency of the Internet use, and attendance at educational technology seminars affect pre-service EFL teachers' digital literacy and TPACK levels?

3. Is there a statistically significant relationship between pre-service EFL teachers' digital literacy and TPACK levels?

4. Does digital literacy predict TPACK level of pre-service EFL teachers?

5. What are the beliefs and views of pre-service EFL teachers regarding the digital competence?

Literature has shown the importance of digital literacy and TPACK levels of pre-service and in-service teachers to meet the needs of 21st century; however, there are a few studies which have investigated the profile of pre-service EFL teachers in Turkey (Akayoğlu et al., 2020; Turgut, 2017). This study aims to fill this gap by examining the relationship between digital literacy and TPACK levels of Turkish EFL pre-service teachers in Turkey. The result of the study could be beneficial to teacher educators because it gives clues on to what extent EFL teacher training programs in Turkey provides necessary digital competence to their students and it could offer some important insights of the Turkish EFL pre-service teachers' digital literacy and TPACK competence. The findings of this research could provide an important contribution to the authorities in developing policies on setting standards in all teacher education programs to make technology an essential part of curriculum.

Methodology

Research Design

Research approach helps researchers to plan how to collect, analyze and interpret data (Creswell & Creswell, 2018). In this research, mixed method approach was used to exploit the advantages of both quantitative and qualitative research and minimize the limitations of using either of them.

Publication Ethics

For this study, ethical committee approval was obtained by Yıldız Technical University Ethics Committee on 02 June 2022. The report number was 20220600524.

Participants

In the present study, convenience sampling which is a type of non-probability sampling was preferred. 118 pre-service EFL teachers from a state university in Turkey participated to the current study. Of 118 pre-service English teachers, 16 of them

voluntarily attended to the focus groups interviews. Focus group interviews were conducted both face-to-face and on Zoom because of convenience. Participants were junior and senior student teachers, who were studying an English Language Teaching (ELT) program at a state university in the spring semester of the 2021-2022 academic year. Students of this program are trained to become teachers, instructors, and academics in the field of English Language Teaching. The participants took courses which provide pedagogical and content knowledge as well as technological knowledge. Those who were in the final year of the program had also started compulsory teaching practicum. This bachelor program offers Information Technology course in the first year of the program and Instructional Technologies course in the second year of the program in the curriculum. The descriptive information of the participants is presented in Table 1.

Table 1. Distribution of the Socio-Demographic Variables

		Frequency	Percent
Gender	Male	43	36.4
	Female	75	63.6
Class	Junior	61	51.7
	Senior	57	48.3
Average Internet Use Total	2-5 Years	2	1.7
	5-10 Years	29	24.6
	10 Years +	87	73.7
Daily Internet Use for School/Work	0-2 Hours	35	29.7
	2-4 Hours	34	28.8
	4-6 Hours	28	23.7
	6 Hours +	21	17.8
Daily Internet Use for Free Time	0-2 Hours	16	13.6
	2-4 Hours	28	23.7
	4-6 Hours	49	41.5
	6 Hours +	25	21.2
Educational Technology Seminars/Workshop Attendance	Yes	68	57.6
	No	50	42.4
Number of Seminars/Workshop Attended	One	15	12.7
	1-2 or two	25	21.2
	2-3 and more	26	22.0

Data Collection and Analysis

A questionnaire was administered to collect quantitative data and focus group interviews were conducted to collect qualitative data and to provide deeper understanding of research questions. The questionnaire consisted of three parts; demographic information, Digital Literacy Scale and TPACK-Deep Scale. Digital Literacy scale, which was administered in this study, was developed by Ng (2012) and adapted to Turkish by Hamutoğlu, Güngören, Uyanık and Erdoğan (2017). The scale was a five-point Likert type ranging from (1) Strongly Disagree to (5) Strongly Agree. It consists of 17 items and 4 subscales which are Attitude, Technical, Cognitive, and Social-Emotional. The Cronbach's alpha coefficient value for the overall scale is .93, and for the subscales, attitude, technical, cognitive, and social-emotional they are .88, .89, .70, and .72 respectively. In this study, the Cronbach's alpha value for overall scale was found as .92 which indicates high internal reliability since it was greater than .8 (Pallant, 2020). To assess the participants' TPACK levels, TPACK-deep Scale was utilized which was developed by Kabakçı Yurdakul, Odabaşı, Kılıçer, Çoklar, Birinci and Kurt (2012). It is a five-point Likert type scale. It

consists of 33 items. Participants could answer each item as “strongly disagree” (1), “disagree” (2), “neither agree nor disagree” (3), “agree” (4), and “strongly agree” (5). The scale includes 4 subscales which were Design, Exertion, Ethics, and Proficiency. The Cronbach’s alpha coefficient value for the overall scale is .95 in the study of Kabakçı Yurdakul et al. (2012). The Cronbach’s alpha value for the design factor is .92, for the exertion factor it is .91, for the ethics factor, it is .86 and for the proficiency factor it is .85. Similarly, in the current study, the Cronbach’s alpha coefficient value for the overall scale was found as .95 which indicated that the scale has very good internal consistency reliability (Pallant, 2020). The alpha values of the subscales were .91, .90, .86, and .85 respectively.

