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Technological Pedagogical Content Knowledge (TPACK) Level and Needs of Pre-Service English as a Foreign Language (EFL) Teachers: Evidence from Turkey

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Artículos científicos

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Nivel de conocimiento del contenido pedagógico tecnológico (TPACK) y necesidades de los profesores de Inglés como Lengua Extranjera (ILE) en pre-servicio: evidencia de Turquía

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Abstract:

The current study investigated the Technological Pedagogical Content Knowledge (TPACK) level and needs of pre-service teachers through a convergent parallel design. The participants included 120 English as a Foreign Language (EFL) pre-service teachers, 79 females and 41 males, studying at a state university in Turkey. The TPACK-Deep scale developed by Kabakçı-Yurdakul et al. (2012) served as the quantitative data collection instrument and an open-ended questionnaire was used to collect qualitative data on the opinion and needs of the participants. As for the analysis of quantitative data, the authors employed descriptive statistics. On the other hand, a thematic analysis was implemented for the qualitative data. The findings indicated that EFL pre-service teachers generally had a high level of TPACK proficiency. Moreover, the TPACK needs of student teachers were mainly related to technology-based problems (TK, TCK, and TPK) and access to technological tools. Finally, at the end of the article, further suggestions and implications are provided for prospective studies and scholars over the above-mentioned issues.

Keywords: Technological Pedagogical Content Knowledge, TPACK, Pre-Service EFL Teachers, English as a Foreign Language, Needs, Technologies.

Resumen:

El estudio actual investigó el nivel de Conocimiento Tecnológico Pedagógico del Contenido (TPACK) y las necesidades de los futuros docentes a través de un diseño paralelo convergente. Los participantes incluyeron 120 futuros maestros de Inglés como Lengua Extranjera (ILE), 79 mujeres y 41 hombres, que estudiaban en diferentes grados en una universidad estatal en Turquía. La *escala TPACK-Deep* desarrollada por Kabakçı-Yurdakul et al. (2012) con respecto a diferentes aspectos de TPACK sirvió como instrumento de recopilación de datos cuantitativos y se utilizó un cuestionario abierto para recopilar datos cualitativos sobre la opinión y las necesidades de los estudiantes de magisterio. En cuanto al análisis de los datos cuantitativos, se utilizó estadística descriptiva. Por otro lado, se implementó un análisis temático para los datos cualitativos. Los hallazgos indicaron que los futuros maestros de ILE generalmente tenían un alto nivel de competencia en TPACK. Además, las necesidades de TPACK de los estudiantes de magisterio estaban relacionadas principalmente con problemas basados en tecnología (TK, TCK y TPK) y el acceso a herramientas tecnológicas. Finalmente, al final del artículo, se brindan más sugerencias e implicaciones para estudios prospectivos y académicos sobre los temas mencionados anteriormente.

Palabras clave: Conocimiento Tecnológico Pedagógico del Contenido, TPACK, Docentes de ILE en formación, Inglés como Lengua Extranjera, Necesidades, Tecnologías.

1. Introduction

Technology has probably been the most important concept of our life in the 21st century. When the ubiquitous nature of technology in our world is taken into consideration, there seems to be no other option for human beings to escape from the irresistible influence it exerts in every aspect of our lives. In the same vein, while teaching the digital natives (Prensky, 2001), who are the original users of technology, all teachers especially those who are categorized mostly as digital immigrants (Prensky, 2001) should have enough knowledge regarding the nature of the technological instruments and how to use them besides the knowledge they possess about a specific content under instruction and the proper pedagogy that content requires. Therefore, based on the needs of the current era, Shulman's (1986) theory of pedagogical content knowledge (PCK) inspired *Technological Pedagogical Content Knowledge* (TPACK), which highlighted the necessity for educators to exhibit their capacity to integrate technology into the subject and the pedagogical domain. Putting this current concept at the center, this paper first presents a description of what TPACK refers to and reviews some current studies conducted on it. Then, the methodological details of the research process are shared, and next, the findings derived from the data sets are presented. Finally, the results are discussed in line with the existing literature and suggestions for further research on TPACK are touched upon.

1.1. Defining TPACK

According to Wang et al. (2018), teachers must dedicate as much attention to the content aspects of teaching as they have devoted to the teaching process elements in order to appropriately combine these two components. Accordingly, the term TPACK was first used in the field of educational research to describe a conceptual framework for analyzing teacher knowledge required for technology integration (Mishra & Koehler, 2006). In other words, this concept is related to teaching specific content with suitable pedagogical approaches and methods while using appropriately selected technologies (Koehler & Mishra, 2009).