In the current research, the focus groups interviews were conducted with both junior and senior participants to be able to get opinions from each level equally. The participants who had taken the survey were informed about the qualitative part of the study. Volunteer students got contacted by the researcher. Semi-structured interview questions were prepared beforehand to lead the discussions. A total of 16 prospective teachers participated the study. Eight junior students were interviewed face-to-face. The senior students were interviewed in two groups of four. One of the interviews was carried out online on Zoom platform and the other was held face-to-face due to the convenience of the participants. They approximately lasted half an hour.

The data were collected and it was interpreted following the quantitative and qualitative data analysis methods. The quantitative data was analyzed statistically on Statistical Package for the Social Sciences (SPSS) version 26.0. Normality tests were administered to the scales and the subscales. Skewness and Kurtosis values were interpreted to understand the distribution of the data. According to the normality test, all scales and subscales are between -1.5 and +1.5, with the exception of Digital Literacy (Kurtosis=2.20) and Attitude (Kurtosis=1.82). Hence, parametric tests were applied to assess normally distributed scales and subscales, while non-parametric analyses were employed for the evaluation of the Digital Literacy scale and its Attitude factor.

For the first research question, the descriptive statistics and frequencies were calculated and analyzed. Means and standard deviations were presented as well as minimum and maximum values of the scales and the subscales. For the second research question, an Independent Samples t-test, Mann-Whitney U test, One-way ANOVA test, and Kruskal Wallis test were conducted. For the third research question, the relationship between Digital Literacy and TPACK was investigated using Pearson Correlation Coefficient test. For the fourth research question, Simple linear regression was used to test if Digital Literacy significantly predicted TPACK. Finally, for the last research question, qualitative data which were collected from focus group interviews were analyzed in and to explore the data, content analysis was conducted. Content analysis is to scan the data to find repeated words or ideas (Patton, 1990). Going through the data, codes were detected and they were grouped under three themes. Codes were counted and the frequency and percentages were calculated depending on the total number of the codes. To ensure the reliability and validity, a second rater, who holds an MA degree on English language

teaching coded and evaluated the data. After second rater's evaluation, codes and themes were revised.

Procedure

The data for this study was collected in the spring term of 2021-2022 academic year in a state university in Turkey. At the time of the study, Covid-19 pandemic still continued, therefore, the participants were having some lectures virtual and some lectures in-person. The surveys were handed to the 118 participants in paper and the participants were informed on paper about the aim of the study, the parts of the survey, and the anonymity of the answers. The researcher collected the surveys and the volunteer students' contact information for the interviews were taken. Completing the quantitative data collection of the study, eight junior and eight senior student teachers were contacted in an online messaging platform. The volunteers were asked to give their consents and they were informed about the focus group discussion. The junior pre-service English teachers were interviewed face-to-face. Four senior students were interviewed face-to-face and four senior students were interviewed online on Zoom. All the interviews were conducted in Turkish. The duration of all the interviews encompassed approximately half an hour. They were recorded by the researcher and transcribed and translated into English afterwards.

Results

In the first research question, we aimed to find the perceived levels of digital literacy and TPACK of pre-service EFL teachers. The mean values of the scales and subscales were calculated and presented in the Table 2 below.

Table 2. Mean Scores of the Research Scales

	N	Mean	*SD*	Min	Max
Digital Literacy Total	118	4.06	0.66	2	5
Attitude	118	4.22	0.72	2	5
Technical	118	3.98	0.82	1	5
Cognitive	118	3.92	0.86	1	5
Social-Emotional	118	3.89	0.88	2	5
TPACK Total	118	134.80	17.58	76	165
Design	118	4.14	0.59	2	5
Exertion	118	4.18	0.54	2	5
Ethics	118	4.16	0.62	2	5
Proficiency	118	3.67	0.79	2	5

The learners perceived level of digital literacy was found to be 4.06 which shows that the participants have a high level of digital literacy (M = 3.68, SD = 5.00). Among the subscales, Social-Emotional (M = 3.89, SD = 0.88), Cognitive (M = 3.92, SD = 0.86), and Technical (M = 3.98, SD = 0.82) similarly indicated a high level of digital literacy. The highest mean score is Attitude (M = 4.22, SD = 0.72) which can be interpreted as the participants having a high level of attitudes toward ICT.