Some scholars claim that TPACK is a synthesis of three main knowledge domains (Schmidt et al., 2009). As noted by Arslan (2020), the above-mentioned domains are content knowledge (CK), pedagogical knowledge (PK), and technological knowledge (TK), and based on these three areas of knowledge, teachers are expected to incorporate their content, pedagogy, and technology expertise into their teaching process to ensure that students learn efficiently and effectively. When instructors use technology in their classrooms, they must build a technological understanding in addition to the pedagogical content knowledge (PCK) they already have. In other words, they must combine TK with PCK (Arslan, 2020). As displayed in Figure 1, another approach to look at TPACK is to observe how these three fundamental bodies of knowledge intersect into Technological Pedagogical Knowledge (TPK), Technological Content Knowledge (TCK), Pedagogical Content Knowledge (PCK), and Technological Pedagogical Content Knowledge (TPACK) (Tseng et al., 2019).

Having mentioned all the knowledge areas related to TPACK, there is still a need for recognizing the difference between each concept to fully understand the importance and integration of them (Wang et al., 2018). Hence, starting with the first knowledge area, TK refers to technological literacy and the effective application of various forms of technology and technological instruments in both personal and educational settings. It is more flexible and subject to change than the other categories of knowledge in the model. As a result, it is constantly renewing and updating itself (Sariçoban et al., 2019; Schmidt et al., 2009). On the other hand, PK encompasses the teachers' ability in understanding teaching techniques, processes, and methods (Koehler et al., 2007). Also, understanding how students learn, classroom management tactics, lesson planning, and student assessment are all part of PK, as well. Therefore, instructors must be familiar with cognitive, social, and developmental theories of learning as well as the skills to implement them in the

classroom (Arslan, 2020; İşler & Yıldırım, 2018). Likewise, related to the teacher, CK entails the quantity and organization of subject knowledge in instructors' mentality. Thus, it refers to the level of subject-matter expertise that teachers must possess (Shulman, 1986; Thohir et al., 2020). Moving on to a further level, the integration of technology once with pedagogical knowledge and then with content knowledge brings about novel areas of knowledge named TPK and TCK. While TPK demands an understanding of how to use technology to implement educational strategies or when to employ them (Nazari et al., 2019; Özdilek & Robeck, 2018), TCK calls for an understanding of how technology can be used to turn subject matter into comprehensible representations i.e., using audio-visual speech synthesis or talking heads to show English pronunciation (Bostancıoğlu & Handley, 2018; Mishra & Koehler, 2006). Finally, a teacher's capacity to integrate pedagogical and content knowledge in such a way that students can easily access the content knowledge originates from PCK (Chai, 2019).

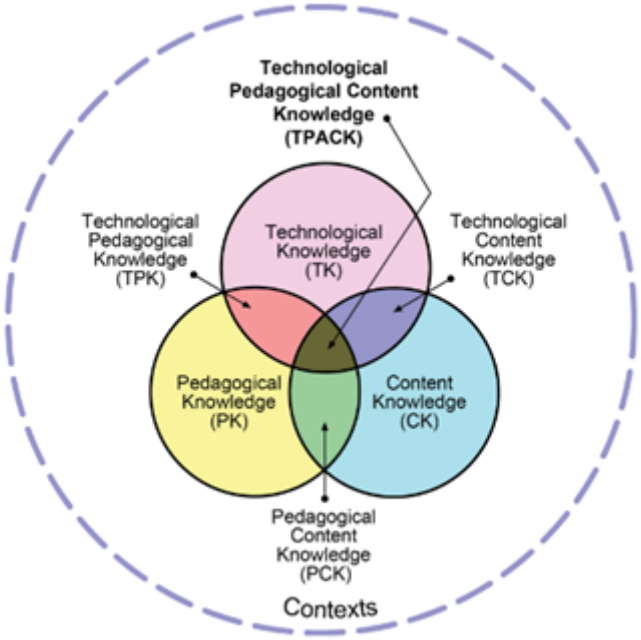

FIGURE 1.
Technological Pedagogical Content Knowledge Framework
Source: Retrieved from Tpack.org (2011).