The participants total TPACK average was found to be 134.80. This indicates a high level of TPACK according to the rubric (Kabakçı Yurdakul, et al., 2012). For the subscales of TPACK, participants have the highest score in Exertion (M = 4.18, SD =

0.54) subscale. It is followed by Ethics (M = 4.16, SD = 0.62) and Design (M = 4.14, SD = 0.59) subscales. Proficiency (M = 3.67, SD = 0.79) subscale's mean score was average which can be interpreted that the participants had medium proficiency to integrate technology with the content and pedagogy.

In the second research question, the effects of independent variables on digital literacy and TPACK levels of pre-service EFL teachers were explored. In this regard, an Independent Samples t-test, Mann-Whitney U test, One-way ANOVA test, and Kruskal Wallis test were conducted. In the Table 3 below, the results of the independent samples t-test and Mann-Whitney U test which explore the gender differences in Digital Literacy and TPACK were presented.

Table 3. Comparison of Males and Females on Digital Literacy and TPACK

	Gender	Mean	*SD*	*t*	*p*
Digital Literacy Total	Male	4.18(*Mdn*)	0.72	1590 (*U*)	.900
	Female	4.18(*Mdn*)	0.62		
Attitude	Male	4.29(*Mdn*)	0.85	1821 (*U*)	.240
	Female	4.29(*Mdn*)	0.62		
Technical	Male	4.10	0.82	1.241	.217
	Female	3.91	0.82		
Cognitive	Male	3.99	0.88	.652	.516
	Female	3.88	0.86		
Social-Emotional	Male	3.79	0.88	-.962	-.338
	Female	3.95	0.88		
TPACK Total	Male	3.98	0.52	-1.579	.117
	Female	4.14	0.53		
Design	Male	4.06	0.52	-1.148	.253
	Female	4.19	0.62		
Exertion	Male	4.07	0.53	-1.615	.109
	Female	4.24	0.54		
Ethics	Male	3.98	0.64	-2.361	.020*
	Female	4.26	0.59		
Proficiency	Male	3.63	0.76	-.414	.680
	Female	3.69	0.80		

It was found that there was a statistically significant difference in Ethics subscale between males and females ($t(116) = -2.361$, $p<0.05$). According to the test result, female participants (M = 4.26, SD = 0.69) have higher man scores than male participants (M = 3.98, SD = 0.64) in terms of Ethics.

In the Table 4 below, the results of the independent samples t-test and Mann-Whitney U test which explain the difference in Digital Literacy and TPACK for the grade level variable were presented.

Table 4. Comparison of Juniors and Seniors on Digital Literacy and TPACK

	Class	Mean	*SD*	*t*	*p*
Digital Literacy Total	Junior	4.12(*Mdn*)	0.65	1841 (*U*)	.577
	Senior	4.18(*Mdn*)	0.66		
Attitude	Junior	4.43(*Mdn*)	0.71	1720 (*U*)	.922
	Senior	4.29(*Mdn*)	0.74		
Technical	Junior	3.90	0.84	-1.032	.304
	Senior	4.06	0.08		
Cognitive	Junior	3.84	0.86	-1.082	.282
	Senior	4.01	0.86		
Social-Emotional	Junior	3.94	0.90	.616	.539
	Senior	3.84	0.86		

TPACK Total	Junior	4.04	0.55	-.864	.389
	Senior	4.13	0.51		
Design	Junior	4.08	0.60	-1.084	.281
	Senior	4.20	0.57		
Exertion	Junior	4.12	0.56	-1.151	.252
	Senior	4.24	0.52		
Ethics	Junior	4.13	0.64	-.508	.613
	Senior	4.19	0.61		
Proficiency	Junior	3.68	0.80	.154	.878
	Senior	3.66	0.77		

Following the analysis, it was found that there was no significant difference in Digital Literacy, TPACK, and their subscales between juniors and seniors. ($p>0.05$).

In the Table 5 below, the results of the One-way ANOVA and Kruskal Wallis Tests which investigate the impact of the duration of the Internet use on Digital Literacy and TPACK were introduced.

Table 5. Multiple Comparison of Duration of Internet Use on Digital Literacy and TPACK

		Mean	***SD***	***F***	***p***
Digital Literacy Total	2-5 Years	4.09	0.45	2.551(*H*)	0.279
	5-10 Years	3.94	0.55		
	10 Years +	4.10	0.69		
Attitude	2-5 Years	4.21	0.70	0.971(*H*)	0.615
	5-10 Years	4.19	0.59		
	10 Years +	4.23	0.76		
Technical	2-5 Years	4.00	0.23	0.757	0.471
	5-10 Years	3.82	0.75		
	10 Years +	4.03	0.85		
Cognitive	2-5 Years	3.75	1.06	1.050	0.353
	5-10 Years	3.72	0.67		
	10 Years +	3.99	0.91		
Social-Emotional	2-5 Years	4.25	0.35	1.140	0.323
	5-10 Years	3.69	0.77		
	10 Years +	3.95	0.92		
TPACK Total	2-5 Years	4.26	0.53	0.236	0.790
	5-10 Years	4.04	0.48		
	10 Years +	4.10	0.55		
Design	2-5 Years	4.35	0.63	0.231	0.794
	5-10 Years	4.09	0.46		
	10 Years +	4.15	0.63		
Exertion	2-5 Years	4.33	0.58	0.262	0.770
	5-10 Years	4.12	0.47		
	10 Years +	4.19	0.56		
Ethics	2-5 Years	4.75	0.35	1.096	0.338
	5-10 Years	4.09	0.72		
	10 Years +	4.17	0.59		
Proficiency	2-5 Years	3.30	0.42	0.218	0.804
	5-10 Years	3.67	0.67		
	10 Years +	3.68	0.83		