1.2. The Current Study

Studies conducted over the concept of TPACK with pre-service EFL teachers, many were found to explore TPACK competency and level through a quantitative assessment tool (Atar et al., 2019; Kavanoz et al., 2015; Sarıçoban et al., 2019; Simsek & Yazar, 2019). Therefore, there is a scant body of literature over a mixed-methods design study over this issue. Moreover, the needs of pre-service teachers regarding TPACK have also received little attention. So, in order to fill the aforementioned gaps, in this study, besides the TPACK level, the needs of the student teachers will be further explored via a convergent parallel design that would focus on both qualitative and quantitative data which will be gathered simultaneously. Hence, the current study aims at investigating the Technological Pedagogical Content Knowledge (TPACK) Level and Needs of Pre-Service EFL Teachers at a state university in Turkey. Accordingly, the following two main research questions will be addressed.

1. What is the current TPACK level of pre-service EFL teachers?

2. What are the opinions and needs of the pre-service EFL teachers related with their TPACK?

2. Literature Review

2.1 Studies on TPACK of Pre-Service Teachers

In the literature, many scholars have focused on TPACK in various contexts and with different methodological perspectives, so far. For instance, Thohir et al. (2020) aimed to identify pre-service teachers' competencies in integrating technology into science instruction through two-step questionnaires. In the same vein, Aktaş and Özmen (2020) looked into the TPACK development of pre-service science teachers who took part in a TPACK Development Course (TPACK-DC) with three stages including a training course, preparing lesson plans using micro-teaching, and school application. Specifically, some studies investigated TPACK considering a specific branch of science such as chemistry, physics, and biology. In their study, for example, Özdilek and Robeck (2018) examined the influence of case-based lesson plans on pre-service Chemistry teachers' TPACK. Comparably, chemistry teachers' TPACK was analyzed via utilizing not only lesson plans but also through TPACK questionnaires, content assessment, reflective journals, and learning process observations in another study (Paristiowati et al., 2020). Likewise, exploring the effectiveness of strategy training for TPACK, Tondeur et al. (2020) applied a two-step mixed-methods study considering pre-service teachers who were specializing in STEM, Arts, and Physical Education.

2.2. Studies on TPACK in EFL teacher education

Many other studies conducted in the literature focused on investigating EFL pre-service and in-service teachers' TPACK levels and perceptions. For instance, taking Wu and Wang's study (2015) about in-service EFL teacher's TPACK at an elementary school into account, it can be said that besides the above-mentioned educational fields, language teaching especially English language teaching can be labeled as one of the fields that have also paid special attention to TPACK. Besides the preceding study, several other studies took in-service EFL teachers as their participants (Hsu et al., 2021; Lai et al., 2022; Nazari et al., 2019; Prasojo et al., 2020; Wu & Wang, 2015); however, pre-service teachers were found to constitute the participants of most of the studies in the EFL context. In a complex study, for instance, over the course of 14 weeks, Tseng et al. (2019) wanted to see how six pre-service English teachers used design thinking to implement various types of TPACK while addressing contextual concerns that influenced their web-conferencing teaching. Their study yielded the idea that while the teachers' conversations were clearly oriented toward Pedagogical Content Knowledge rather than technology-based knowledge, these discussions were not notably related to Technological Pedagogical Knowledge. Additionally, identified as two interfering contextual factors, technical problems related to the quality of the sound and the teachers' concerns regarding the students' short attention span and their prior knowledge were found to affect web-conferencing teaching. Furthermore, in spite of the short-term program which was mentioned in the above study, a longitudinal study was designed to see if pre-service teachers' perceptions of their own TPACK follow an increasing linear trend in four-year teacher preparation programs, particularly in ELT. However, the findings of the research indicated a nonlinear pattern of TPACK development over time (Turgut, 2017). On the other hand, in their mixed-methods studies, both Cesur and Ertas (2018) and İşler and Yıldırım (2018) investigated the perception of pre-service Turkish EFL teachers with a difference that the former only paid attention to pedagogical content knowledge (PCK) instead of TPACK. The results of the first study displayed a mismatch between the theoretical and practical knowledge of pre-service teachers with regard to pedagogical content knowledge. But in the latter study, both quantitative and qualitative data revealed a high level of perception on TPACK.

Likewise, Atar et al. (2019) and Sariçoban et al. (2019) identified the TPACK competence level of EFL pre-service teachers and determined the impact of several variables such as gender and grade on TPACK. Consequently, these two separately done studies came up with nearly the same results indicating that pre-service English teachers' TPACK level was high and some variables such as age were found to have effects on TPACK. Furthermore, through observing four Malaysian pre-service TESOL teachers, Singh and Kasim (2019) investigated how TPACK mastery of the pre-service teachers can help them with their actual practice of teaching and found that the pre-service teachers not only had enough information about TPACK but also came up with useful and effective TPACK strategies which were appealing to students. Also, even though both Ekmekçi, (2018) and Wang et al. (2018) prepared review papers about EFL pre-service teachers' TPACK, the former determined the research tendency of the selected articles about TPACK and the latter one examined pre-service teachers' TPACK development organized around different research methods.