It was found that there were no significant differences in terms of the research scales across the duration of the Internet use among groups ($p>0.05$). In other words, the duration of Internet usage among pre-service English teachers had no impact on their levels of Digital Literacy and TPACK.

In the Table 6 below, the results of the One-way ANOVA and Kruskal Wallis Tests which compare the effect of the Daily Internet Use for school/work on Digital Literacy and TPACK were presented.

Table 6. Multiple Comparison of Daily Internet Use for School/Work on Digital Literacy and TPACK

		Mean	*SD*	*F*	*p*
Digital Literacy Total	0-2 Hours	4.07	0.55	2.277(*H*)	.517
	2-4 Hours	4.09	0.64		
	4-6 Hours	4.15	0.67		
	6 Hours +	3.87	0.82		
Attitude	0-2 Hours	4.24	0.72	3.421(*H*)	.331
	2-4 Hours	4.25	0.70		
	4-6 Hours	4.34	0.71		
	6 Hours +	4.00	0.78		
Technical	0-2 Hours	4.02	0.75	1.091	.356
	2-4 Hours	4.00	0.75		
	4-6 Hours	4.07	0.84		
	6 Hours +	3.77	1.03		
Cognitive	0-2 Hours	3.96	0.67	.157	.925
	2-4 Hours	3.88	0.88		
	4-6 Hours	3.98	0.85		
	6 Hours +	3.83	1.15		
Social-Emotional	0-2 Hours	3.76	0.86	.808	.492
	2-4 Hours	4.06	0.89		
	4-6 Hours	3.95	0.85		
	6 Hours +	3.79	0.95		
TPACK Total	0-2 Hours	3.97	0.54	1.091	.356
	2-4 Hours	4.11	0.54		
	4-6 Hours	4.21	0.55		
	6 Hours +	4.07	0.44		
Design	0-2 Hours	4.05	0.59	.834	.478
	2-4 Hours	4.17	0.57		
	4-6 Hours	4.27	0.60		
	6 Hours +	4.06	0.60		
Exertion	0-2 Hours	4.04	0.58	1.498	.219
	2-4 Hours	4.18	0.53		
	4-6 Hours	4.33	0.52		
	6 Hours +	4.18	0.49		
Ethics	0-2 Hours	4.07	0.69	.398	.755
	2-4 Hours	4.22	0.56		
	4-6 Hours	4.15	0.71		
	6 Hours +	4.21	0.47		
Proficiency	0-2 Hours	3.51	0.75	1.045	.376
	2-4 Hours	3.69	0.82		
	4-6 Hours	3.86	0.76		
	6 Hours +	3.63	0.82		

The results indicated that there were not statistically significant differences in Digital Literacy and TPACK with respect to the participants' average daily Internet use for school/work ($p>0.05$).

In the Table 7 below, the results of the One-way ANOVA and Kruskal Wallis Tests which explore the differences in Digital Literacy and TPACK in terms of the Daily Internet Use in Free Time were presented.

Table 7. Group Comparisons of the Daily Internet Use in Free Time on Digital Literacy and TPACK

		Mean	*SD*	*F*	*p*
Digital Literacy Total	0-2 Hours	3.76	0.93	2.411(*H*)	.492
	2-4 Hours	4.01	0.61		
	4-6 Hours	4.16	0.53		
	6 Hours +	4.12	0.71		
Attitude	0-2 Hours	4.04	0.97	0.464(*H*)	.927
	2-4 Hours	4.15	0.79		
	4-6 Hours	4.30	0.59		
	6 Hours +	4.26	0.71		
Technical	0-2 Hours	3.60	1.08	1.672	.177
	2-4 Hours	3.91	0.79		
	4-6 Hours	4.12	0.64		
	6 Hours +	4.03	0.95		
Cognitive	0-2 Hours	3.63	1.21	1.162	.327
	2-4 Hours	3.91	0.89		
	4-6 Hours	3.91	0.66		
	6 Hours +	4.14	0.91		
Social-Emotional	0-2 Hours	3.41	1.12	2.286	.083
	2-4 Hours	3.88	0.76		
	4-6 Hours	4.06	0.79		
	6 Hours +	3.90	0.93		
TPACK Total	0-2 Hours	4.07	0.64	0.069	.976
	2-4 Hours	4.11	0.63		
	4-6 Hours	4.10	0.47		
	6 Hours +	4.05	0.47		
Design	0-2 Hours	4.04	0.65	0.263	.852
	2-4 Hours	4.16	0.66		
	4-6 Hours	4.18	0.52		
	6 Hours +	4.10	0.61		
Exertion	0-2 Hours	4.14	0.63	0.051	.985
	2-4 Hours	4.21	0.62		
	4-6 Hours	4.18	0.52		
	6 Hours +	4.17	0.45		
Ethics	0-2 Hours	4.38	0.59	0.964	.412
	2-4 Hours	4.18	0.74		
	4-6 Hours	4.13	0.57		
	6 Hours +	4.05	0.60		
Proficiency	0-2 Hours	3.69	0.99	0.074	.974
	2-4 Hours	3.66	0.78		
	4-6 Hours	3.70	0.71		
	6 Hours +	3.65	0.83		