3. Method

3.1. Research Design

Used for merging and interpreting the quantitative and qualitative data, the convergent-parallel design as a concurrent approach entails the accumulation of complementary data on a specific phenomenon at the same time. In other words, it is a single-phase approach that collates and analyses quantitative and qualitative data separately but at the same time (Creswell, 2012; Edmonds & Kennedy, 2017). In this regard, to comprehend whether quantitative data coming from a Likert-scale survey overlaps or supports the ideas and themes stemming from qualitative data which in turn has been gathered through the open-ended questionnaire in the same period as the TPACK questionnaire, this study implemented a convergent-parallel design.

3.2. Participants and Research Context

The participants of the study were determined through convenience sampling in which the researcher collects data from a participant group that is easy to access for research purposes (Creswell, 2012). 120 EFL pre-service teachers studying at the English language teaching department (ELT) of a state university in Turkey participated to the study. In the program, students have to get a certain level of achievement in a nation-wide exam after high school, and if they are admitted to the program, they have to pass a language proficiency test to be eligible to study in that program. After entering the program, EFL pre-service teachers receive a four-year education consisting of skill courses lectured in English, pedagogical courses, subject matter courses, and the practicum phase.

As illustrated in Table 1, among 120 participants (79 females and 41 males), 26 of them were first-year students, 13 were second graders, 67 of them were third-year students, and 14 students were in their fourth-year preparing lesson plans for their practicum courses and practically implementing them in real classrooms which are designed to prepare them for the prospective actual teaching process.

TABLE 1
Distribution of the Participants

Grade	Female		Male		Total	
	F	%	f	%	F	%
1st Year	19	15.8%	7	5.8%	26	21.7%
2nd Year	8	6.7%	5	4.2%	13	10.8%
3rd Year	46	38.3%	21	17.5%	67	55.8%

Source: Own elaboration.

3.3. Data Collection Instruments

The quantitative data of this study were gathered through the 'TPACK-Deep Scale' developed by Kabakçı-Yurdakul et al. (2012). The scale consisted of 33 items with a five-point Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). The content of the questionnaire included questions about the aspects of TPACK such as the teachers' proficiency in designing the lesson based on TPACK (design) and using technology for the execution of the content (exertion), ethical issues in teaching and technology-related policies (ethics), and leadership and problem-solving abilities regarding TPACK (proficiency) (Kabakçı-Yurdakul et al., 2012). Used by several other studies in the literature to determine the TPACK level of pre-service EFL learners (Atar et al., 2019; Ersoy et al., 2016; İşler & Yıldırım, 2018), 'TPACK-Deep Scale' was considered as a highly valid and reliable instrument, with an internal reliability of .95.

On the other hand, an open-ended questionnaire with three questions was used to collect the qualitative data. Subsequently, an expert opinion was taken to validate the open-ended questions. Then, nearly ten percent of the total participants (n=13) took part in this part of the data collection process. The open-ended questionnaire, thus, included the following 3 questions which were formed by the researchers:

1. How sufficient do you feel about the use of technology in the classroom environment?
2. As a teacher candidate (prospective teacher), what kind of (technological) tools can you use in EFL classrooms? Please explain it with examples.
3. As a prospective English teacher, what do you think your needs are in terms of your technological pedagogical content knowledge?

3.4. Data Collection and Analysis

Data collection process took place in the second semester of 2021-2022 academic year. During this phase, the questionnaire was turned into an online form in Google Forms. Convergently, after altering some parts of the questions based on the feedback received from an expert who has a PhD in the field of English Language teaching, the open-ended questions were also written in Google Forms. Next, via email and educational classroom platforms, the TPACK scale and open-ended survey were distributed to pre-service teachers in the program. The phase of data collection nearly took 15 to 20 days with 120 students answering the TPACK scale and 13 students from among those 120 providing responses for the open-ended one.

To analyze the quantitative data, descriptive analyses such as frequency, mean score, standard deviation, minimum, and maximum scores were obtained. On the other hand, via thematic analysis (Boyatzis, 1998) the data coming from the open-ended questionnaire were analyzed in order to find the significant themes and

categories underlying the EFL teachers' TAPCK opinion and needs. To begin, for thematic analysis, primary chunks representing the participants' perceptions and needs were identified by coding the recorded data. Second, codes with comparable content were grouped together, and the common contents were eventually labeled as exhibited in Figure 2. Also, the qualitative analysis process of the data was assisted by a colleague pursuing his/her MA studies in English language teaching.