The findings of one-way ANOVA and Kruskal Wallis indicated that the participants' daily Internet use in their free time had no effect on Digital Literacy and TPACK scores ($p>0.05$). It can be said that the time spent on the internet by pre-service English teachers had no impact on their levels of Digital Literacy and TPACK.

An Independent t-test and Mann-Whitney U test were conducted to explore the differences in Digital Literacy and TPACK with regard to attending an education technology training variable. The findings were presented in the Table 8 below.

Table 8. Comparison of Attending an Education Technology Training on Digital Literacy and TPACK

		Mean	*SD*	*t*	*p*
Digital Literacy Total	Yes	4.21(*Mdn*)	0.63	1309 (*U*)	.033*
	No	4.09(*Mdn*)	0.67		
Attitude	Yes	4.50(*Mdn*)	0.66	1379 (*U*)	.079
	No	4.21(*Mdn*)	0.77		
Technical	Yes	4.09	0.78	1.707	.090
	No	3.83	0.86		
Cognitive	Yes	3.99	0.81	0.961	.339
	No	3.83	0.92		
Social-Emotional	Yes	3.98	0.82	1.204	.231
	No	3.78	0.95		
TPACK Total	Yes	4.18	0.48	2.284	.024*
	No	3.96	0.57		
Design	Yes	4.23	0.53	1.855	.066
	No	4.02	0.64		
Exertion	Yes	4.26	0.51	2.099	.038*
	No	4.06	0.56		
Ethics	Yes	4.24	0.58	1.754	.082
	No	4.04	0.66		
Proficiency	Yes	3.80	0.67	2.203	.030*
	No	3.48	0.89		

According to the Mann-Whitney U test result, there was a significant difference in Digital Literacy between participants who attended an educational technology training and participants who did not attend any (U = 1309, $p<0.05$). Digital Literacy levels of participants who participated to an educational technology training (Mdn = 4.21) were higher than those of participants who did not participated any trainings (Mdn = 4.09).

According to the Independent Samples t-test results, there were significant differences in TPACK ($t(116) = 2.284$, $p<0.05$), Exertion ($t(116) = 2.099$, $p<0.05$), and Proficiency ($t(116) = 2.203$, $p<0.05$) between groups. Participants who attended seminars/workshops on educational technology (M = 4.18, SD = 0.48) had higher mean scores than those who did not attend any (M = 3.96, SD = 0.57) in TPACK. They (M = 4.26, SD = 0.51, M = 3.80, SD = 0.67) also had higher mean scores in Exertion and Proficiency (M = 4.06, SD = 0.56, M = 3.48, SD = 0.89).

In the Table 9 below, the results of the One-way ANOVA and Kruskal Wallis Tests which compare the effect of the frequency of pre-service English teachers' attendance at educational technology trainings on Digital Literacy and TPACK were presented.

Table 9. Group Comparisons on Digital Literacy and TPACK according to the Frequency of Educational Technology Trainings Participants Attended

		Mean	*SD*	*F*	*p*
Digital Literacy Total	1	4.02	0.80	6.369(*H*)	.095
	1-2 and 2	4.15	0.71		
	2-3 and +	4.29	0.43		
Attitude	1	4.14	0.79	4.529(*H*)	.210
	1-2 and 2	4.30	0.76		
	2-3 and +	4.47	0.46		
Technical	1	3.91	1.00	2.095	.077
	1-2 and 2	4.07	0.80		

	2-3 and +	4.38	0.56		
Cognitive	1	3.73	1.05	1.034	.380
	1-2 and 2	4.00	0.84		
	2-3 and +	4.13	0.65		
Social-Emotional	1	4.17	0.88	1.034	.381
	1-2 and 2	4.04	0.88		
	2-3 and +	3.81	0.77		
TPACK Total	1	4.11	0.51	2.343	.077
	1-2 and 2	4.17	0.49		
	2-3 and +	4.26	0.46		
Design	1	4.21	0.55	1.276	.286
	1-2 and 2	4.20	0.52		
	2-3 and +	4.28	0.56		
Exertion	1	4.21	0.57	1.708	.169
	1-2 and 2	4.28	0.52		
	2-3 and +	4.30	0.50		
Ethics	1	4.10	0.65	2.410	.071
	1-2 and 2	4.23	0.58		
	2-3 and +	4.40	0.48		
Proficiency	1	3.69	0.71	2.395	.072
	1-2 and 2	3.81	0.65		
	2-3 and +	3.92	0.67		

Subjects were divided into four groups according to their answers to the open-ended question which asks how many educational technology trainings (seminars/workshops) they have attended so far (Group 1: 1 training, Group 2: 1-2 and 2 trainings, Group 3: 2-3 and more trainings). The results obtained from the tests showed that there were not any significant differences in Digital Literacy and TPACK based on the frequency of attendance at educational technology training groups ($p>0.05$).

In the third research question, the relationship between Digital Literacy and TPACK was investigated using Pearson Correlation Coefficient test and the findings were presented in the Table 10 below.

Table 10. Correlation Analysis Between Digital Literacy and TPACK Scales

Scales	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
TPACK Total	1									
Design	.920**	1								
Exertion	.944**	.845**	1							
Ethics	.709**	.481**	.608**	1						
Proficiency	.840**	.744**	.707**	.482**	1					
DL Total	.581**	.555**	.554**	.346**	.511**	1				
Attitude	.439**	.403**	.437**	.302**	.339**	.882**	1			
Technical	.574**	.555**	.531**	.309**	.554**	.876**	.594**	1		
Cognitive	.417**	.392**	.388**	.283**	.360**	.720**	.474**	.672**	1	
Social-Emotional	.413**	.427**	.395**	.186*	.368**	.660**	.607**	.396**	.348**	1

The findings revealed that there was a positive relationship between Digital Literacy and TPACK and their subscales ($p<0.05$). There was a strong positive correlation between Digital Literacy and TPACK ($r = .581$, $p<0.05$), between Digital Literacy and Design ($r = .555$, $p<0.05$), between Digital Literacy and Exertion ($r = .554$, $p<0.05$), and between Digital Literacy and Proficiency ($r = .511$, $p<0.05$). There was also a strong positive correlation between TPACK and Technical dimension of Digital Literacy ($r = .574$, $p<0.05$), between Technical and Design dimension ($r = .555$, $p<0.05$), between Technical

and Exertion dimension (r =.531, p<0.05), and Technical and Proficiency dimension of TPACK (r =.554, p<0.05).

In the fourth research question, simple linear regression was used to test if Digital Literacy significantly predicted TPACK and the findings were presented in the Table 11 below.

Table 11. Regression Analysis for Digital Literacy Predicting TPACK

Predictor	*B*	Std. Error	Beta	*t*	*p*
Constant	71.980	8.281		8.692	.000
Digital Literacy	0.910	0.118	0.581	7.685	.000*

The results of the regression indicated that Digital Literacy significantly predicted TPACK ($\beta = 0.581$, $p < 0.01$). This finding showed that Digital Literacy explained 33.7 % of the variance in TPACK.

For the last research question, focus group interviews were conducted with the total of 16 junior and senior pre-service English teachers. Going through the data, codes were detected and they were grouped under three themes. Codes were counted and the frequency and percentages were calculated depending on the total number of the codes. Table 12 shows the main themes and the distribution of the codes.

Table 12. Themes and Codes of Pre-Service EFL Teachers' Views on Digital Competence

Themes	Codes	*f*	%
Institution-related Issues	Inefficient Courses	9	14
	Need for Courses on Technology Integration	4	6
	Need to Learn Useful Apps and Digital Tools	5	8
	Need of Seminars / Workshops on Educational Technology	6	9
Teacher Educators - related Issues	TE as Role Models	8	13
	TE's Lack of Technology Integration in Courses	7	11
Pre-Service EFL Teachers - related Issues	Pre-Service EFL Teachers' Incompetence	4	6
	Self-learning	8	13
	Learning by Doing	11	17
	Peer-Learning	2	3
	TOTAL	64	100

The views of pre-service English teachers on how their teacher training institutions and departments address digital competence were centered around three major themes which are institution-related, teacher educators-related and pre-service EFL teachers related issues.

The participants were asked questions about whether departmental courses and educational technology courses were effective and they contribute to their understanding of digital competence. The most elicited answers from the participants were inefficiency of Informational Technology and Instructional Technologies courses which are required

courses for teacher training programs. Regarding this, some of the comments made by the participants can be seen below:

> We took a technology course at the first years of the university. It was such an inefficient course that we were given encyclopedic knowledge such as even the tiniest hardware of a computer which does not concern us at all (P9).
>
> We took courses (Instructional Technologies and Informational Technology) two terms and the content was not beneficial at all because they were teaching software and hardware pieces and they were not intended for our profession. They were mainly technical (P12).