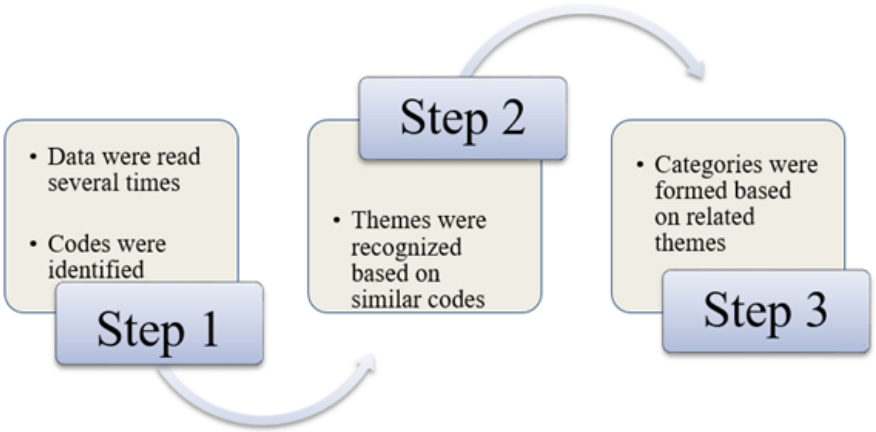

FIGURE 2.
Thematic Analysis Process
Source: Own elaboration.

4. Findings

4.1. TPACK Level of Pre-service Teachers

According to the descriptive analysis of the data, the TPACK level of the EFL pre-service teachers was generally found to be at a high level (M= 132.61, SD= 18.36). As illustrated in Table 2, the highest and the lowest mean scores were 165 and 68, respectively.

TABLE 2
Pre-service teachers' level of TPACK

	N	Minimum	Maximum	Mean	Std. Deviation
General TPACK	120	68	165	132.61	18.36

Source: Own elaboration.

Based on the explanations given for the analysis of the questionnaire by Kabakçı-Yurdakul et al. (2012), the scores which are lower than 95 are categorized as *Low,* the ones between 96 and 130 are named *Average*, and the rest which are more than 131 are labeled as *High* with regard to TPACK level. Hence, considering the above-mentioned rule, in this study, 4 participants had a low level of TPACK, 45 of them were under the category of average level of TPACK, and 71 were found to have high level of TPACK as can be seen in Table 3 below.

TABLE 3
TPACK Level Ranges and Frequencies

TPACK Level	Frequency	Range of scores
Low	4	Lower than 95
Average	45	Between 96

Source: Own elaboration.

4.2. TPACK Perceptions and Needs of Pre-service EFL Teachers

Some major recurring themes were highlighted as the needs and perceptions of pre-service teachers via the analysis of the qualitative data. The emerging themes were categorized as the sufficiency of pre-service teachers with regard to TPACK proficiency, the technological tools used in EFL classrooms, and the needs of prospective EFL teachers in terms of TPACK. The afore-mentioned information is summarized in Table 4.

TABLE 4
Categories, Themes, and Codes Related to TPACK Perceptions and Needs of Pre-Service Teachers

Categories	Themes	Codes
Sufficiency in TPACK	Self-sufficiency in feeling and use	Interest in technology, Technology competence, Previous experience with technology
	Institutional insufficiency	Lack of technological tools, Outdated materials
	Instructors' insufficiency	Repetitive use of the same technological tools (materials), Low proficiency of older teachers
	Self-insufficiency	Individualized (personal) insufficiencies in TPACK
Technological devices and applications	Quiz platforms	Kahoot and Quizlet
	Learning and assignment management platforms	Google classroom, Edmodo, Padlet, Presentation tools, Storyboard, Online video-conferencing platforms (Zoom, Microsoft teams)
	Learning platforms	Free online courses, Videos, Podcasts, and Talking books
	Devices	Laptop, Computer, Mobile phones, Smart board, Tablet, Headphones, and Radio
Needs regarding TPACK	Technological knowledge (TK)	Control over technology, Learning some software in detail
	Technological pedagogical knowledge (TPK)	Choosing the best technological tools considering the level, age, and the interest of the students
	Technological content knowledge (TCK)	Technology integration considering the appropriate resources (content)
	Following trends (tech & interests for learners)	Keeping updated regarding the needs of the new generation and the new technological tools
	Access to Technological devices	Smartboard, Projector, Phone

Source: Own elaboration.