When the data is examined in detail it seems that teacher educators are seen as role models in terms of the use of technology in education. Following comments were shared regarding the issue:

> In English Literature course, we have learned lots of (examples for technology integration).
> Our instructor is a person who loves using the Internet very much. I took notes of digital tools. For example, there was a map travelling around the world and s/he told the names of these (P13).

When we look into details in the qualitative data, it is obtained that pre-service English teachers are aware of their parts in learning technology and its integration in undergraduate level. The most mentioned things by pre-service English teachers was Learning by Doing (17%). In general, the participants shared that they need a hands-on experience to learn and practice new technologies instead of talking about theories.

> I do not remember the name of the course. We learned how to write a blog. We wrote English blogs. It was really good. We prepared advertisements. I think they were so impressive in terms of teaching English….The university should expose us to it. It should establish some criteria for instructors while giving presentations and teaching. We need to use them or it should provide hands-on experience so that we can see (P5).
> The content of the computer courses that we mentioned should be determined properly. In the exam we were given questions. We memorized them and it does not benefit. Instead there could have been performance-oriented things in the assessment (P12).

Discussion

With respect to the first research question, which is asked to identify the digital literacy and TPACK levels of pre-service English teachers, the results revealed that the participants had a high level of digital literacy and TPACK. These findings are in line with those of previous studies (Peled, 2021; Liza & Andriyanti, 2020; Ata & Yıldırım, 2019; Redmond & Lock, 2013; Luik, Taimalu & Suviste, 2018). They also showed high perceptions on sub dimensions of TPACK which are Design, Exertion and Ethics. However, their Proficiency level could not exceed the average. Kabakçı Yurdakul (2011, 2018) also reported that pre-service teachers' perceptions of Design, Exertion and Ethics were high except for Proficiency which was moderate. Based on this finding, it can be inferred that pre-service teachers conceived themselves competent in designing a lesson with the help of technological and pedagogical knowledge, implementing it considering ethical issues; however, they do not feel proficient enough to integrate technology into content, and furthermore, they may have problems in finding solutions to possible problems with respect to this. This is also corroborated by the qualitative analyses which suggest that pre-service English teachers do not feel competent enough to use technology

in education and in their teaching training programs, they demand courses in which they can practice and learn new things by being an active learner.

The results of this study indicated that gender did not play a significant role in influencing Digital Literacy and TPACK scores, including its sub dimensions. However, a notable exception was identified in the Ethics subdimension of TPACK, where female pre-service teachers exhibited significantly higher scores than their male counterparts. Additionally, the findings of parametric and non-parametric tests also indicated that the participants' academic level (junior, senior) had no effect on their Digital Literacy and TPACK scores. These results seem to be consistent with other research which found that digital literacy and TPACK does not differ significantly according to academic level (Karagözoğlu & Gezer, 2022; Altun, 2017; Atar et al., 2019). When it comes to the duration of the Internet use and the frequency of the Internet use for school or work, the results showed that these independent variables had also no effect on digital literacy and TPACK scores. This outcome is contrary to that of Ata & Yıldırım (2019) who found that the more participants spend time on the Internet, the more digital literacy skills they have. It can be said that participants in the current study may not use the Internet for the aspects of digital literacy or they may not be aware of the fact that they can turn internet use into a gain in knowledge and skills. As for the educational technology trainings such as seminars or workshops, the participants who attended any educational technology trainings before had higher digital literacy scores than those who did not attend any. However, this difference was not affected by the number of trainings attended. When educational technology trainings and TPACK were examined, it was found that there was a significant difference between participants who attended educational technology trainings and those who did not attend any in terms of TPACK, Exertion, and Proficiency. Although the number of trainings did not lead to any significant differences between groups across all the scale and subscales, this shows the importance of the impact of trainings for technology use in education. ICT support and training can cause efficient technology integration in the classrooms (Tondeur et al., 2008). These trainings might help pre-service teachers to understand the philosophy behind technology integration and they can see the current trends in education and even get hands-on experience. They can meet experts from the field and learn different applications and practices which they can apply in their own teaching. Thus, these trainings could be an additional way to develop pre-service teachers' TPACK competence.

The findings revealed that there was a strong positive relationship between Digital Literacy and TPACK. In the subscale level, there was a strong positive correlation between Digital Literacy and Design, Exertion, and Proficiency. This finding corresponds to the that of the study conducted by Altun (2017) who found a significantly high relationship between TPACK and digital literacy. Additionally, there was a significant positive relationship between Technical dimension of digital literacy and TPACK. There was also a significant correlation between Technical dimension of Digital Literacy and the Design, Exertion, and Proficiency factors of TPACK. This means that participants who reported high technical competence showed higher perceptions of TPACK. This could underline the importance of technical skills in cultivating digital competence of pre- service EFL

teachers, even though research claimed that it should not be the sole focus of instruction (Tondeur et al., 2018).