4.2.1. TPACK Sufficiency of Pre-Service Teachers and the Technological Tools Used Within the EFL Context

In view of the first category, pre-service teachers mostly regarded themselves as self-sufficient over the integration of technology with content and pedagogy. Their responses were predominantly related to their interest in technology, competence in using it, and prior experience with it in EFL classrooms. To be more specific, they felt sufficient enough to use technology in their prospective and current EFL classroom atmosphere.

For instance, one participant expressed his/her self-sufficiency via saying:

> "I think I have sufficient information about using technology in the classroom environment." (P12, personal communication, April 18, 2022).

Another pre-service teacher reported her/his self-sufficiency through mentioning the following statements:

> I feel pretty sufficient about the use of technology in the classroom environment. To be more specific, I am pretty accustomed with technology, apps, web 2.0 tools, online course platforms, podcasts, and also online evaluations. I believe I can use them in my classes easily. (P2, personal communication, April 18, 2022).

The decision over other themes related to the sufficiency of the participants came from the codes that were related to the technological problems of the institute and the place in which pre-service teachers received training. This situation, in turn, led to the feeling of insufficiency over TPACK in pre-service teachers. In the same vein, some student teachers referred to some factors such as instructors' insufficiency in effectively using the required technological materials within the EFL context due to the absence of creativity or instruction over this issue. Therefore, in an implicit manner, this issue aroused insufficiencies in the TPACK level of pre-service teachers as well. The final theme of this main category, on the other hand, was mainly labeled based on the codes related to the pre-service teachers' personal insufficiencies in TPACK. The above-mentioned ideas were evident in the following responses given by pre-service teachers:

> I don't think technology is used enough in classrooms right now. In my opinion, our schools in our country do not have the means to use technology adequately. Although every classroom has a smart board, it is difficult to even enter most YouTube applications. Therefore, technology cannot be used effectively in classrooms. (P5, personal communication, April 18, 2022).

> "We have good materials but some of my teachers cannot use them effectively." (P4, personal communication, April 23, 2022).

> I don't think I am sufficient about the use of technology not only in the classroom environment but also in my life. Technology is an incredible thing and it is one of the most important needs in our life, it is inevitable for a person to use it in their daily life. But I didn't exactly grow up in a technological environment, I preferred to be outside, in nature, while growing up. This is why I lack information and efficiency about technology in the classroom environment. (P6, personal communication, April 23, 2022).

Having identified the main category of perceptions over TPACK, it can be concluded that while many pre-service teachers reported their sufficiency in using technological instruments within the EFL classroom environment, some felt insufficient in this regard. This finding partially aligned with that of the quantitative results which illustrated a generally high TPACK proficiency level of pre-service teachers.

Secondly, concerning the technological tools used in the EFL classroom, several themes such as quiz platforms, assignment and learning platforms, and learning only platforms were identified, and consequently a main category labeled as technological devices and applications was formed. Kahoot and Quizlet as one of the most frequent online applications among pre-service teachers' responses brought about the *quiz platform* theme. Furthermore, network-based platforms such as Google Classroom, Edmodo, Padlet, presentation tools, Storyboard, and online video-conferencing sites or applications (Zoom, Microsoft teams) created the *learning and assignment platform* theme. Similar to the above-mentioned virtual learning tools, free online courses, videos, podcasts, and talking books served as learning-only platforms which was the third theme recognized. As the last theme, devices such as laptops, computers, mobile phones, smart boards, tablets, headphones, and radios were thought to be the basic part of each class for integrating technology within the borders of the EFL classroom. All in all, all these devices and online or offline applications developed into the main category of *technological devices and applications*.

4.2.2. TPACK Needs of Pre-Service EFL Teachers

Finally, as for the needs of the pre-service teachers with regard to TPACK, it was found that training and access were among the most pivotal needs of prospective teachers. The participants implicitly shared a lack of TK, TPK, TCK, and TPACK competency which, indeed, required a well-design course and training over these components of TPACK. Some of the pre-service teachers' concerns entailed not only how to use technological tools but also how to utilize the appropriate technological apparatus considering the level and

age of the students and their pedagogical needs as well as the content in EFL settings. The following responses are the examples of the preceding problems:

> In my opinion, all candidates should receive a short-term training in this subject before they start teaching. Other than that, for my part, I may need to work on what is and isn't technologically appropriate for students. I may also have a need to understand what kids like and dislike in terms of technological tools. (P5, personal communication, April 18, 2022).