Together with the relationship between Digital Literacy and TPACK, this study aims to find out whether Digital Literacy affect TPACK. Having conducted regression analysis, it was revealed that Digital Literacy significantly predicted the TPACK scores of pre-service English teachers. This finding showed that Digital Literacy explained 33.7 % of the variance in TPACK. These results are in alignment with Altun's (2017) finding which showed that digital literacy is a predictor of TPACK level of pre-service teachers. Digital literacy combines all the skills and knowledge from cognitive and technical skills to social aspect of digital environment to be able to survive in digital world. Therefore, it is plausible to expect that digital literacy becomes an essential to design technology integrated lessons and it influences TPACK competency of pre-service teachers accordingly (Casillas Martin et al., 2020; Reisoğlu, 2022).

The final research question investigated participants' perspectives on digital competence and evaluations of the effectiveness of their ICT and departmental courses within their teacher training institutions. After the extensive analysis of focus group interviews, three themes were elicited. They were Institution-related Issues, Teacher Educators-related Issues and Pre-service EFL Teachers-related Issues. The study showed that pre-service EFL teachers do not believe they achieve digital competence by taking these courses. This result is supported with the study by Baek and Sung (2021) which was conducted in South Korea. They claimed that pre-service teachers considered their technology education courses inadequate and these courses were not connected to each other. It was also suggested that there was a need to have a technology course in which they could learn up-to-date information from the area and effective ways to integrate technology into lessons and trainings on educational technology. This result is in line with the study carried out by Aslan and Zhu (2017). In their study, they investigated the variables effecting the successful ICT integration into teaching practice and they concluded that pedagogical knowledge and ICT related courses were the important predictors of a successful technology integration. Chai et al. (2010) also claimed that skill-based ICT courses can enhance pre-service teachers' understanding of TPACK.

It was also observed that the participants saw their instructors as role models in technology integration. This result is in line with the studies which underline the importance of teacher educators as role models when presenting educational technologies (Akayoğlu et al., 2020; Dinçer, 2018; Redmond & Lock, 2013; Tondeur et al., 2018; Wang et al., 2018). Interestingly, the participants mentioned that they felt incompetent in terms of technology integration although they were raised in digital era. This is aligned with the studies that have revealed that, although student teachers were active users of the digital technologies and the Internet, their usage remained at a basic level, their actual proficiency in utilizing these skills was low, and they lacked the necessary competence to integrate ICT into teaching (Aslan & Zhu 2017; McGarr & McDonagh, 2021). In the current study, it is also found out that hands-on experience was more effective and preferable by pre-service EFL teachers. This result seemed to be consistent with other research which emphasized the importance of learning by doing in technology integration education for

prospective teachers (Kimm et al., 2020; Reisoğlu & Çebi, 2022; Tondeur et al., 2012; Lohnes Watulak et al., 2018). Peer-learning is another way to learn different educational technologies. Collaboration with peers provide an opportunity to see examples of digital applications and tools (Kurt et al., 2014).

Conclusion

In conclusion, this study has provided valuable insights into the digital literacy and Technological Pedagogical Content Knowledge (TPACK) levels of Turkish pre-service English teachers. Firstly, the findings underscored a generally high level of perceived TPACK and digital literacy levels among participants. Interestingly, female participants displayed higher mean scores in Ethics factor within TPACK. Additionally, the study highlighted the impact of educational technology training, as participants who attended such training demonstrated higher proficiency in Digital Literacy, TPACK, Exertion, and Proficiency factors. This study has also revealed significant correlation between Digital Literacy and TPACK levels among Turkish pre-service English teachers. Notably, a positive relationship was identified, emphasizing the interconnected nature of these competencies. Additionally, the study found that digital literacy serves as a predictor of TPACK proficiency, shedding light on the pivotal role of digital literacy in shaping technological and pedagogical knowledge. These findings underscore the importance of considering the interdependence of Digital Literacy and TPACK in the professional development of pre-service EFL teachers, highlighting the need for targeted interventions to enhance both competencies. Finally, qualitative analysis further enriched the understanding of pre-service EFL teachers' perceptions of digital competence and TPACK. Consequently, teacher training programs need to renew computer courses to align with current language education technology trends. Offering subject-specific courses in English language teaching applications and tools is also crucial. Moreover, pre-service English teachers must be given opportunities for TPACK development through targeted technology integration courses, allowing them to experiment with diverse digital tools and resources. Although the results cannot be generalized mostly because of the small number of participants and self-reported surveys, it adds valuable insights into EFL programs in terms of digital competence and TPACK in Turkey. For further research, it is recommended to conduct a broader study that includes lesson plans and class observations Furthermore, developing a competence test to measure the actual digital literacy and TPACK of pre-service teachers might be considered.

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