> I need to have a properly designed course for it because ı know some of the technological activities for classroom but ı still have a lot to learn. I need to search for it and ı do when I have to but sometimes that cannot be enough. A well-designed lesson wouldn't be bad. (P9, personal communication, April 23, 2022).

Besides the aforementioned shortcomings, keeping updated over technological resources and following the trends about the interests of the new generation was the other theme generated from the answers given by pre-service EFL teachers. Additionally, as the last theme, access to technological tools including devices such as smartboards, projectors, and phones within the EFL classroom environment was also shared as a need.

> I feel like using technology along with the subjects to show visual and audio examples is necessary for the children to understand the subject better and to keep their attention on the class, so according to the number of the students in the class I think a phone (if the number of the students is little) or a smart board, or a projector is necessary. (P11, personal communication, April 23, 2022).

5. Discussion

5.1. TPACK Level of Pre-Service Teachers

The aim of this mixed-methods study was to investigate the TPACK level, perceptions, and needs of pre-service EFL teachers. It was revealed that the perceived TPACK levels of pre-service teachers of Anadolu university was generally high. This finding was in line with some studies in the literature that have explored pre-service EFL teachers' TPACK level and proficiency through different ways (Atar et al., 2019; İşler & Yıldırım, 2018; Öz, 2015; Sariçoban et al., 2019; Simsek & Yazar, 2019). To some extent supporting the findings of the current study, Sariçoban et al. (2019) indicated that prospective teachers had average to high levels of TPACK. Similarly, Atar et al. (2019) found that while pre-service teachers had a high level of TPACK in many dimensions of the TPACK scale that they used, one dimension (ethics) was among the moderate level ones. Also, in this study, the presence of some low (n= 4) and moderate (n=45) TPACK level students among the high TPACK level pupils (n=71) could be due to the attendance of participants from different levels including the freshmen and sophomores.

5.2. Opinions and Needs of Pre-Service EFL Teachers regarding TPACK

The open-ended responses of participants yielded some specific themes over the beliefs and perceptions of prospective teachers on TPACK and their needs in this regard. As for the prominent categories emerged through this analysis, sufficiency over TPACK, technological tools used within the EFL classroom, and the needs of pre-service teachers considering TPACK can be named.

While some student teachers believed in their TPACK self-sufficiency, others put forward the impact of some negative factors such as instructors' lack of knowledge or competency over using technology in class and the insufficiencies regarding the technological tools provided by the school (institute) on their lack of sufficiency over TPACK. The results of the part that implied sufficiency over TPACK were supported by the findings of Simsek and Yazar (2019), who investigated the self-efficacy of pre-service teachers studying in various subject areas and came up with a result regarding the high self-efficacy of pre-service teachers in

foreign languages subject area. Likewise, Sariçoban et al. (2019), in their study, shared the same beliefs by stating the sufficiency of pre-service teachers in all sub-domains of TPACK through a self-evaluation form.

The ineffective use of technology or its limited alternation with the scope of the lesson and the students' profile was said to be more apparent in older teachers, who usually have more experience in teaching which implies a better PK and CK-related competencies than novice and younger tutors. This issue was also mentioned in studies namely Kirana and Nabhan (2021); Nazari et al. (2019); Öz, (2015), Park and Son (2020); and Turgut (2017). A logical rationale for these TK-related abilities may be the result of the digital nativity of the younger instructors when compared with more experienced teachers who are mainly digital immigrants of this technological era. So, the absence of qualified role models in terms of TK-related domains could exert an impact on the insufficiency of the students.

Moreover, another obtrusive factor that was mentioned under the category of TPACK sufficiency was the lack or scarcity of a robust infrastructure and technological tools provided by the educational institute, which implies a partial paucity in teachers' and students' TPACK level, particularly within a teacher education program. With this in hand, another scholar maintained this view by mentioning internet connection and technical problems stemming from the poor connection facilities at school (Taopan & Drajati, 2020).

The results also provided insight regarding the technological tools preferred by pre-service teachers for their prospective teaching career in the EFL context. Analogous to the technological tools named by pre-service teachers in the current study, Aşık et al. (2018) also found Kahoot as the most frequently utilized platform for assessing the performance of learners with their peers in a stress-free environment. Furthermore, aligned with specific purposes such as comprehension, assessment, learning, and feedback, technological applications and devices were profited from in EFL classrooms of Aşık et al. (2018) and Ding et al. (2019) studies.

As for the needs of the pre-service teachers regarding TPACK in this study, training via a well-designed course over TK, TPK, TCK, and TPACK domains and access to technological devices and tools were put forward by the student teachers. The finding over the need for TCK was in harmony with that of Valtonen et al. (2018) stating that pre-service teachers' least confidence level over TPACK was TCK which indicated a need for courses over this problem. They also considered the challenges regarding TK and TPK indicating that technical skills, problems, and low confidence in using ICT during lessons were prevalent among pre-service teachers' TPACK. Yet, considered to be digital natives, the participants of the present study were expected to have more pedagogy and content-based problems rather than technology-related concerns. But the results were in the opposite stance showing less merely pedagogical and content-based problems. The explanation for this status may have stemmed from the diversity of the grade of the students who answered the open-ended questions.

The extent to which the school climate enables access to the equipment is critical in developing favorable attitudes towards TPACK. Hence, the findings related to technological access as a need among pre-service EFL teachers were in harmony with that of Simsek and Yazar's (2019) study where the importance of having access to technological resources and teachers as role models were emphasized in teacher education programs while investigating the pre-service teachers' self-efficacy for technology integration. Mentioned as a negative factor faced by pre-service teachers in İşler and Yıldırım's (2018) study of perceptions over TPACK, internet problems were also indirectly related to having access to proper technological environment and tools which, in turn, showed similarity with the present study. Despite the needs recognized, since the boundaries of technology are too close, it was difficult to fully discriminate the differences between the categories of TPACK in between the responses coming from the students.

6. Conclusion and Implications

Aimed at investigating the general TPACK level of Turkish EFL pre-service teachers and probing the TPACK perceptions and needs of these prospective teachers, this study found that pre-service EFL teachers mostly shared a high level of TPACK proficiency. Statistically, it was revealed that a significant difference was present between the pre-service teachers studying at different levels. However, surprisingly, not a noteworthy difference was distinguished between any two levels according to Tamhane's T2 test. Contrary to education year, not a significant difference was recognized between males and females about TPACK. Aside from these, the perceptions and needs of the student teachers put forward valuable categories including sufficiency in TPACK, technological tools integrated with English teaching, and needs of pre-service teachers considering TPACK. More importantly, there was not much information about the needs of pre-service teachers with regard to TPACK in literature, hence, to the best of researchers' knowledge, the findings of this study can serve as a pioneer reference for prospective studies.

Through a small-scale needs analysis, the results of this study yielded beneficial information on the TPACK needs of pre-service teachers, thus, several invaluable implications can be drawn from this mixed-methods study. To start with, based on the needs stated by pre-service teachers, the lack of a well-designed course or study mostly based on TK-related domains within the teacher education program was identified and this situation emphasized the need for recruiting an updated program both for instructors and student teachers to keep up with the technological pace of the 21st century taking into consideration the novel pedagogies and content areas. Next, considering the importance of technology and the outbreak of covid-19 pandemic which led to emergency remote language teaching for some courses, there should be an assessment over TPACK or at least technology-related domains at schools/universities for students as well as the instructors each year or at least every two years. Finally, despite the high proficiency level of pre-service teachers in TPACK, the results of the qualitative part partially supported this idea with student teachers stating their sufficiency and inferred insufficiency in integrating technology in the EFL classroom. Hence, this outcome may potentially guide the teacher education programs to include a well-designed technology-based curriculum or course for ensuring a compact proficiency in TPACK via assigning students to create their materials (technological applications or assignments) considering content and pedagogy.

In addition to these implications for teacher education programs, the current study has some research recommendations as well. The first point research needs to focus on is the extent to which pre-service teachers reflect their TPACK into their practice teaching experiences. In this regard, their preferences on technological tools and their decision-making processes regarding technology integration should be investigated. Secondly, the factors that may potentially promote or hinder prospective teachers' technology may be another topic to focus on by researchers. Finally, researching pre-service teachers TPACK and practices related to it with a longitudinal perspective may enrich researchers' understanding of this research phenomena.

In respect of the results this study exerted on the TPACK area regarding pre-service teachers, some limitations were noteworthy of mentioning. The qualitative part of the study was carried out with a small sample size and it could have been better if the participants' opinions had been supported with some more data like reflection reports. As for the final suggestion, comparing the beliefs and experiences of pre-service teachers in terms of TPACK within their practicum year, which was a missing element in this study, would be a perfect touch for further studies investigating any potential inconsistency between the two.

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